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STRATEGY AND THE DESIGN OF STRUCTURE

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STRATEGY AND THE DESIGN OF STRUCTURE

Abstract

This paper compares two representations of organizational structure -- the organizational chart and the policy structure diagram -- and shows how each representation provides unique insights into organizational design. The building block of the organizational chart is the responsibility center, usually a box showing reporting and authority relations. The design problem is to arrange responsibility centers in the chart to obtain a clear division of business responsibilities and a good balance of operational efficiency and market responsiveness. The building block of the policy structure diagram is the behavioral decision function showing the function's access to and processing of information. The design problem is to arrange for each decision function to receive and process appropriate information so that different managers' decisions (in pricing, capacity expansion, production planning, marketing, etc.) lead to actions that are mutually supportive and consistent with the firm's strategic objectives.

The paper uses a case study of organizational design in a datacommunications firm to compare and contrast the two representations. The paper ends with suggestions on how the insights from the two representations might be combined to improve organizational design and the implementation of strategy.

TWO REPRESENTATIONS OF STRUCTURE

Background

Ever since Chandler's pioneering work Strategy and Structure (Chandler, 1962) researchers in the policy and strategy field have paid close attention to the relationship between an organization's administrative structure and its strategy. The 1960's and the 1970's saw a period of intense empirical work, as researchers collected data from many corporations, to trace the evolution of the organizations' structure in response to product diversification and geographical expansion (Wrigley 1970, Channon 1971, Stopford and Wells 1972, Rumelt 1974). This empirical work supported Chandler's thesis that 'structure follows strategy' and showed for example that companies following a strategy of product diversification are generally more successful if they adopt a multi-divisional structure, rather than a functional structure.

It is only a short step from empirical observations about strategy and structure to the notion of organizational design. If some organizational forms are more effective than others then it should be possible to help corporations design organizational and administrative structures that help them implement their product and geographical strategies. The area of design is attractive from both a theoretical and practical standpoint and much interesting work is now being done

in this area. Williamson's well-known research examines the theoretical underpinnings of business efficiency as influenced by organizational design (Williamson 1975, 1981). By analysing the cost of transactions, Williamson argues, for example, that for large firms operating in diverse businesses, the multi-divisional structure is a more effective means of allocating capital in order to maximize profit, than either the functional organization or the holding company. Using the results of empirical studies, Galbraith (1973, 1977) suggests that different organizational structures arise in response to the information processing requirements of the environment. He identifies both the divisional and matrix structures as designs for coping with information overload [1]. More recently Malone and Smith (1984) have developed an analogy between information processing in organizations and in complex computer networks as a means for exploring effective designs . Drawing on contingency theory, Hax and Majluf (1984, Chapters 20 and 21) have developed an interesting and practical methodology for helping corporations design an organizational structure that supports their intended strategy. In addition a number of major strategy consulting firms, most notably McKinsey and Co., have developed frameworks that help their business clients think through the relationship between strategy and structure (Waterman 1982).

Much of the work now being done on organizational design uses the organization chart as the representation of the firm's structure and as the vehicle for discussing the merits of alternative designs. In this paper we present and explain an alternative representation of structure which is also very helpful as the basis for a discussion of organizational design. This alternative representation, the policy structure diagram, is particularly useful for understanding how the firm's administrative processes and procedures (its routines for 'doing business') influence the execution of new strategic moves. In the paper we will show how the two representations of structure are related and how they each provide valuable insight into the organizational design process. We use a case study of a company in the datacommunications industry to illustrate the design issues one can address with each representation. We also show how the policy structure diagram is converted into a behavioral simulation model that allows one to experiment with alternative policies and procedures. We end with some reflections on how the two design methodologies might be used together to extend and deepen understanding of the relationship between strategy and structure.

Organizational Chart

When people in the policy and strategy field talk about structure they most often mean structure as shown by the organizational chart -- the set of reporting relationships, responsibilities and channels of authority depicted by the chart's boxes, names and interconnections. A new structure is a new way of 'carving-up' business responsibilities and a new way of defining the flow of authority. The building block of the organization chart is the 'responsibility center', the box showing the particular activity (such as marketing/sales or production) that is the chief concern of the individuals in that part of the organization. Figure 1 shows a typical responsibilty center for marketing/ sales, with an upward reporting relationship to high executive levels and several downward authority relationships to individuals and activities that support marketing/sales.

With the responsibility center as the building block, the representation of the organization is the traditional organizational chart, as shown in figure 2. The organization is visualized as a network of reporting relationships, a series of boxes interconnected by lines of authority and communication. Of course the real organization is a much more complicated network of communication than depicted by the organizational chart (even the most complicated chart). Nevertheless the chart is a very powerful and convenient way of summarizing many important relationships in an organization's structure -- it helps one to grasp the organization as a whole and to visualize design at the level of the whole corporation.

The design process, using the organizational chart, is a narrative/verbal discussion (among the company's executives and/or process consultants) to identify an 'effective' arrangement of responsibility centers. An effective arrangement here means an assignment of tasks and decision-making responsibilities that allows each center adequate autonomy (to get the local job done) while providing sufficient coordination between centers to ensure that corporate (or business unit) objectives are pursued and met. Obtaining this balance of autonomy and coordination is no easy matter, but undoubtedly the organizational chart is a great help in structuring executives' and consultants' thinking process. The reader is refered to Hax and Majluf (1984, Chapter 21) for an excellent example of the power of the organizational chart in catalysing discussion about organizational design and structure.

Policy Structure Diagram

Policy structure represents the organization in terms of decisionmaking processes rather than responsibility centers. This way of visualizing a firm's structure comes from the field of system dynamics (Forrester 1961, particularly chapter 10 'Policies and Decisions'). Quoting from Forrester:

> .....we shall look upon the manager as an information converter. He is the person to whom information flows and from whom come streams of

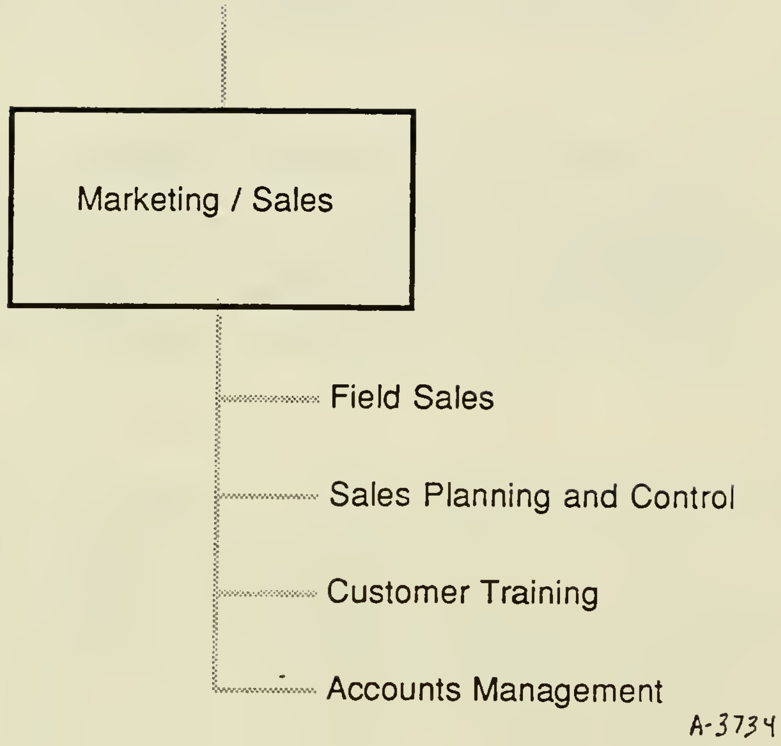


Figure 1: Responsibility Center — Building Block of an Organizational Chart

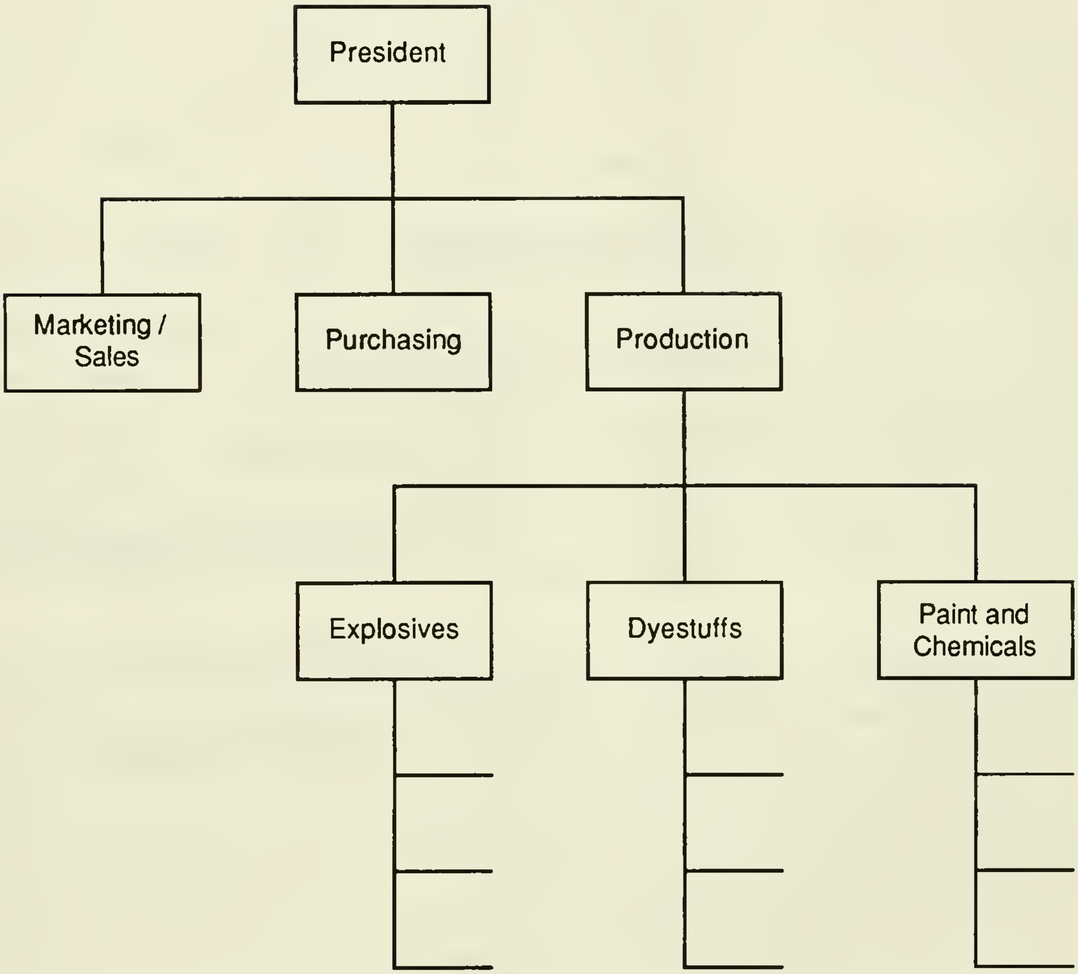


Figure 2: Representation of Organization — Organizational Chart

> decisions that control actions within the organization. ....Viewing the manager in this way shows us immediately why we are interested in decisionmaking and information flow. An industrial organization is a complex interlocking network of information channels. These channels emerge at various points to control physical processes such as the hiring of employees, the building of factories and the production of goods. Every action point in the system is backed up by a local decision point whose information sources reach out into other parts of the organization and the surrounding environment.

The same kind of representation of the organization is also used by the Carnegie school. In Administrative Behavior Simon (1976) talks about organizations in terms of distributed decisionmakers with bounded rationality. Similarly, Cyert and March (1963) see organizational structure as a set of decisionmaking units in a communication network. Their emphasis is on the actual decisionmaking processs, the resolution of conflict, the coordination among units and the flow of information.

The building block of the policy structure diagram is the behavioral decision function. Figure 3 shows the business analyst's image of decisionmaking. Decisions lead to actions and the results of actions accumulate in 'levels' (Forrester 1961, chapter 6) [2]. Each decision function exists in a 'sea of information', but information is filtered by organizational structure (one's position in the organizational chart), by the firm's administrative procedures and routines, and by intangibles such as corporate culture, tradition and leadership (which together affect the importance one attaches to information). (Morecroft July 1985). Information is also filtered by individuals' cognitive limits and biases (Tversky and Kahneman 1974, Kahneman and Tversky 1982, Hogarth 1980). The information that passes through the two filters is the basis for decision and action at that particular point in the organization.

Even at the level of the behavioral decision function there is a visible relationship between organizational structure and policy structure, as figure 3 shows. If the organizational chart changes (say as a result of changing from a functional to a divisional structure), one would expect the information content of important policy functions like capacity planning, pricing, and sales control to change. Conversely, figure 3 also shows that changes in the organizational chart may leave untouched many vital aspects of a firm's policy making. For example, a redefinition of business responsibilities may have little or no effect on a firm's competitive behavior in a fast growing market, if its business planning procedures are dominated by conservative traditions built up through decades of company history and experience. (Consider

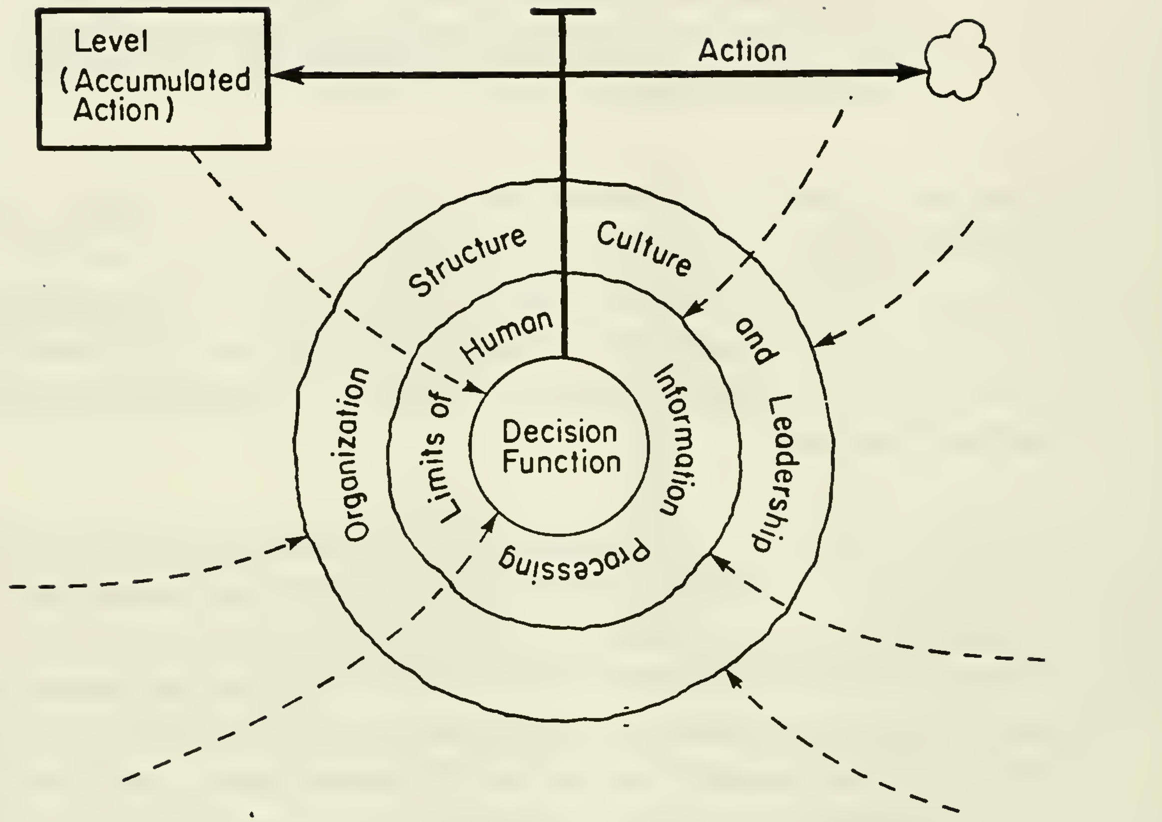


Figure 3: Behavioral Decision Function — Building Block of the Policy Structure Diagram

Zenith's capacity expansion policy during the growth of the color television market during the mid 1960's, HBS Case Services 1973).

