

Systems Analysis of Apparel Company Problems *

by

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ABSTRACT

This paper illustrates the effectiveness of System Dynamics modeling in treating apparel industry problems. It is based on a case study of a cooperating apparel manufacturer. The study was one part of a several years effort by my consulting firm, Pugh-Roberts Associates Inc., sponsored by the Textile and Apparel Technology Center of the U.S. Department of Commerce. The contracts developed systems analyses of a broad variety of textile and apparel industry problems and produced trial applications of the techniques to one major textile company and one medium-sized apparel firm.

In conducting the case study of the cooperating apparel company we began with a general familiarization phase, including interviews with company personnel and the study of operating data over a several year period. During this first phase ideas were formulated as to how individual management practices might be related structurally to produce the company trends observed. As certain aspects of the firm began to appear influential on the firm's

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overall performance were translated into a System Dynamics computer model. The resulting computer model was then tested using computer simulation to see if the hypothesized model structure produced the same type of behaviour that was actually observed in the firm's history. In particular, the case study model was tested against the company's performance over the previous five years. Once the model produced the basic underlying trends and changes that were apparent in the real situation, it became a useful tool with which to understand the problems of the apparel firm.

HISTORICAL PERSPECTIVE

The apparel company that had been selected for study is identified here as the Everdry Company. It is a rainwear manufacturer and is one of the older firms in the industry, having been in business for over fifty years. Considering its current sales volume, it is a medium-sized manufacturer, larger firms having developed only recently due to some basic changes in the nature of the industry. Like many apparel firms, it is held and operated primarily by the family of the founder, who in this case only recently passed away.

The analysis of Everdry has come up with a number of problem symptoms that suggest the need for management systems analysis. Despite the firm's success in the long run, its most recent performance has been disappointing compared to the potential indicated by other firms and by the economy in general. Although sales previously had doubled during a five-year period, dollar volume in the past five years has been approximately constant. Moreover, the fact that the firm is now selling a product with a higher average price somewhat disguises the fact that unit sales have actually been declining.

Everdry has also been plagued recently by difficulties in meeting delivery commitments. Outside problems have contributed to the situation but plant control seems to be more difficult with the increased number of products in the line. This was indicated also by the fact that the plant recently encountered a period with record work-in-process inventories, despite the fact that unit sales were below those of earlier years. Other difficulties have been encountered with quality control recently - the introduction of the new products places a strain on the system in terms of training workers to perform several different jobs.

Labor turnover has been a general problem in this part of the country in that the apparel industry has fared relatively poorly in competing with some of the alternative job opportunities available. This has been particularly true during the recent economic boom. Fluctuations in the work available at Everdry have also had an effect on turnover in the plant.

The decline in sales in recent years has also had a detrimental effect on turnover amongst the company salesmen. Other companies in the industry that have been expanding have attracted some salesmen and other salesmen apparently have not been able to maintain sales high enough to satisfy their income requirements. In addition to salesmen difficulties, the firm also has changed advertising agencies several times because of management's apparent dissatisfaction with the results.

MODEL DESCRIPTION

One way to better understand the situation in a company is to build a representation of what has taken place that has resulted in the symptoms described previously. This representation is called a model and Industrial Dynamics provides us with a way to build a model that provides a concise and lucid description of what may have

been the important factors in this case. The model is best described by considering the cause and effect relationships between small groups of factors at a time. The overall effect of the factors on the company's performance will be considered after we have examined several individual sectors of the model.