With the behavioral decision function as the building block, the representation of the organization is the policy structure diagram, as shown in figure 4. The organization is visualized as a network of distributed behavioral decision functions, interconnected by information flows and by 'levels' that accumulate the actions initiated by decisionmakers. This is a 'feedback' representation, because one is able to trace around the information network and find closed feedback paths where decisions lead to actions which change the system's levels, and where the levels in turn provide the information on which future decisions are based. Of course the real organization is a much more complicated network of communication and control than depicted by the policy structure. Nevertheless the policy structure diagram gives the business analyst another way to grasp the organization as a whole and to visualize the process of design (this time the coordination of decisionmaking rather than the assignment of responsibilities).

The design process, using the policy structure diagram, is a narrative/verbal discussion of the firm's decisionmaking structure to identify situations in which policies may be acting at cross purposes and inadvertently defeating corporate or business unit objectives (Morecroft October 1985). Dysfunctional behavior is a common feature of complex organizations in which decisionmaking is decentralized and shared between many actors in the firm and its markets (Forrester 1975a; Hall 1984 and 1976; Morecroft July 1985; Morecroft and Paich 1984). Diagrams of policy structure are also converted into mathematical models and simulated on a microcomputer to understand policy interactions and to identify 'effective' decisionmaking procedures (Forrester 1975a and 1961). The simulation model becomes a 'learning laboratory' to aid the intuition of participants in the modeling process and to deepen the discussion of policy design (Richmond 1985).

RELATIONSHIP BETWEEN ORGANIZATIONAL AND POLICY STRUCTURE -- THE MASSACHUSETTS BUSINESS MACHINES CASE

To illustrate the relationship between organizational structure and policy structure we will use the results of an ongoing research project with a datacommunications firm. For the sake of confidentiality we refer to the company as Massachusetts Business Machines, or MBM for short. MBM is a player in the growing, but highly competitive, market for advanced electronic office equipment. Like many other players in this market its products include microcomputers,

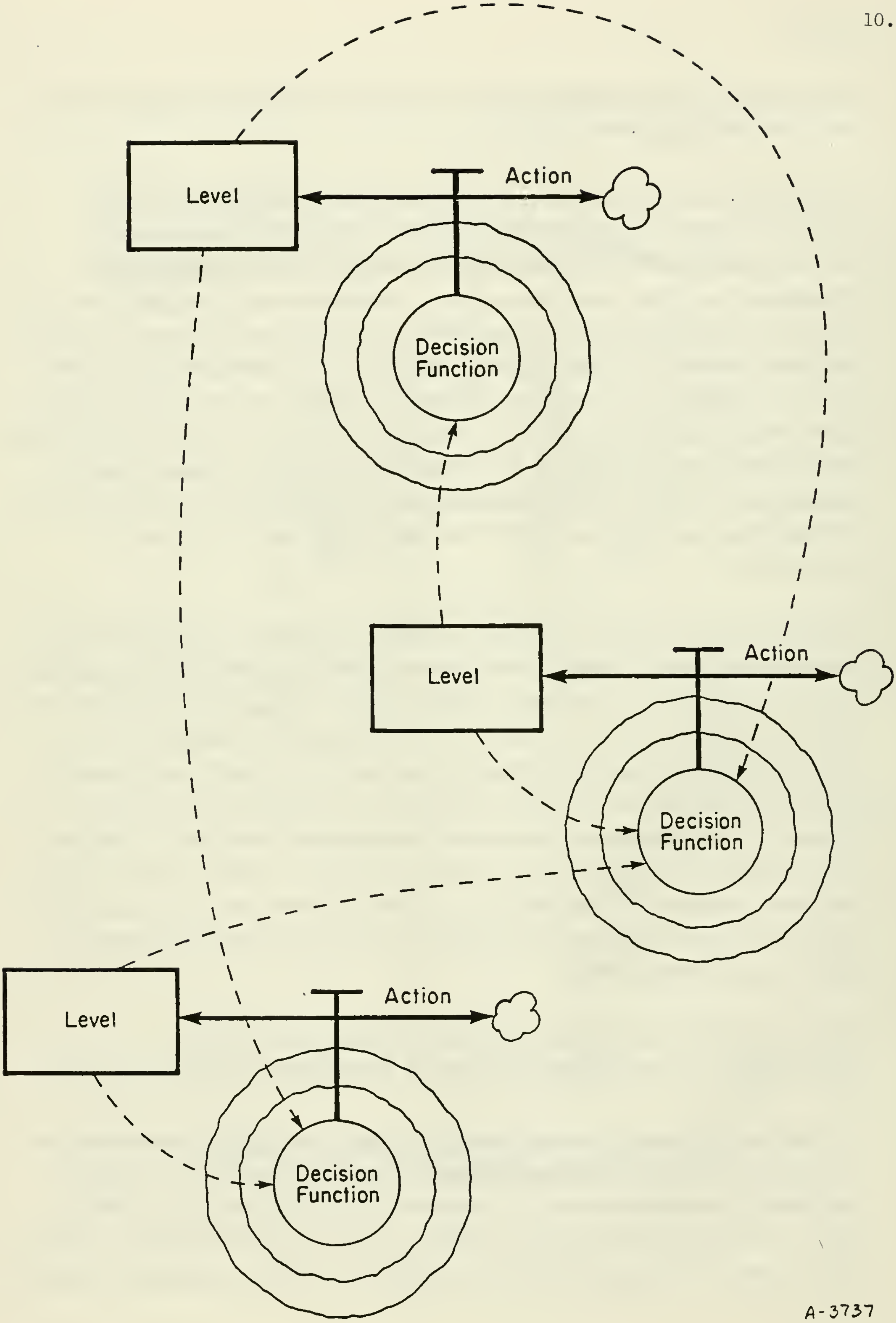


Figure 4: Representation of Organization — Policy Structure Diagram

electronic workstations, minicomputers, switching systems (Private Branch Exchange or PBX systems and smaller key systems), voice terminal equipment (telephones) and networking systems (to hook all the components together).

At the time the research project began MBM was undergoing a major internal reorganization. At the same time the company was experiencing substantial business problems -- sales of many of its product lines were much lower than planned, some product lines had delivery intervals of 15 to 18 months, much higher than the industry average. The reorganization and business problems produced a need for simultaneous (though independent) studies of MBM's organizational structure and its policy structure. In other words the project provided the rare opportunity to compare the two representations of the organization -- the organizational chart and the policy structure diagram. The following sections examine the design issues considered important by one of MBM's managers who was involved in both the organizational design project and the business policy modeling project.

Carving up the Business -- The MBM Organizational Design Problem

There were a number of historical reasons MBM felt an urgent need for reorganization. For many years the company had been organized functionally, but with regional sales and service divisions. So manufacturing was centralized along with R&D. Each of the regional sales divisions had its own independent sales and service force and sold all the product lines produced by the factories. Many executives in the firm felt that this functional organization was inadequate in the increasingly competitive and complex market for datacommunications equipment. A chief weakness was in sales and marketing. The existing structure required marketing executives, product managers, sales managers and salespeople alike to be informed about the firm's full range of markets and products, which ranged from small, inexpensive telephone sets to complex microprocessors, networking systems and advanced electronic switching systems. With rapid product proliferation and increasing technical sophistication of products there was a real danger of MBM losing an in-depth understanding of the needs of its customers and markets.

MBM needed an organizational structure that allowed its marketing executives, sales managers and salespeople to be better informed about products and to be closer to customers. To address this need a group of MBM's top executives worked with a major strategy consulting firm over a period of a year to review the merits of alternative organizational designs [3]. The consultants recommended that MBM should segment its market. Then people in marketing/sales could focus their attention on a subset of the company's broad product line. A segmentation into large and small systems seemed logical, because there was little overlap between customers for large switching systems (usually large corporations) and customers for small switching systems (small service firms, lawyers and doctors). Naturally, the segmentation was not completely 'clean'. Both large and small customers order computers and data/voice terminal equipment which MBM classifies as small systems. Moreover, customers for large switching systems often require small switches for local distribution of voice and data messages. But despite the overlap in product size and account size, the large/ small system segmentation appeared to be a sensible simplification to relieve the information overload on marketing/sales [4].

Design 1 -- Independent Business Units

Having agreed on a market segmentation, MBM's executives and consultants then turned their attention to organizational design. How much should the company's functions be segmented to match the market segmentation? The simplest design is independent business units, as shown in figure 5. Each business unit has entirely separate functions for marketing/sales and for manufacturing. (One might also imagine separate R&D functions, but to avoid undue complexity in the diagram the R&D function has been omitted). Under marketing/sales there are many areas of responsibility. There are managers and staff responsible for sales planning and for market support. There are others responsible for sales administration and control (making sure that corporate sales objectives are communicated and met), for compensation planning and for force planning. Each business unit has its own salesforce. Under manufacturing there are separate factories (or separate manufacturing units within factories) for large and small system products. Each business unit has its own managers and staff responsible for planning and scheduling, purchasing, materials management and factory administration. With this organizational design each business unit operates like a self contained firm.

The advantage of the independent business unit design is in the focus that marketing/sales and manufacturing can achieve in planning and making their products and bringing them to market. The disadvantage lies in the costly duplication of planning staff, salesforce, administrative procedures, factory equipment and materials management. In MBM's case, it's executives felt that complete separation of large and small system manufacturing was impossible and undesireable. The product lines shared both components and capacity in common, so that splitting materials management, puchasing and scheduling would be very difficult and disruptive. Separation of marketing/sales responsibilities looked easier and desireable (because a chief motivation for the organizational redesign was to focus marketing/sales activities). But

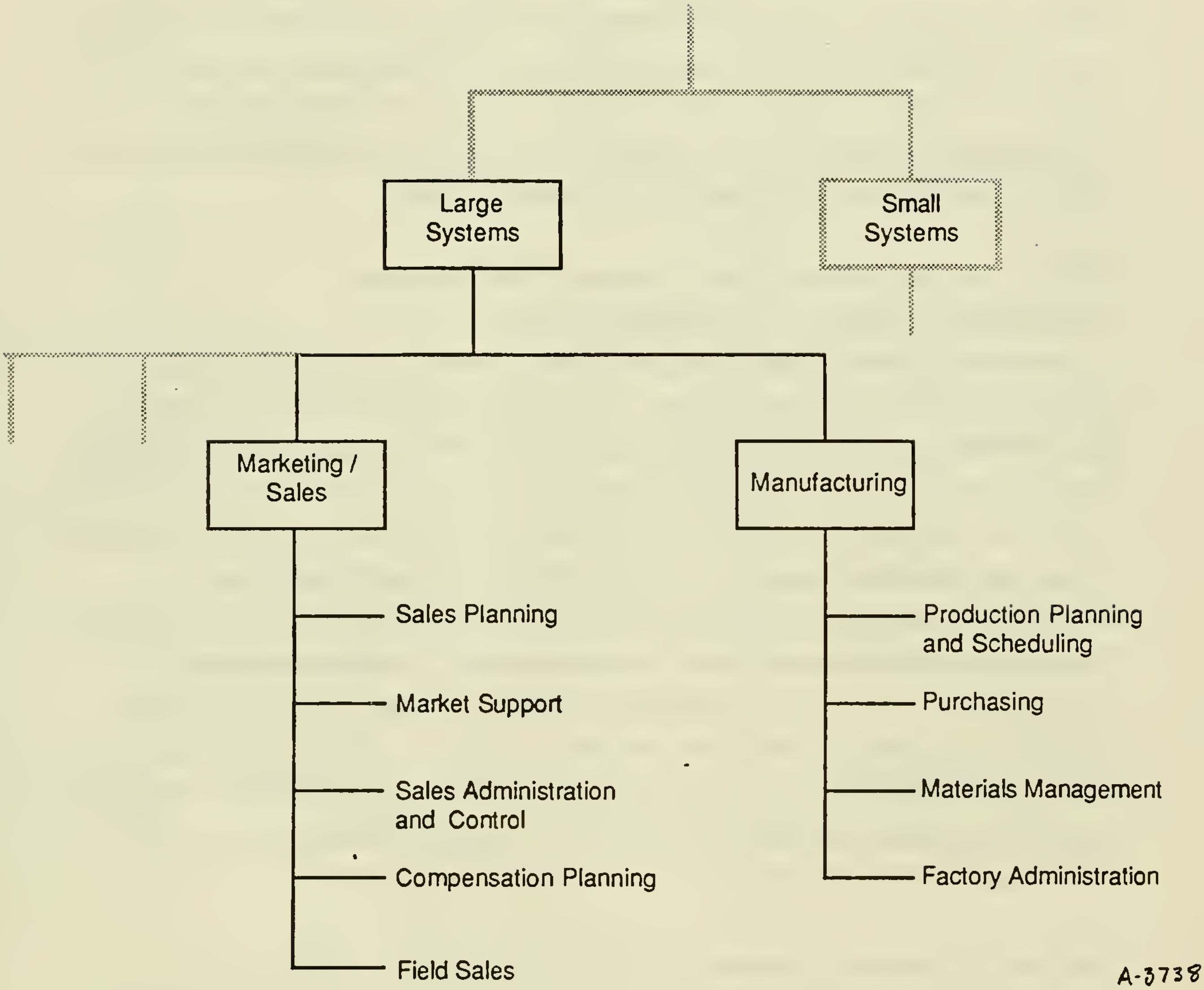


Figure 5: Design 1 Independent Business Units
(Small System Business Unit is Identical to Large)

even here, independent salesforces for large and small systems were not practical or cost effective. In particular, the large systems salesforce would always find themselves selling small systems (computers, terminals and key systems) as part of a large system 'package'. Moreover large account customers might be confused if they found themselves dealing with different salespeople in the process of placing a single large system order. For these reasons and others, MBM's executives rejected the independent business unit design.