Promotional Market Sector

Figure 1 illustrates the major relationships in the environment in which the company sells its product. The factors have been aggregated to a great extent to allow an overview of the relationships and later of the effects of this sector on other portions of the apparel company model. The key relationship is the way in which total industry promotional expenditures result in sales for the entire apparel industry. This includes promotional efforts of all the

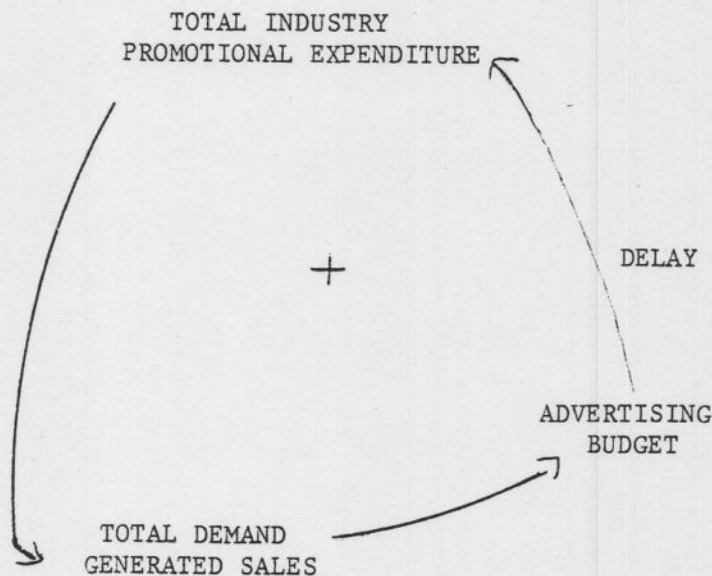


FIGURE 1. INDUSTRY PROMOTIONAL FEEDBACK

companies, although in the case of the Everdry Company's market, one company had dominated the industry's promotional effort until recently. Sales, in turn have an effect on the promotional budget in that next year's plans depend very much on this year's sales. Thus a company that is growing due to its promotional efforts tends to reinforce its growth by expanding its budget for the next year each time its sales improve. This positive feedback effect is an important structural factor that appears to have been the cause of one company dominating the rainwear market for the higher priced coats.

Everdry's share of these "demand-generated" sales is based on its own promotional efforts and how they compare to that of the total industry. In addition, the company's market share is also affected by product innovation where early introduction of a new product gives the firm an extra advantage in promotional benefits. As in the industry case, the sales generated by the firm's promotional efforts create the revenues necessary to produce next year's promotional budget. Figure 2 illustrates these relationships along with the industry market structure shown in Figure 1.