Design 2 -- Distinct Business Units, Independent Sales Planning and Control, Shared Salesforce and Shared Manufacturing

The consultants proposed a second design --distinct business units with shared salesforce and shared manufacturing, as shown in figure 6. Under this arrangement the large and small system business units are distinct because sales planning, market support, sales administration and control and compensation planning are separate for large and small systems. The business units are not independent though, because they share a salesforce and they share capacity and components in manufacturing. The new design overcomes the costly duplication of manufacturing planning, administration and salesforce that diminished the appeal of design 1. The new design also addresses the fundamental problem of information overload in marketing/sales. The planning, administration and control of large and small systems is independent, allowing marketing/sales managers and staff to focus their attention on a subset of MBM's broad product line. The design's only apparent drawback is that it doesn't relieve the information overload on the salesforce. Salespeople must still be familiar with all products, because large account customers order a mix of large and small systems.

Coordinating Policies and Procedures -- The MBM Policy Design Problem

The organizational chart shows how the firm's selling and manufacturing responsibilities are assigned to different individuals and groups. It provides insight into the coordination of responsibility centers and the information load of executives and managers. But it doesn't provide much insight into the likely time pattern of the firm's orders, production, salesforce, revenue and profit. Is design 1 (independent business units) likely to lead to better sales performance than design 2 (distinct business units with shared manufacturing and shared salesforce)? What are the operational difficulties encountered as a result of sharing the salesforce between the large and small system business units, under design 2? One can of course speculate on these questions using the organizational chart. One might sense that a shared salesforce could lead to conflict between business units and that independent salesforces are easier to manage. But what is the nature of the possible conflict and how would it affect the growth, revenue and profit of a business unit?

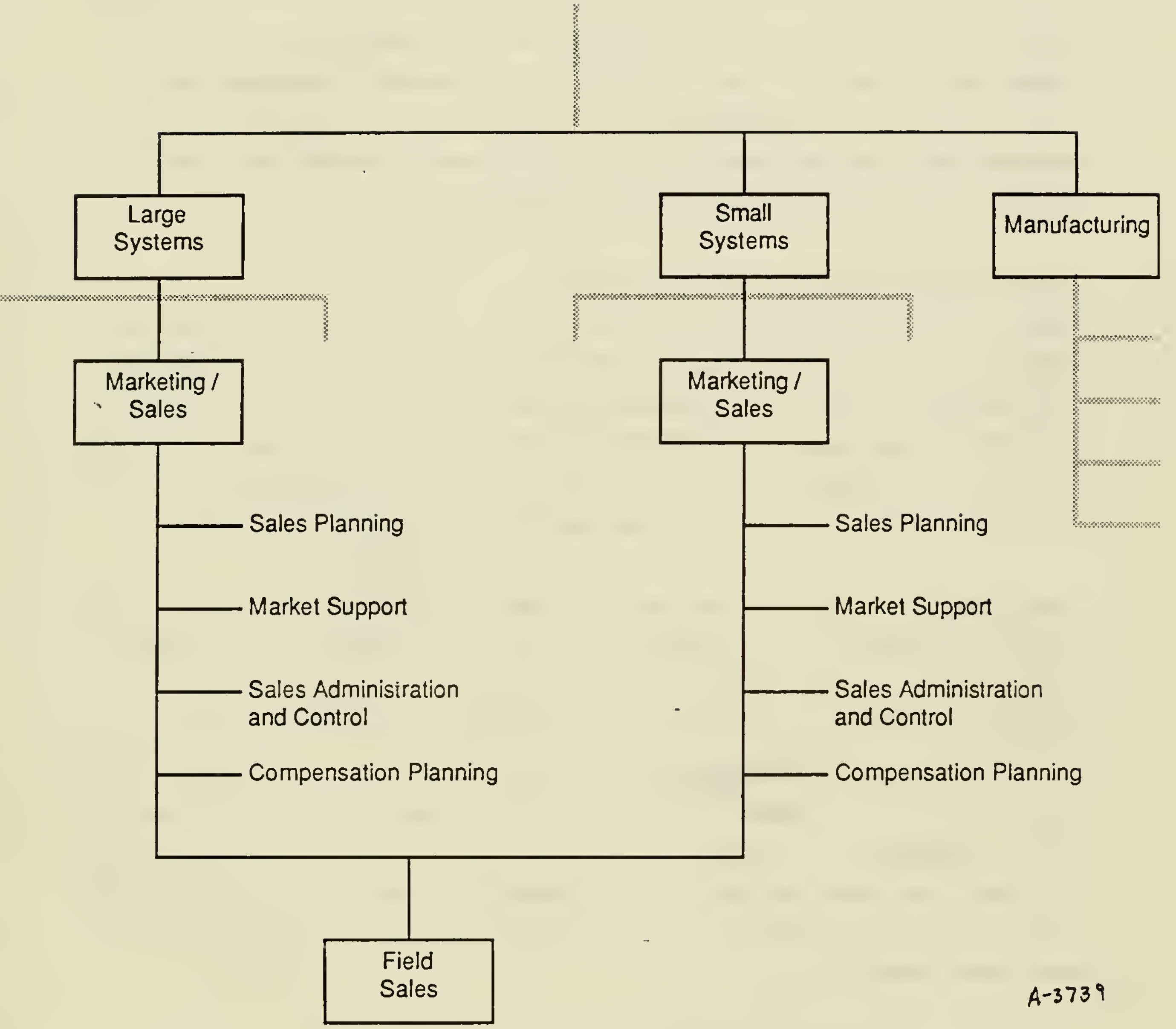


Figure 6: Design 2 — Distinct Business Units, Independent Sales Planning and Control, Shared Salesforce and Shared Manufacturing

The policy structure representation of the organization is particularly effective for addressing questions about performance over time. It shows the decision rules and procedures that business units are using to plan and control sales and to plan and schedule manufacturing. In this section we describe two policy structures that correspond to the organizational charts mentioned earlier. We also examine, using a system dynamics simulation model, the business behavior that these alternative policy structures generate.

Policy Structure of Independent Business Units

Figure 7 shows the policy structure of an independent business unit with its own dedicated management, planning staff and salesforce [5]. To keep the diagram clear we have chosen to omit manufacturing and to focus on marketing/sales [6]. Below we describe the principal assumptions of each behavioral decision function. (The reader will notice that the responsibility centers of the organization chart (see figure 5) map quite well into the behavioral decision functions of the policy structure, though this easy mapping may not always occur).

Sales planning is a complex procedure that consolidates information and judgment from market analysts, salespeople, product managers, product schedulers and manufacturing planners. Although a great deal of information is used in sales planning, a most important input is the recent history of customer orders. Planners use the volume and trend of customer orders to compute a base estimate of demand. Executives usually increase the base estimate by a 'stretch margin' to arrive at the business sales objective. The stretch margin is a simple, but powerful, way for executives to set challenging sales targets in an environment of great uncertainty about future demand and salesforce productivity. The objective requires sales managers to continually increase sales volume, by holding them accountable for an objective that is greater than last year's (or last quarter's) sales.

Compensation planning is the interface between business sales objectives and the salesforce, where control of sales effort takes place. Compensation planners look at each product line's performance against objective and decide how to adjust product 'points' (which ultimately translate into dollars) to encourage salespeople to sell products in the quantity called for by the objective. So if sales of a particular product line are below objective, compensation planners will increase the points value of the product, making it more attractive to sell. On the other hand, if sales of a product line exceed the business sales objective, planners will maintain, or possibly decrease, its points value.

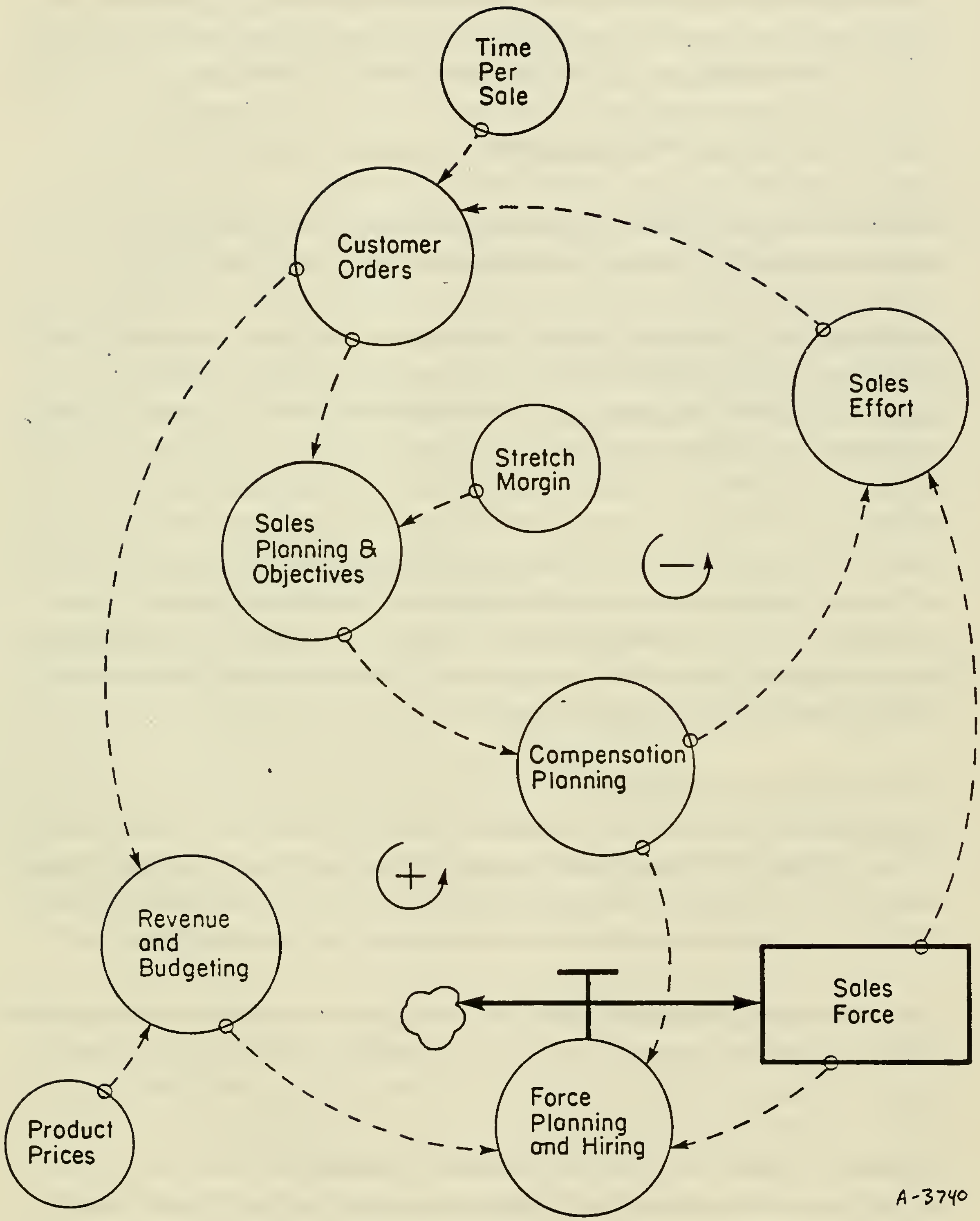


Figure 7: Policy Structure of Sales Planning and Control in an Independent Business Unit

Sales effort (the number of hours per month the salesforce spends making customer contacts) is influenced by compensation planning and by force planning. Changes in the compensation plan affect salespeoples' pay and therefore (usually) the amount of effort they put into selling. An increase in compensation leads to an increase in sales effort [7]. Similarly, increases in force size, resulting from force planning decisions, lead to an increase in sales effort.

A distinctive feature of the policy structure representation (by comparison with the organizational chart) is that it often reaches outside the organization's boundary to the behavioral decision functions of customers, suppliers and competitors. In this case the policy structure includes the customers' ordering policy. A principal influence on ordering is sales effort. Few purchasers of complex electronic office equipment will place an order spontaneously without first having a demonstration and talking with salespeople. Very often it is salespeople who initiate the customer's interest and make them aware of the existence of the product and its features. Even if a customer knows precisely which product he wants, he is unlikely to be able to place an order without first contacting a salesperson. Once a customer is aware of the product, a variety of criteria such as price/performance, delivery interval and quality may influence the ultimate decision to place an order. However, because our chief interest here is with the company's procedures for planning and controlling sales, the diagram focuses on the role of sales effort in customer ordering, and represents the other effects on ordering in terms of the time required to make a sale.

The policies for sales planning, compensation planning, sales effort and customer ordering are linked in a negative feedback loop that regulates orders and sales effort. If a business unit's orders are below objective, compensation planners increase the points (dollars) that salespeople receive for winning an order, and so encourage more sales effort. More effort results in more orders (ceteris paribus) and therefore better performance against the sales objective.

There is another feedback loop in the business unit's policy structure. The second loop couples budgeting, force planning, sales effort and customer orders. The business unit's budgeting policy is a complex process which the model's policy function only outlines. The important point is to capture the inertia and myopia that characterize budgeting in most large organizations. Major budget items (such as advertising expense, R&D expense, sales and service expense) rarely change dramatically from year to year as a proportion of the total budget. New budgets are often just incremental adjustments to old budgets, because organizational politics cannot cope with radical change and because it is complicated and time consuming to justify every budget item from scratch each year. The budgeting policy captures these incremental, inertial adjustments. The budget for the salesforce is represented as a fraction of total sales revenue (revenue itself is the product of customer orders and average product price). The fraction is 'sticky' (slow to change) though not rigidly fixed.