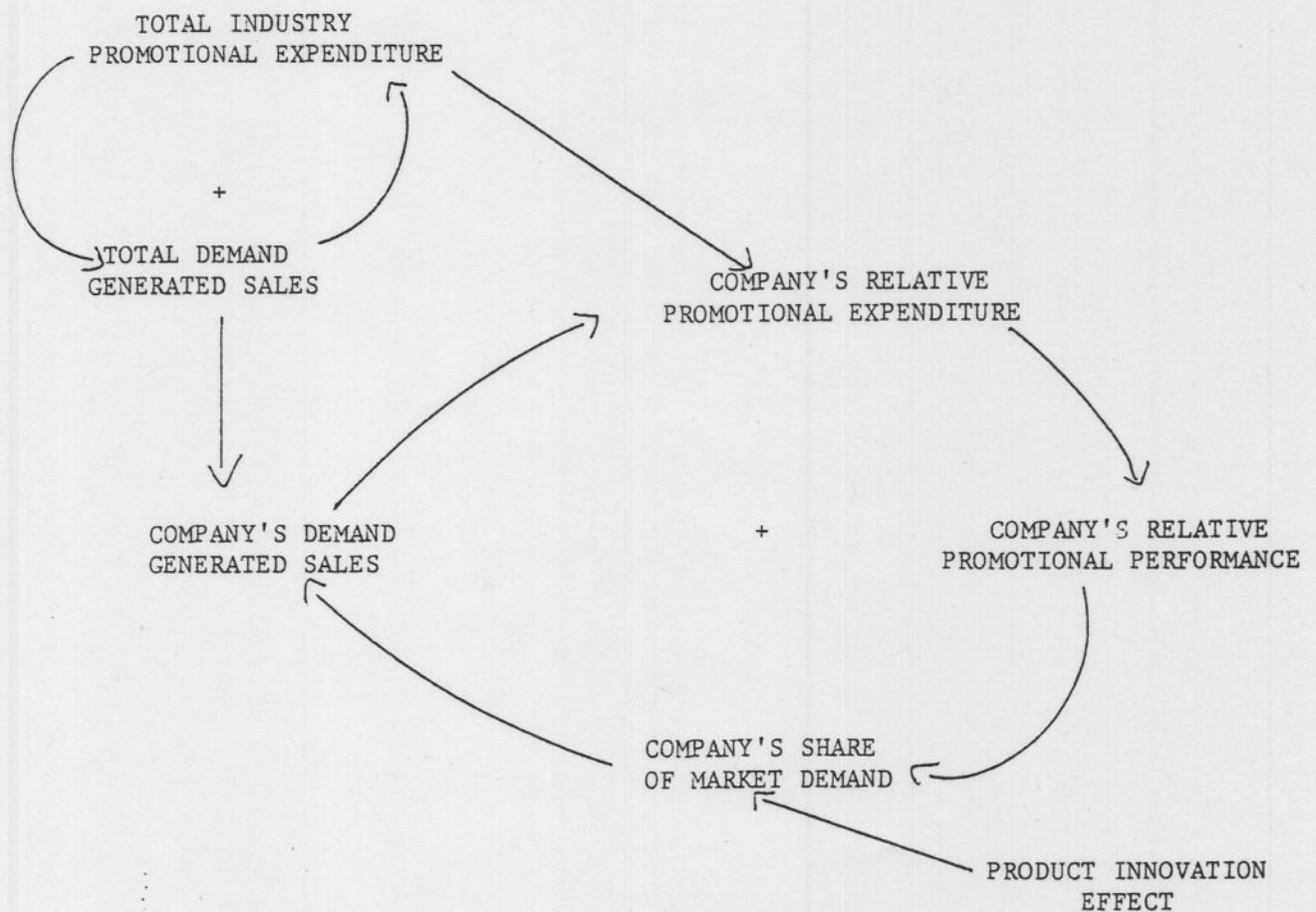


FIGURE 2. COMPANY PROMOTIONAL FEEDBACK

Sales Sector

In addition to the sales created by promotional efforts, the original market for Everdry's products consisted of customers who purchased the coats because of the apparent physical characteristics when seen at a retail store or because of the retailer's reputation. This basic market can be considered to relatively constant, changing primarily only with population growth. The number of coats that represent the company's sales in this market are equivalent to the exposure they get to the public through the retailers. Therefore,

the company's share of the basic market is shown in Figure 3 as that proportion of the total market that is covered by the retail outlets that carry the company line.