Force planning is driven by the budget. Given the budget and average salesforce compensation, planners compute the authorized salesforce. If the authorized force exceeds the current force then hiring takes place and the salesforce grows. Conversely, if the current force exceeds the authorized force then layoffs takes place and the salesforce contracts.

The feedback loop involving budgeting and force planning is a positive loop that can generate growth in the business unit's orders, revenues and salesforce. If the salesforce increases, sales effort expands leading to an increase in customer orders. More orders bring in more revenue which allows the salesforce budget to grow. With a larger budget the salesforce increases still more. (A similar positive loop is described in Forrester 1968).

Dynamic Behavior of Independent Business Units

What is the likely dynamic behavior of independent business units that follow the sales planning and control procedures described above? How will their orders, revenue, sales objectives and force size vary over time? How will these indicators change if the business units share a common salesforce? The policy structure diagram and corresponding behavioral simulation model enable us to examine these questions [8].

Imagine first the following scenario. MBM has independent business units for large and small systems. Each business unit has a well balanced portfolio of products. The products are attractive to customers, so that salespeople are able to generate enough orders to satisfy the business sales objective. Because the business units have focussed product responsibilities, planners are able to adjust the compensation scheme (product points) so that each product receives an adequate share of the salesforce time. How will the business units' sales and revenue evolve over time? Figure 8 shows a simulation of the scenario, for the large system business unit [9].

Orders for large systems start at 108 units per month and grow exponentially to 170 units per month during the 24 month simulation. In the same period revenue increases from $10.8 million/month to $17 million/month. Figure 9 shows how the growing revenue stream fuels expansion of the salesforce. The salesforce budget grows exponentially as a fraction of

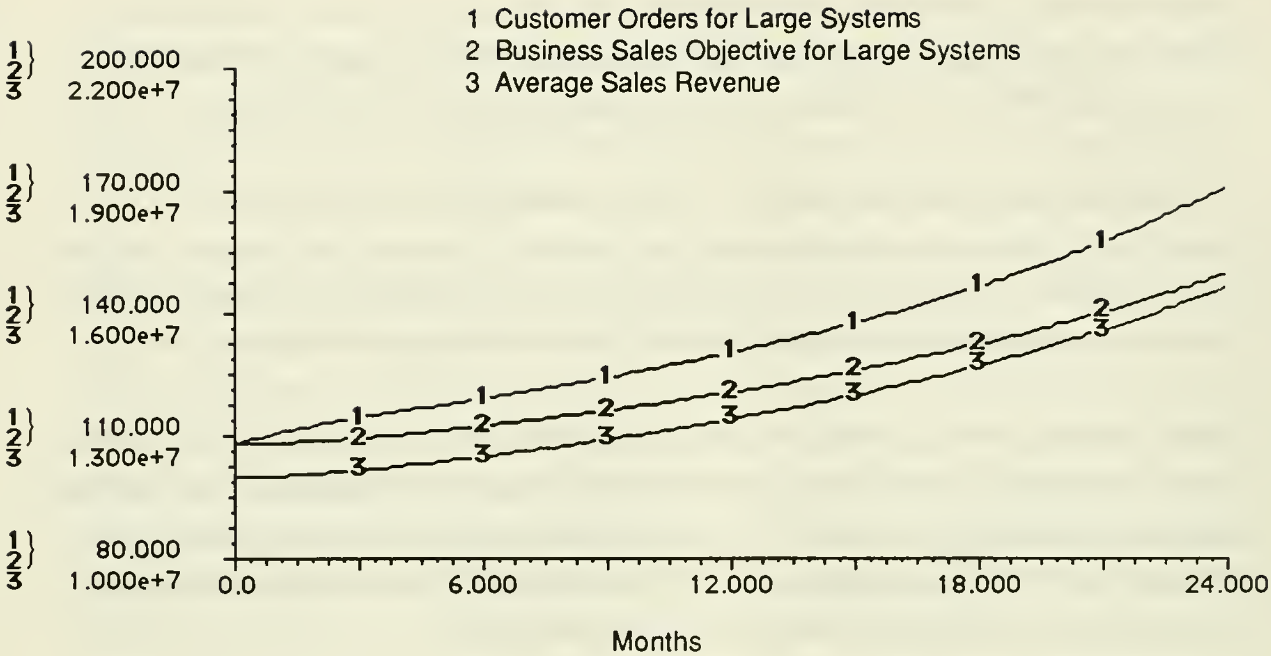


Figure 8: Orders, Sales Objective, and Sales Revenue for Large Systems

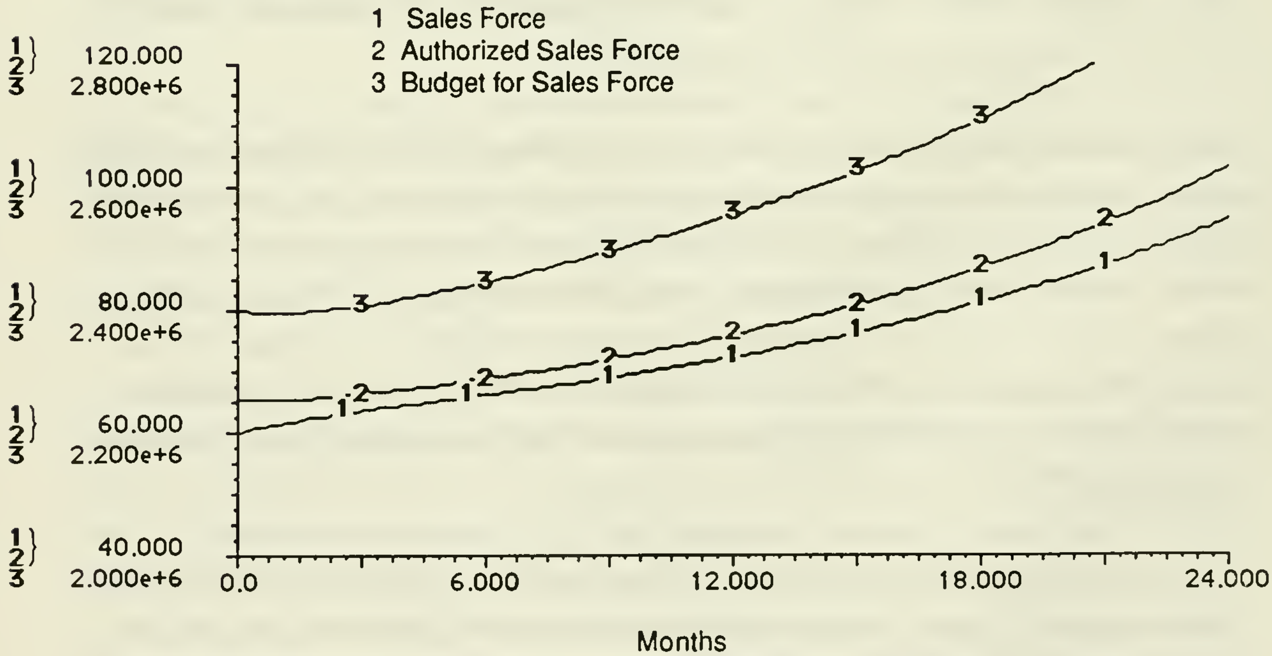


Figure 9: Budget and Sales Force for Large Systems

revenue. As a result the authorized salesforce grows, so there is continual pressure to hire new salespeople.

The independent business unit's dynamic behavior is quite simple to understand. With a well balanced portfolio of products that are attractive to customers, and priced to generate a profit, the business unit grows. Growth is easy to manage, because the salesforce is dedicated to the business unit and because the compensation scheme accurately adjusts sales effort to achieve the business sales objectives.

Policy Structure of Distinct Business Units With a Shared Salesforce
When the large and small business units share a common salesforce an important change takes place in the organization's policy structure. Figure 10 shows the new arrangement of behavioral decision functions. Sales planning, compensation planning, budgeting and force planning remain the same as in figure 7, because the business units plan and control sales independently, just as they do in the independent business unit design. The difference is in the salesforce time allocation. Salespeople must now decide how to allocate their time between the two business units. But how do they make this decision?

Figure 11 shows the factors influencing salespeoples' time allocation. An important consideration is the number of points awarded for the sale of each business units products, because salespeoples' salary and bonus increase with the number of points they accumulate during the year. But points alone do not dictate how they spend their time. Large systems always carry many more points than small systems, but they usually take much longer to sell. A salesperson must spend a lot of time with a large system customer, explaining product features and options, and arrranging installation. He judges the payoff to selling large or small systems in terms of both points and estimated time per sale.

It is interesting to notice that salespeople operate in an 'engineeered' decisionmaking environment. All they have to know to make intelligent use of their time are the details of the compensation scheme and the estimated time per sale of large and small system products (information they pick up first hand in the field). They do not have to know corporate sales objectives, the company's goals for revenues and units sold, or whether sales goals are being attained. They do not have to know manufacturing schedules, planned pricing actions, or the marketing plans of competitors. Conversely, marketing/sales managers and planners do not have to know the precise time allocation of the salesforce in order to regulate sales (and in practice managers never do know this information accurately).

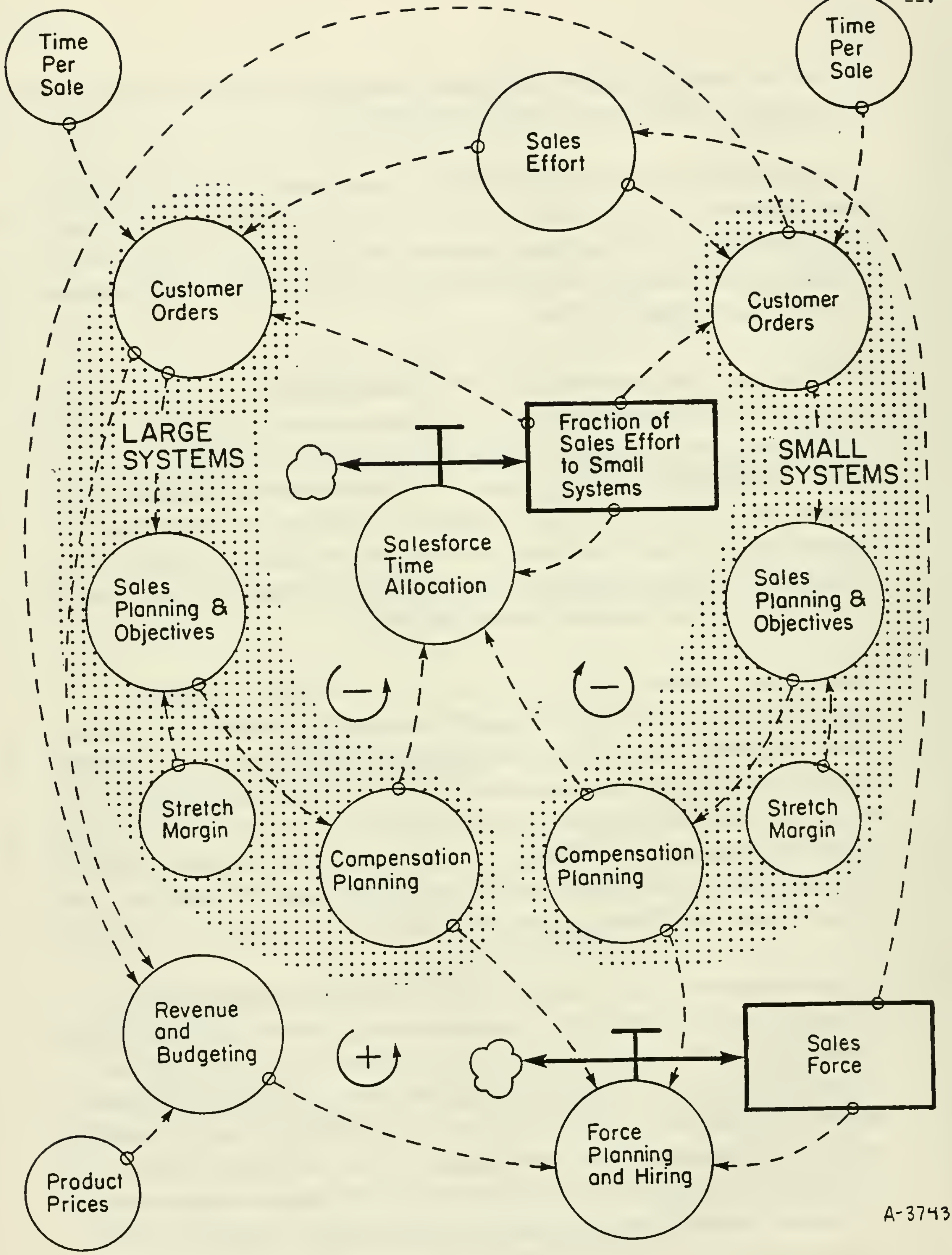


Figure 10: Policy Structure of Sales Planning and Control in Business Units that Share a Salesforce

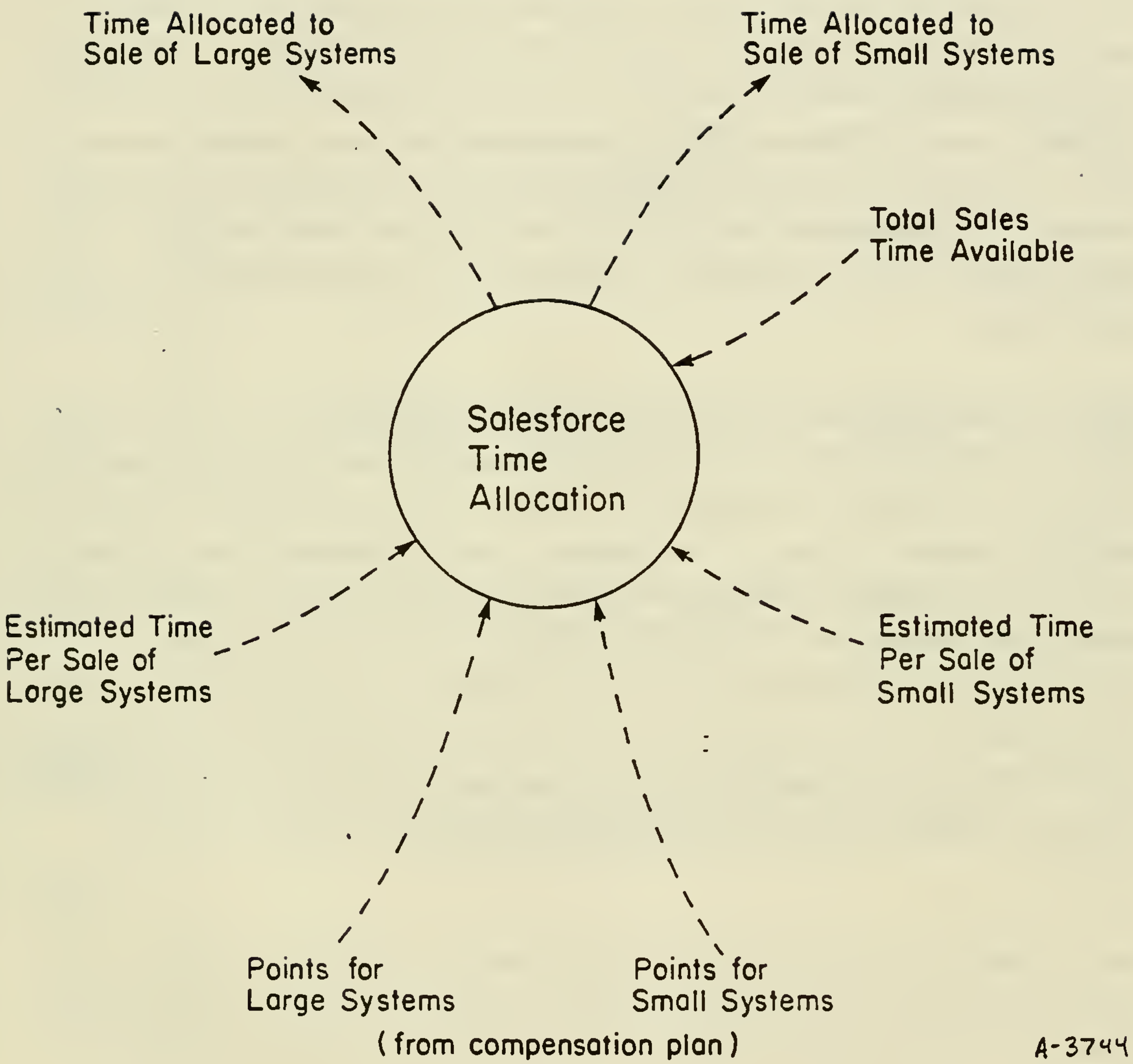


Figure 11: A Closer Look at Salesforce Time Allocation

Given the rather myopic, self-interested way in which the salesforce chooses to spend time, how can business unit executives be sure of achieving their sales objectives? The answer is that compensation planners must provide the correct incentives for the salesforce, so that when salespeople act in their own self-interest they also satisfy business sales objectives. The task of providing the correct incentives is difficult when business units share a common salesforce, but do their sales planning and control independently. For the decisions and actions of any one business unit are geared to achieving its local business objectives. When a business unit has a dedicated saleforce the task of providing the correct incentives is easier (though not necessarily always simple).

Dynamic Behavior of Distinct Business Units With Shared Salesforce

Imagine the following scenario. The large system business unit has a well balanced portfolio of products. It is the dominant business unit because traditionally large systems have generated most of the company's revenues. As a consequence, most of the salesforce time is allocated to large system sales (90 percent at the start of the scenario). The small system business unit has a changing portfolio of products. In particular its products include new key systems, microcomputers and workstations. These new products promise to generate plenty of revenue. Moreover, MBM is anxious to strengthen its position in the integrated office system market and is therefore trying to encourage sales of the new products. How will each business unit's sales and revenue evolve over time? Figure 12 shows a simulation of the scenario for small systems.

Orders for small systems start at 70 units per month and grow rapidly for 5 months to a peak value of more than 100 units per month. In month 5 orders begin to decline, and fall to a minimum of 75 units per month by month 10. Then orders recover and go through another (diminished) cycle of growth and decline between months 10 and 20. By the end of the 24 month simulation, orders for small systems are still fluctuating slightly, but are clearly settling at about 90 units per month, almost 30 percent higher than at the start of the simulation. The business sales objective for small systems rises, but only gradually because it is an average of recent customer orders. As a result of this inertia, orders for small systems exceed the sales objective during (and immediately following) any period of rapid growth in orders -- for example in months 0 through 7, and again in months 12 through 19.

The growth of orders makes sense in the context of our scenario. One would expect orders for small systems to increase, because small systems are attractive to customers, and because they

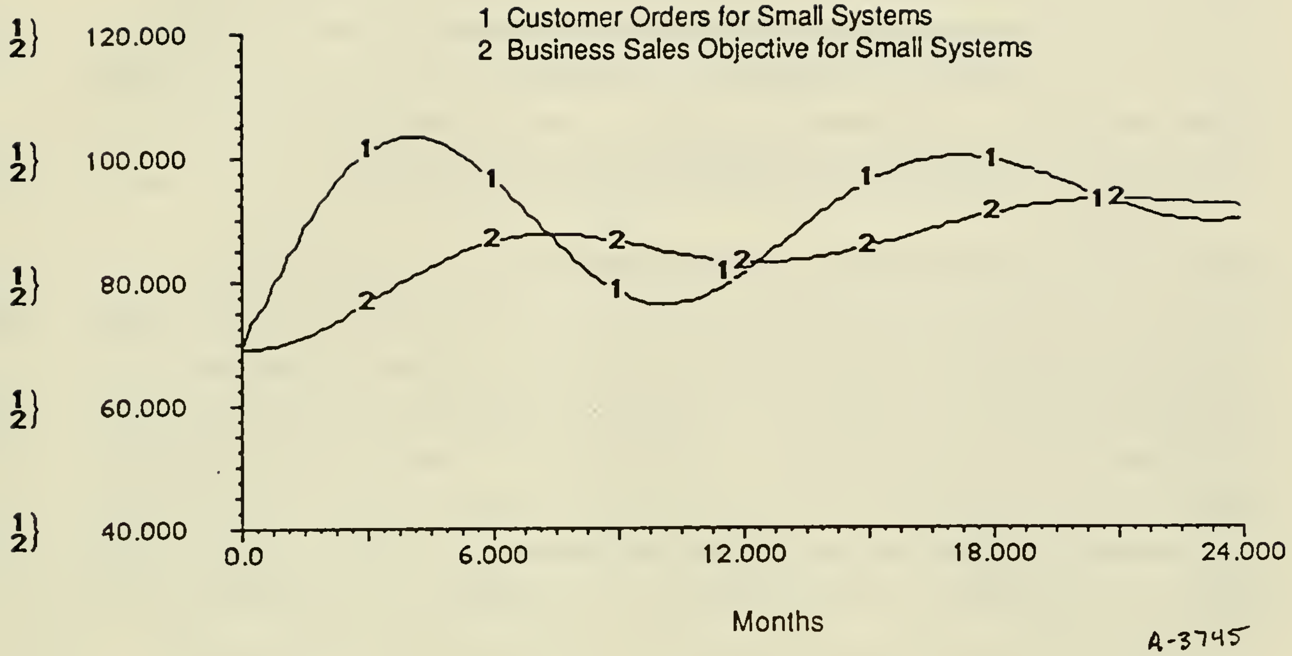


Figure 12: Customer Orders and Business Sales Objective for Small Systems

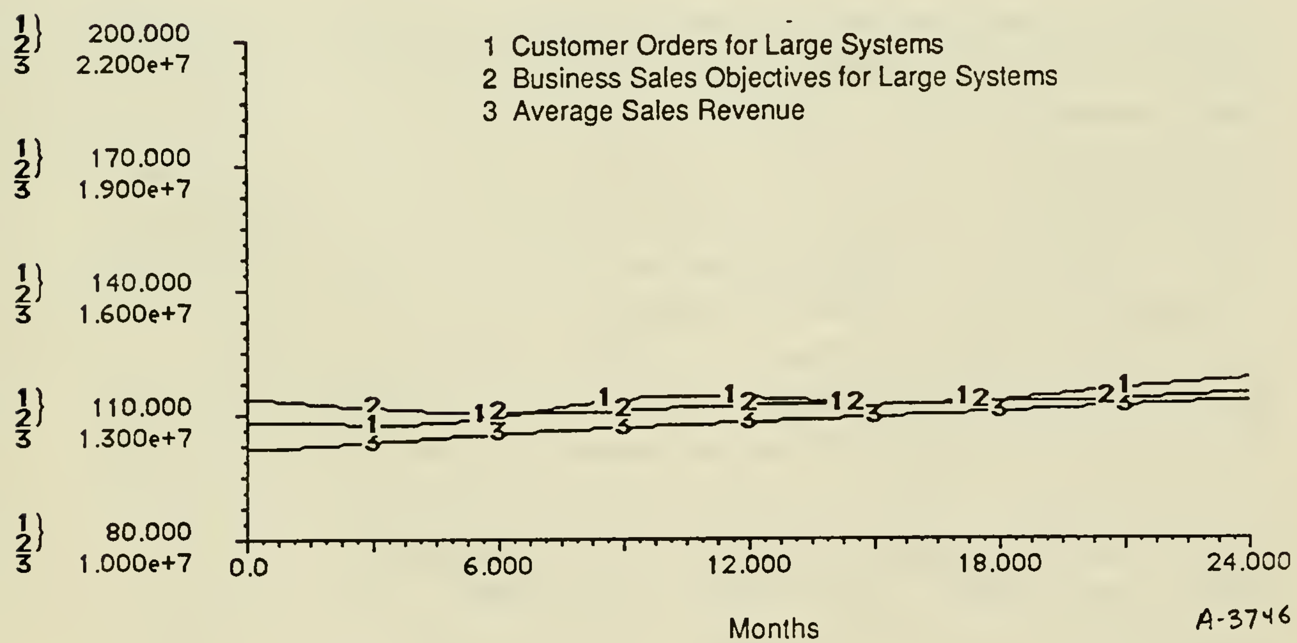


Figure 13: Customer Orders and Business Sales Objective for Large Systems

generate more revenue per sales-hour than large systems (by assumption). However the fluctuation of orders is somewhat surprising and certainly disrupts factories' production planning. But what causes the fluctuation? It was not a feature of the behavior of independent business units. Previous simulations showed steady growth in orders and revenue. Also, what is the impact of the fluctuations on the other business unit's behavior?

Figure 13 shows orders and the business sales objective for large systems. The figure also shows the combined sales revenue of the two business units. For ease of comparison, figure 13 uses the same scales for orders and revenue as figure 8 (the simulation of the independent large system business unit). One can see a very slight fluctuation in orders for large systems. But the most striking feature of the simulation is that orders and revenue are almost constant. Orders for large systems start at 108 units per month (the same as in figure 8), but by the end of the 24 month simulation they are only 110 units per month. By contrast, orders rose to 170 units per month during the same time interval in the independent business unit scenario. But why should the business unit's growth be halted when both its product portfolio and its methods of planning and controlling sales are identical in both scenarios? The answer must lie in operational difficulties stemming from a shared salesforce, since this is the only factor that distinguishes the two scenarios.

A close look at the conditions surrounding salespeople's time allocation gives insight into the puzzle. Figure 14 shows compensation per hour for large systems and for small systems. Initially compensation per hour is greater for small systems than for large systems. In other words, salespeople find it more attractive to sell small systems than to sell large systems, because they are better compensated (they receive more points) for each selling hour. The imbalance arises because the small system business unit has an attractive compensation plan to encourage the sale of its new products, and because the products yield more revenue per selling hour than large systems. Salespeople start allocating more time to selling small systems. As figure 15 shows, they begin by allocating 10 percent of their time to small systems, but they increase their allocation to 13 percent after only 4 months, as this new allocation serves their self-interest best (remember that salespeople are not held directly acccountable for a business unit's sales objectives). The shift in sales effort to small systems is small, but sufficient to cause a 30 percent increase in orders! By itself, the salesforce time reallocation is quite appropriate since it is economically desireable for MBM to sell a bigger proportion of small system products. However, the sales planning and control procedures of the two business units respond to the time reallocation with a dysfunctional 'battle' for sales time.

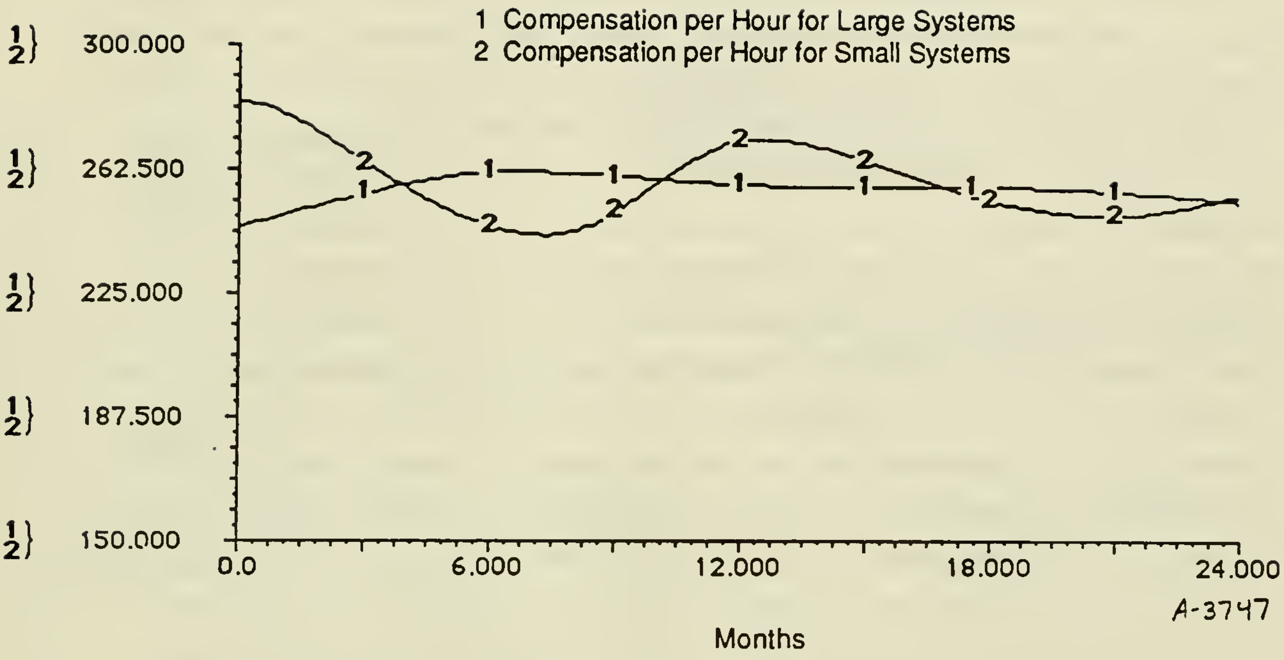


Figure 14: Compensation per Hour for Large and Small Systems

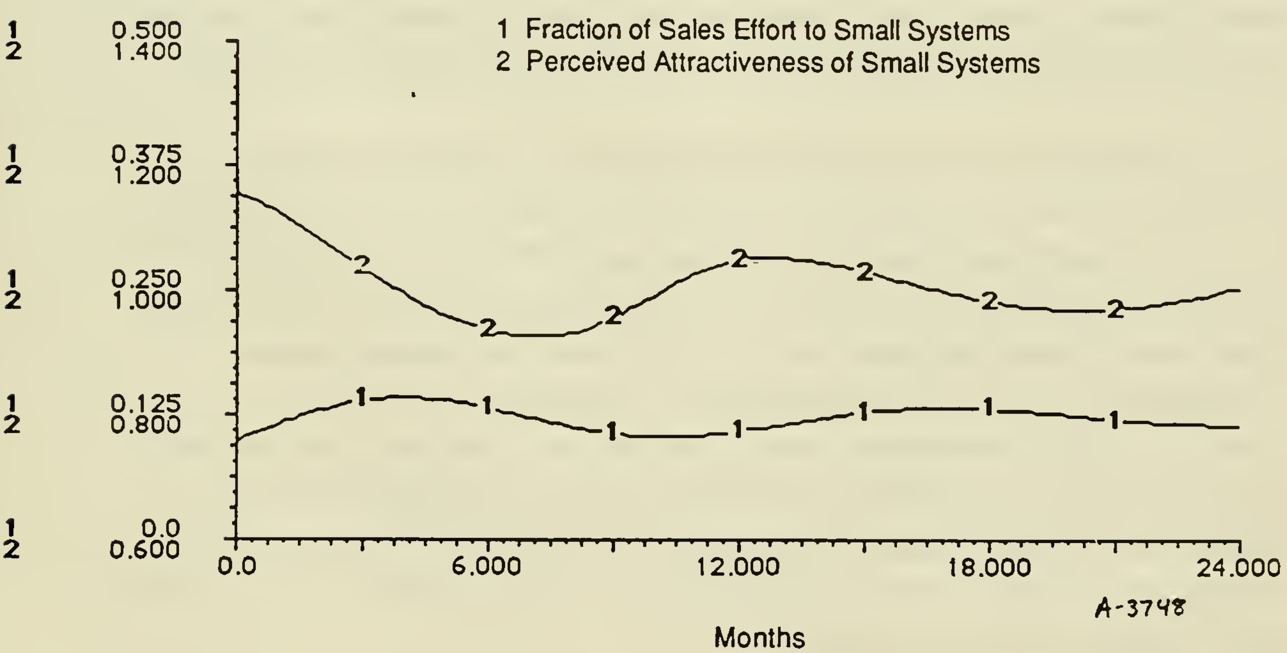


Figure 15: Fraction of Sales Effort Allocated to Small Systems

The reader can trace the battle for sales time in figures 12, 13, 14, and 15. The story begins in figure 14. Compensation per hour for small systems exceeds compensation per hour for large systems, thereby causing a shift in sales effort to the small system business unit. As a result, orders for small systems increase unexpectedly, above the business sales objective, while orders for large systems dip unexpectedly, below the business sales objective. Because each business unit's planning and control is independent (a feature of the organization's chosen design) its compensation planners make separate adjustments to product points in order to correct the sales variance. In the large system business unit, planners increase points to win back salespeople's time and thereby boost sales. In the small system business unit, planners reduce points. But, given the magnitude of the positive sales variance, their corrective action is quite mild. They are reluctant to decrease points too drastically for fear of seeming to 'cheat' the salesforce. The result is shown in figure 14. Compensation per hour for large systems rises during months 0 through 6 while compensation per hour for small systems falls. Shortly after month 4, large systems begin to look more attractive to the salesforce than small sytems. Between months 4 and 9 salespeople reallocate their time increasingly in favor of large systems, as figure 15 shows. Orders for small systems decline while orders for large systems increase. By month 10 the sales variance situation is entirely reversed -- small system sales are now below objective (the variance problem is compounded because the business sales objective for small systems has been revised upward to reflect the initial sales success) and large system sales are above objective. The compensation planners of the two business units then engage in another round of points adjustments in their quest to bring orders in line with objective.

The battle for sales time has two dysfunctional effects on business unit performance. First, sales effort allocated to each business unit fluctuates, playing havoc with manufacturing schedules (though these effects are not addressed specifically by the model, because it does not include a manufacturing sector). Second, the average compensation of the salesforce rises. Each round of the battle for sales time bids up the firm's selling expense, because compensation planners are more willing to increase points than they are to decrease them. The increase in selling expense stifles growth, by reducing the growth rate of the salesforce, as shown in figure 16. As salespeoples' compensation rises, the existing force absorbs an increasing proportion of the sales budget, thereby leaving less for force expansion. The process reinforces itself. With lower force expansion , revenue growth is suppressed and the sales budget itself grows less quickly.

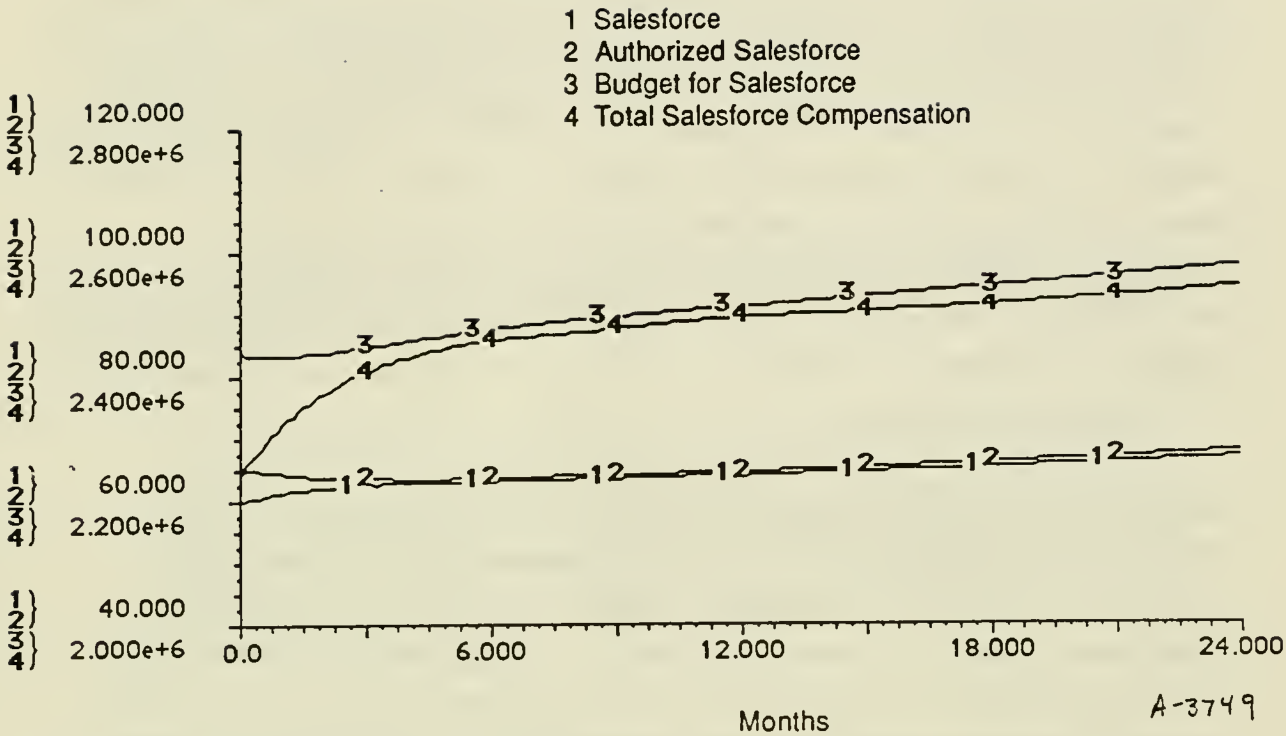


Figure 16: Budget and Salesforce

New Insight Into Strategy and Structure

The net result of the system's adjustment is quite curious. The small system business unit introduces some attractive new product lines that have the potential to earn the company more revenue per sales hour than existing products. But the products' success ignites a battle for salesforce time between the two semi-autonomous business units. The battle, which is waged inadvertently through the business unit's independent sales planning and control procedures, causes an inflation of selling expense that overwhelms the revenue advantage of the new product lines. Expense rises more rapidly than revenue. As a result the distinct business units with shared force grow more slowly than independent business units which, by virtue of their independent salesforces, are immune from the problem of competition for salesforce time and escalating selling expense.

By studying MBM's design through the policy structure representation one obtains new insights into the strengths and weaknesses of the independent and distinct business unit designs. Distinct business units that share a salesforce have a design weakness. They can readily become locked into a dysfunctional battle for salestime, which is difficult to prevent because each business unit plans and controls its sales independently. Curiously, the more succesful a given business unit's products are, the more intense the ensuing internal competition for salestime. Any competition slows the company's growth rate (relative to a company with independent business units that has equal selling expense [10]). Particularly severe competition for salestime, stemming say from the introduction of an extraordinarily succesful product line, has the potential to destroy a company's growth momentum and send it spinning into decline.

These new insights into business performance indicate how business problems can arise from the firm's structure. But they are 'food for thought', not rigid predictions. Knowing how competition for salestime arises, one can review with executives and managers the firm's sales planning and control procedures to discover how (or whether) the procedures avoid the problem. Equally important, one can use the simulation model to design policy changes that ease the conflicts arising from a shared salesforce [11]. The ultimate objective of policy redesign is to make the business units with shared salesforce behave as if they had independent salesforces.

IMPLICATIONS FOR ORGANIZATIONAL DESIGN

We have discussed two representations of organizational structure -- the organizational chart and the policy structure diagram. We conclude the paper with some thoughts on how the two representations might be used together to help in the complex and challenging task of organizational design.

First some observations on the value of different representations for problem solving (recognizing that design is a special kind of problem solving). Simon (1982) provides the following illustration:

> That representation makes a difference [in problem solving] is a long familiar point. We all believe that arithmetic has become easier since arabic numerals and place notation replaced Roman numerals (p153)....[and in social systems] an appropriate representation of the [social] problem may be essential to organizing efforts toward solution and to achieving some kind of clarity about how proposed solutions are to be judged. Numbers are not the name of this game but rather representational structures that permit functional reasoning, however qualitative it may be. (p169)

Different representations are commonly used in complex engineering design problems. Consider for example the design of a nuclear power station. Designers use architectural drawings to design the spatial arrangement of the power station and its many components. But the architectural drawings alone are not enough to ensure an effective design. Designers also use engineering drawings and computer simulation models (totally different representations of the power station) to understand how the station's power generating components will interact over time. What power loads will the station handle? How well will the station's safety mechanisms work in the event of an explosion, a component failure, or some other emergency?

It is clear that different but complementary representations can help solve complex design problems. But how does one use different representations in the analysis of organizational design? When in the analysis does one use the organizational chart, and when the policy structure diagram? Here we suggest that the organizational chart is the natural lead-in, and the policy structure diagram the follow-up, to design problems in organizations undergoing radical change. By contrast, the policy structure diagram (and behavioral simulation modeling) is the natural lead-in, and the organizational chart the follow-up, to design problems in organizations that are faced with a recognized business problem (declining market share, stagnation in sales, low productivity in manufacturing or sales).

Radical Change -- Organizational Chart Then Policy Structure Diagram

The organizational chart is a good starting point for addressing design problems in organizations undergoing radical change. It matches the way people think about organizations more closely than the policy structure diagram. Hence, it allows one to represent more quickly several quite different organizational designs and to select among them.

For entrepreneurs who are launching a new business enterprise, the organizational chart allows them to visualize the layout of the new firm's fledgling functions, just as the architectural drawing enables one to visualize the layout of the power station. For executives of an established firm which is introducing new products, or acquiring subsidiaries, or expanding into new geographical markets, the organizational chart helps them to visualize how the functions and responsibility centers of the existing organization might be adapted to support the new strategic thrust.

In this first stage of design the organizational chart enables one to study the layout of the organization's responsibilities. It focuses one's attention on conflicts between responsibility centers, on the information load (or overload) of executives and managers, and on the coordination of people's activities.

In the second stage of design, business analysts and executives diagram and discuss the policy structure implied by the organizational chart. The style of analysing policy structure should be a flexible combination of narrative and debate that builds on structural diagrams and simulation experiments (as described in Morecroft October 1985). The discussion provides new insight into the way a business unit interacts with other business units and with its environment, in much the same way that engineering drawings and simulation models help power station designers understand the station's likely operating behavior.

Business Problem -- Policy Structure Diagram Then Organizational Chart

The policy structure diagram (and behavioral simulation modeling) is a good starting point for addressing design problems in organizations with a recognized business problem, but not necessarily a recognized structural problem. (It is also the traditional way of starting a system dynamics policy project, Richardson and Pugh 1981, chapters 1 and 2; Randers 1980). The diagram helps one to visualize the firm's key decision functions (for example pricing, capacity planning, sales planning and control), to see how decisions and actions are coupled in feedback loops, and to understand (using simulation) how the system's feedback structure generates its dynamic behavior (or business problems).

For executives of a company with a business problem, the process of diagraming policy structure and making simulations helps stimulate debate and discussion of business operations. For example, the MBM policy structure study was motivated by a business problem. The project team first examined the firm's policies and procedures for sales planning and control. They used the policy structure diagram to see how the different business units compete internally for sales time. Simulations revealed how this competition for time led to escalating sales expense and suppressed sales growth.

The second stage of design for business analysts and executives is to experiment with policy changes that alleviate the problem. Sometimes the policy changes will point to the need for changes in organizational structure. In other words, exploring design in the policy structure representation might lead to change in organizational design, using the organizational chart [12]. For example, one solution to MBM's dysfunctional competition for sales time might be to integrate responsibility for compensation planning in a single staff group that is shared between large and small systems. Sometimes the policy changes can be implemented within the exisiting organizational structure. For example, another solution to MBM's dysfunctional competition for sales time might be to have more frequent review of business objectives and less rapid adjustment of points in compensation planning -- policy changes that can be introduced without modifying the autonomy each business unit has in sales planning and control.

Conclusion -- The Importance of Research in Organizational Design

Organizational design is perhaps one of the most challenging and interesting areas for research in the policy and strategy field. The prospect of helping to create superior business organizations (and superior social organizations) -- organizations with 'administrative advantage' -- is very appealing. This paper adds to the growing interest in organizational design and, we hope, points to a promising new style of research for matching strategy and structure [13].

FOOTNOTES

[1] Galbraith and Nathanson (1978) provide a valuable summary of conceptual and empirical research on strategy and structure during the late 1960's and the 1970's.

[2] Decision functions do not always generate action; sometimes they generate commands (information).Then they are connected to other decision functions rather than to flow requlators and levels.

[3] The authors did not see consultants' final report. However, the authors were able to discuss the design alternatives with one of MBM's senior managers who had been briefed about the consultants' recommendations.

[4] The large/small system segmentation is simpler than MBM's actual segmentation. The simplification is made in part to disguise the company's identity and in part for conciseness.

[5] The large circular symbols in figure 7 represent behavioral decision functions, but their information filters have been removed to avoid undue visual complexity. However, in reading about the assumptions of each decision function, it is useful to imagine the filters in place. The small circular symbols in figue 7 represent external constants.

[6] A policy structure diagram representing MBM's manufacturing policies has, in fact, been constructed (Morecroft June, 1985). But the diagram that includes both manufacturing and sales is complex -- much more complex than the corresponding organizational chart. This added complexity makes policy structure diagrams more difficult to use than organizational charts. However, visual complexity is the price one pays for reaching deep into business operations and for trying to portray the firm's formal and informal communication network instead of its lines of authority and reporting.

[7] The model used in the paper assumes that changes in compensation have no effect on sales effort. This simplifying assumption means that the negative loop shown in figure 7 is inactive.

[8] Documentation of the model is provided in the appendix. The model is written in an innovative new simulation language STELLA (Richmond 1985) which allows the business analyst to create a model hierarchically, first as a diagram (similar to the policy structure

diagram but more detailed) and then in equations. The diagram, once created, guides the analyst's equation writing.

[9] The independent business unit simulation is produced with a model that includes both large and small system business units -- in fact the same model used for simulating distinct business units with shared salesforce. The two business units behave as though they are independent (salespeople allocate a constant proportion of their time to each business unit throughout the simulation) if the model is parameterized so that the salesforce finds each business units' products equally attractive, and so that each unit is meeting its sales objective. The parameter conditions are: 1) expected time per sale of small systems XTSSS=15 hours/system; 2) time per sale of small systems TSSS=15 hours/system. Conditions 1 and 2 ensure that the time per sale of small systems is just the right amount to make small systems equally attractive to salespeople as large systems (large systems are assumed to take 75 hours each to sell, but they carry 5 times the points of small systems). In addition the initial value of base orders for large systems BOLS is set equal to sales effort to large systems SELS divided by expected time per sale of large systems ETSLS. This initialization ensures that the large system business unit's orders are exactly equal to the sales objective at the start of the simulation.

[10] The simulation experiments assume that the independent business units have identical selling expense to the business units with shared salesforce. The assumption favors an independent business unit design, since the independent units gain all the advantages of independent salesforces with no greater expense. In a fairer test, the independent business unit design might be simulated with an indirect salesforce expense that is higher than the indirect expense of business units with shared salesforce. The higher indirect selling expense would reduce the independent business unit's initial growth rate. But total selling expense (direct and indirect) would likely end up smaller than for the business units with shared salesforce because there is no competition for salesforce time to drive up salesforce compensation.

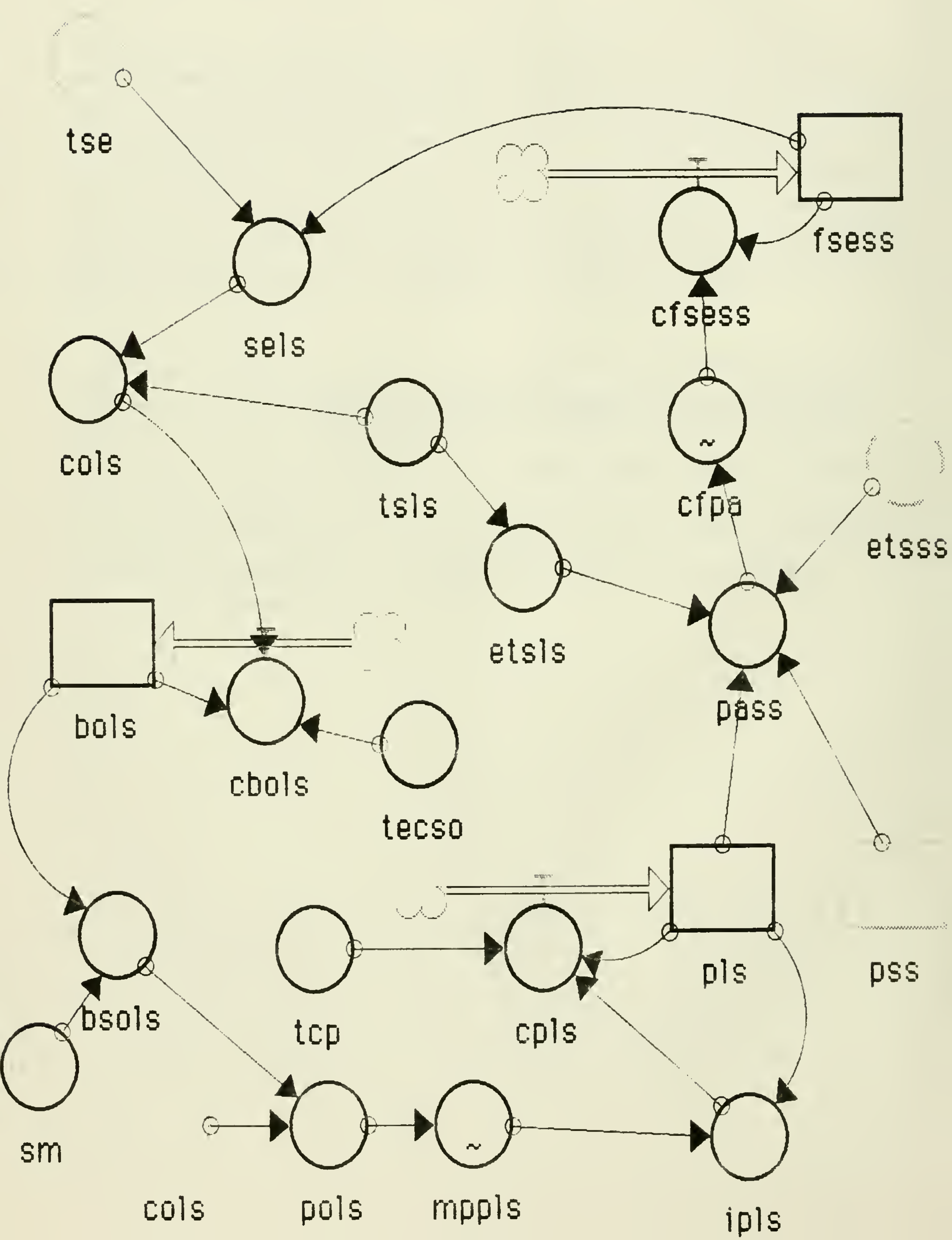
[11] One can imagine several ways to ease the conflicts arising from a shared salesforce. The business unit's sales objectives might be reviewed more frequently and adjusted upward or downward to account for changes in salesforce time allocation. Compensation planners may need to adjust points more slowly in response to sales variances. Salespeople might be conditioned to the idea that product points are reduced if sales exceed objective. All these measures are intended to moderate inflation of selling expense by reducing the 'battle' for salesforce time between the business units. Alternatively one might think of ways to increase

total sales effort quickly, so that an increase in sales effort to an attractive product line is achieved with overtime or hiring , instead of at the expense of other product lines.

[12] The sequence of analysis, policy structure then organizational chart, is very similar to the sequence followed by duPont executives in their redesign of the company's organizational structure. A business problem prompted them to study closely the operation of the company's new paints and varnishes business (Chandler 1962, pp 91-96). Dupont had diversified into paints and varnishes in order to use excess capacity from the explosive powder factories, as powder demand declined at the end of World War I. Although the strategic move made sense, the paints and varnishes business ran at a loss during its first three years. By studying business operations, Dupont executives were eventually led to an important structural redesign -- the creation of an independent business unit for paints and varnishes.

[13] The decisionmaking/information processing perspective on organizational structure has led to a number of provocative articles on organizational design. In his Sciences of the Artificial Simon (1980), provides a wide ranging discussion of the 'science of design' (chapter 5) and 'social planning' (chapter 6). Forrester (1975b), provides a thought provoking discussion of principles for a 'New Corporate Design'. (The principles have been used by executives of several medium sized firms in the U.S.). Kiefer and Senge (1984), building on Forrester's work, explore the organizational design factors that help create challenging and highly motivating work environments in business firms.

Appendix: Model Documentation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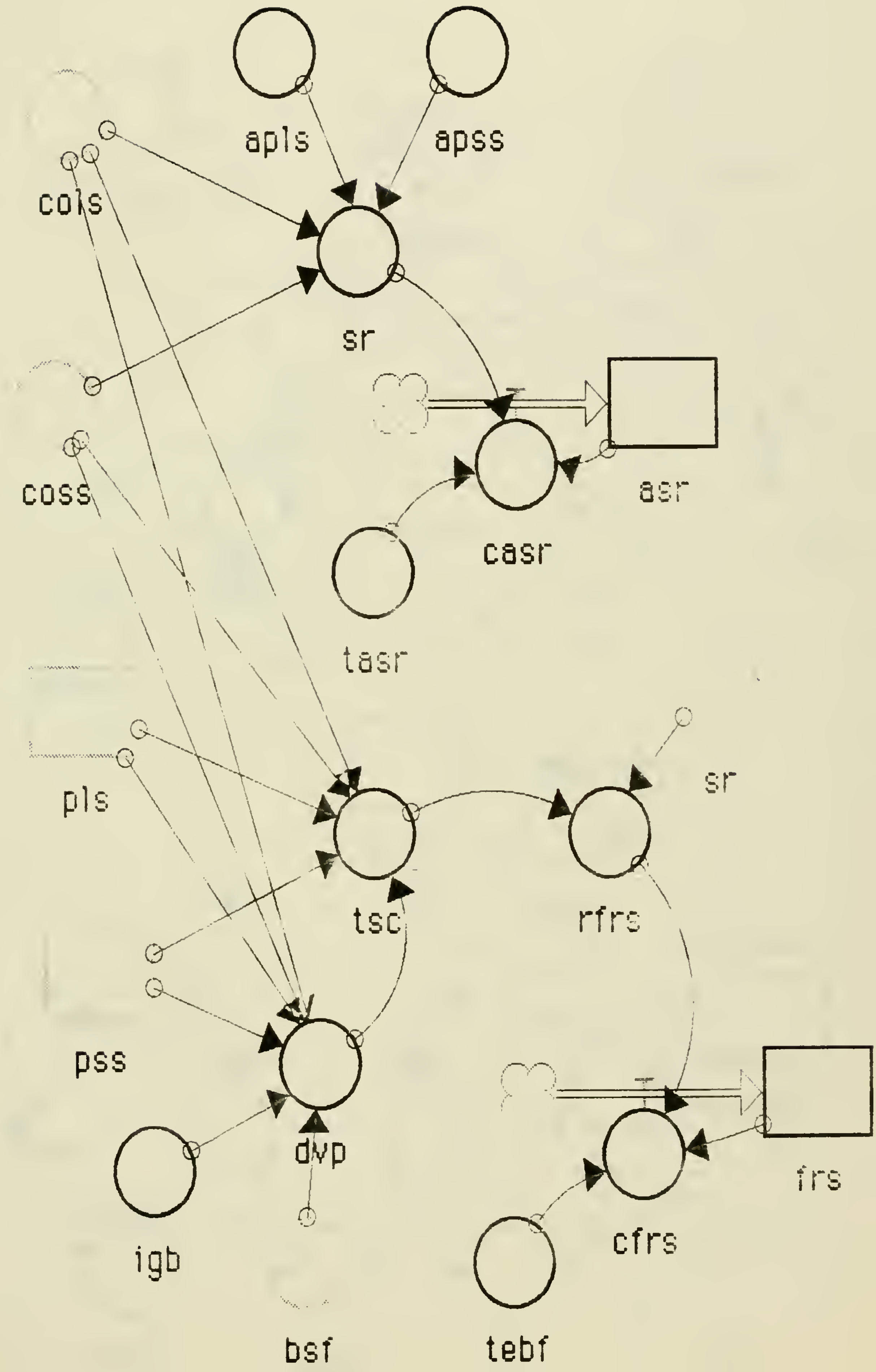
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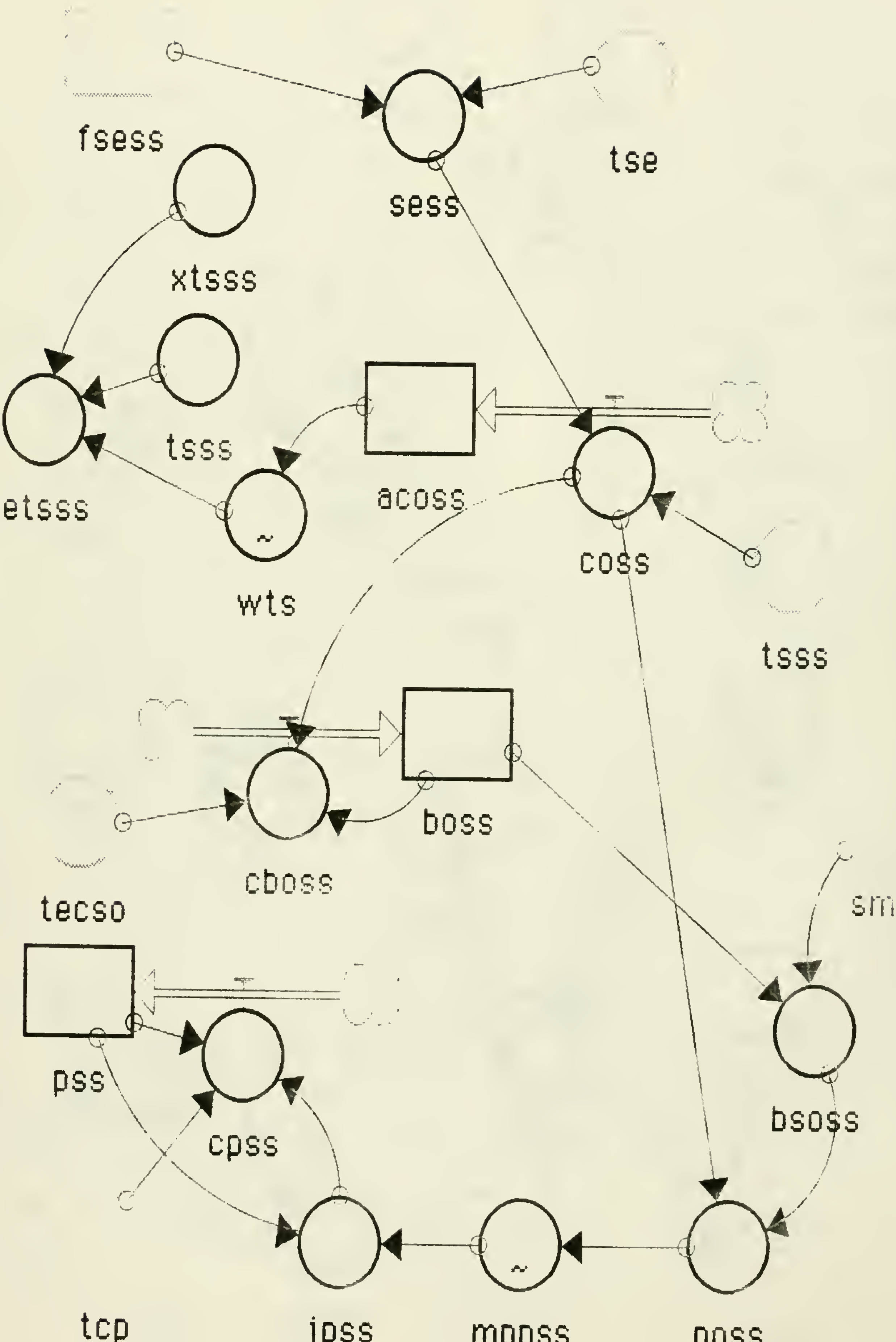
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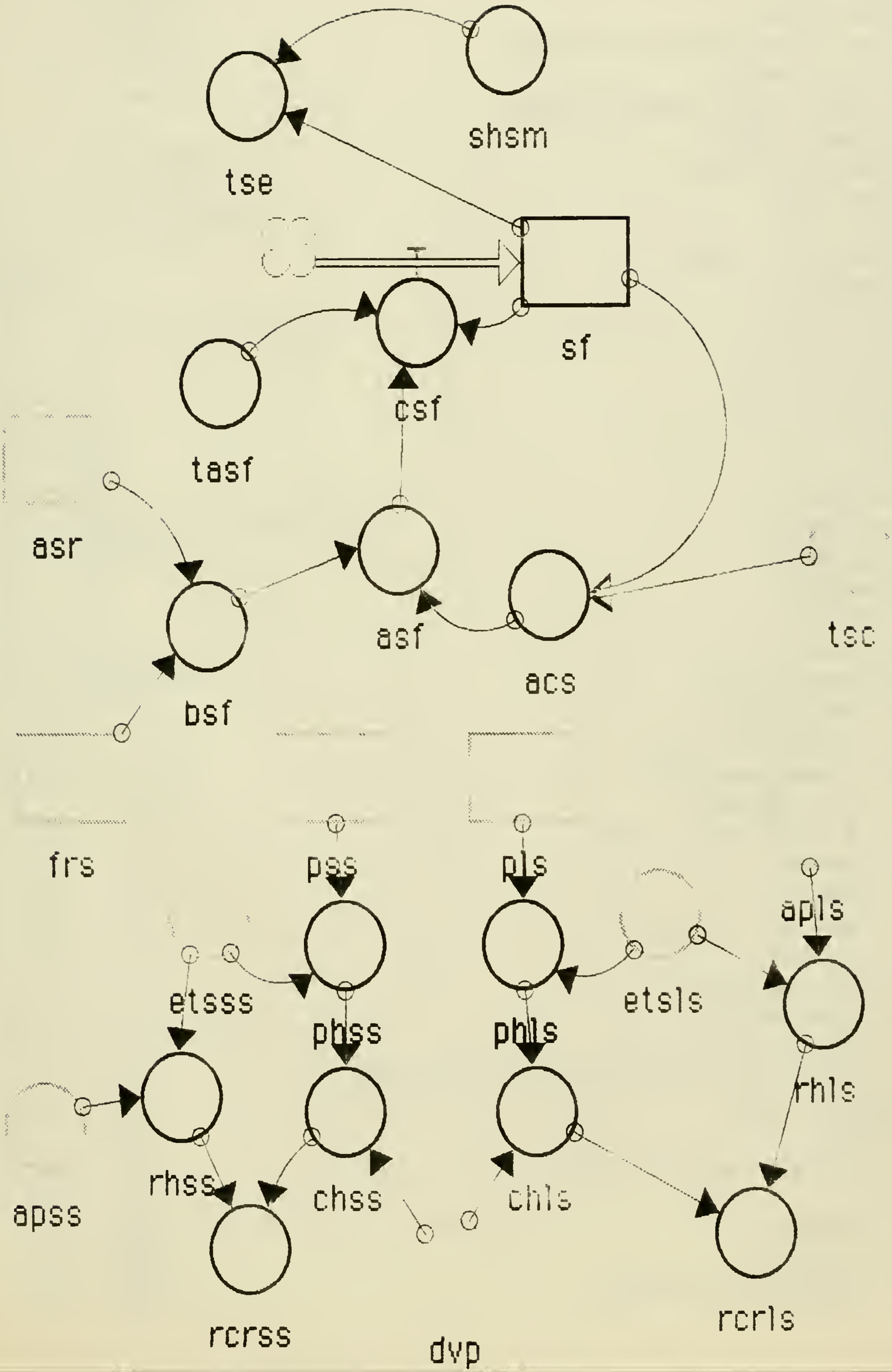
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phls
rhls
rhss
chss
chls
apss
rcrss
rcrls
dvp

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□ acoss = acoss + coss
  INIT(acoss) = 0
□ asr = asr + casr
  INIT(asr) = (coss*apss)+(cols*apls)
□ bols = bols + cbols
  INIT(bols) = ((tse*0)+(sels*1))/etsls
□ boss = boss + cboss
  INIT(boss) = sess/tsss
□ frs = frs + cfrs
  INIT(frs) = .2
□ fsess = fsess + cfsess
  INIT(fsess) = .1
□ pls = pls + cpls
  INIT(pls) = 25000
□ pss = pss + cpss
  INIT(pss) = 5000
□ sf = sf + csf
  INIT(sf) = 60
○ acs = tsc/sf
○ apls = 100000
○ apss = 20000
○ asf = bsf/acs
○ bsf = asr*frs
○ bsols = bols*(1+sm)
○ bsoss = boss*(1+sm)
○ casr = (sr-asr)/tasr
○ cbols = (cols-bols)/tecso
○ cboss = (coss-boss)/tecso
○ cfrs = (rfrs-frs)/tebf
○ cfsess = fsess*cfpa*(1-fsess)
○ chls = phls*dvp
○ chss = phss*dvp
○ cols = sels/tsls
○ coss = sess/tsss
○ cpls = (ipls-pls)/tcp
○ cpss = (ipss-pss)/tcp
○ csf = (asf-sf)/tasf
○ dvp = INIT(bsf)/((INIT(coss)*INIT(pss))+(INIT(cols)*
  INIT(pls))*(1+igb))
○ etsls = tsls
○ etsss = tsss*wts+xtsss*(1-wts)
○ igb = .1
○ ipls = pls*mppls
○ ipss = pss*mppss
○ pass = (pss/etsss)/(pls/etsls)
○ phls = pls/etsls
```

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phls = pls/etsls
phss = pss/etsss
pols = cols/bsols
poss = coss/bsoss
rcrls = rhls/chls
rcrss = rhss/chss
rfrs = tsc/sr
rhls = apls/etsls
rhss = apss/etsss
sels = tse*(1-fsess)
sess = tse*fsess
shsm = 150
sm = 0
sr = (coss*apss)+(cols*apls)
tasf = 3
tasr = 6
tcp = 3
tebf = 24
tecso = 6
tsc = ((coss*pss)+(cols*pls))*dvp
tse = sf*shsm
tsls = 75
tsss = 15
xtsss = 15
cfpa = graph(pass)
 0.0 -> -2.500
0.200 -> -1.700
0.400 -> -1.100
0.600 -> -0.600
0.800 -> -0.250
1.000 ->  0.0
1.200 -> 0.250
1.400 -> 0.600
1.600 -> 1.100
1.800 -> 1.700
2.000 -> 2.500
mppls = graph(pols)
0.500 -> 1.500
0.600 -> 1.450
0.700 -> 1.400
0.800 -> 1.250
0.900 -> 1.100
1.000 -> 1.000
1.100 -> 0.960
1.200 -> 0.930
1.300 -> 0.910
```

```
1.400 -> 0.900
1.500 -> 0.900
```

⊘ mppss = graph(poss)

```
0.500 -> 1.500
0.600 -> 1.450
0.700 -> 1.400
0.800 -> 1.250
0.900 -> 1.100
1.000 -> 1.000
1.100 -> 0.960
1.200 -> 0.930
1.300 -> 0.910
1.400 -> 0.900
1.500 -> 0.900
```

⊘ wts = graph(acoss)

```
0.0 -> 0.0
100.000 -> 0.095
200.000 -> 0.200
300.000 -> 0.335
400.000 -> 0.500
500.000 -> 0.800
600.000 -> 0.970
700.000 -> 1.000
800.000 -> 1.000
900.000 -> 1.000
1000.000 -> 1.000
```

Definitions

ACOSS	Accumulated Orders for Small Systems (Orders)
ASR	Average Sales Revenue (Dollars/Month)
BOLS	Base Orders for Large Systems (Orders/Month)
BOSS	Base Orders for Small Systems (Orders/Month)
FRS	Fraction of Revenue to Sales (Dimensionless)
FSESS	Fraction of Sales Effort to Small Systems (Dimensionless)
PLS	Points for Large Systems (Points/System)
PSS	Points for Small Systems (Points/System)
SF	Salesforce (Account Executives)
ACS	Average Compensation Per Salesperson (Dollars/Account Executive/Month)
APLS	Average Price of Large Systems (Dollars/System)
APSS	Average Price of Small Systems (Dollars/System)
ASF	Authorized Saleforce (Account Executives)
BSF	Budget for Salesforce (Dollars/Month)
BSOLS	Business Sales Objective for Large Systems (Orders/Month)
BSOSS	Business Sales Objective for Small Systems (Orders/Month)
CASR	Change in Average Sales Revenue (Dollars/Month/Month)
CBOLS	Change in Base Orders for Large Systems (Orders/Month/Month)
CBOSS	Change in Base Orders for Small Systems (Orders/Month/Month)
CFRS	Change in Fraction of Revenues to Sales (Fraction/Month)
CFSESS	Change in Fraction of Sales Effort to Small Systems (Fraction/Month)
CHLS	Compensation Per Hour for Large Systems (Dollars/Hour)
CHSS	Compensation Per Hour for Small Systems (Dollars/Hour)
COLS	Customer Orders for Large Systems (Orders/Month)
COSS	Customer Orders for Small Systems (Orders/Month)
CPLS	Change in Points for Large Systems (Points/System/Month)
CPSS	Change in Points for Small Systems (Points/System/Month)
CSF	Change in Salesforce (Account Executives/Month)
DVP	Dollar Value of Points (Dollars/Point)
ETSLS	Estimated Time to Sell Large Systems (Hours/System)
ETSS	Estimated Time to Sell Small Systems (Hours/System)
IGB	Initial Growth Bias (Dimensionless)
IPLS	Indicated Points for Large Systems (Points/System)
IPSS	Indicated Points for Small Systems (Points/System)
PASS	Perceived Attractiveness of Small Systems (Dimensionless)
PHLS	Points Per Hour for Large Systems (Points/Hour)
PHSS	Points Per Hour for Small Systems (Points/Hour)
POLS	Performance Against Objective for Large Systems (Dimensionless)
POSS	Performance Against Objective for Small Systems (Dimensionless)
RCRLS	Revenue to Compensation Ratio for Large Systems (Dimensionless)
RCRSS	Revenue to Compensation Ratio for Small Systems (Dimensionless)
RFRS	Reported Fraction of Revenue to Sales (Fraction/Month)
RHLS	Revenue Per Hour for Large Systems (Dollars/Hour)
RHSS	Revenue Per Hour for Small Systems (Dollars/Hour)
SELS	Sales Effort for Large Systems (Hours/Month)
SESS	Sales Effort for Small Systems (Hours/Month)
SHSM	Standard Hours Per Salesperson Month (Hours/Account Executive/Month)
SM	Stretch Margin (Dimensionless)
SR	Sales Revenue (Dollars/Month)
TASF	Time to Adjust Salesforce (Months)
TASR	Time to Adjust Sales Revenue (Months)

TCP	Time to Change Points (Months)
TEBF	Time to Establish Budget Fraction (Months)
TECSO	Time to Establish Corporate Sales Objective (Months)
TSC	Total Salesforce Compensation (Dollars/Month)
TSE	Total Sales Effort (Hours/Month)
TSLS	Time per Sale of Large Systems (Hours/System)
TSSS	Time Per Sale of Small Systems (Hours/System)
XTSS	Expected Time Per Sale of Small Systems (Hours/System)
CFPA	Change in Fraction from Perceived Attractiveness (1/Month)
MPPLS	Multiplier from Performance on Points for Large Systems (Dimensionless)
MPPSS	Multiplier from Performance on Points for Small Systems (Dimensionless)
WTS	Weight for Time Per Sale (Dimensionless)

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