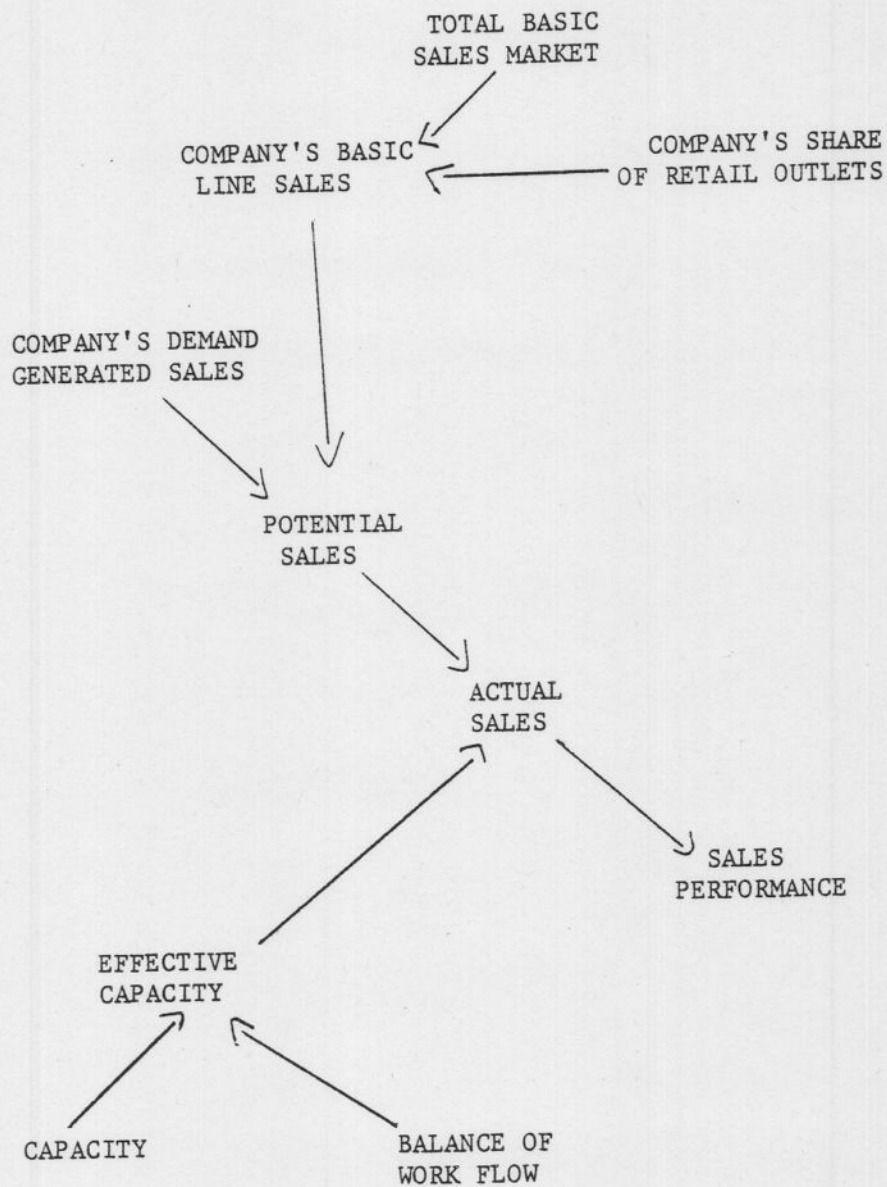


FIGURE 3. COMPANY SALES DETERMINANTS

The sales from the basic market and the demand generated sales combine to represent the total sales that might be sold by the apparel company. If this is in fact within the production capability of the firm, this total will become actual sales. The sales rate will be the capacity of the firm, however, if production becomes a limiting factor. Management has an idea of what type of growth is possible from the conditions in the industry in general and compares the current rate to the perceived industry trend.

Product Line Sector

One of the effects of low sales performance, that is, not achieving the growth rate that management feels is attainable, is for serious doubts to be raised about the suitability of the company's product line for the market conditions. In this case, it appears that after mediocre performance has persisted for some period of time, management responds by planning the introduction of new products. The time it takes management to respond to the pressure caused by poor sales performance is not an exact figure and in this situation appears to have been one to two years. If a period of low sales performance persists, management will, after the initial delay, introduce new lines on a continual basis. As the new apparel products are offered to the market, there is usually a season or two of market enthusiasm and good sales volume, then a gradual falling off in interest occurs. The initial boost might result from several factors - the novelty of the product, the salesmen's initial enthusiasm for a new item, or the retailers' estimates of the product's potential combined with inventory filling by retailers. After this initial phase, however, it appears that the product's performance falls back on the same factors that affect all of Everdry's products: promotional effort, reputation, number of retailers, effectiveness of the company salesmen, etc. These factors are illustrated in Figure 4.

The rate at which new products are introduced together with the rate at which Everdry management decides to prune out some of the old products causes variations over time in the number of products in the company's line. In recent years the trend of product lines for the apparel company studied has been very definitely upward, particularly when one considers all the color-pattern combinations offered within any one basic style. The effect of this upward trend

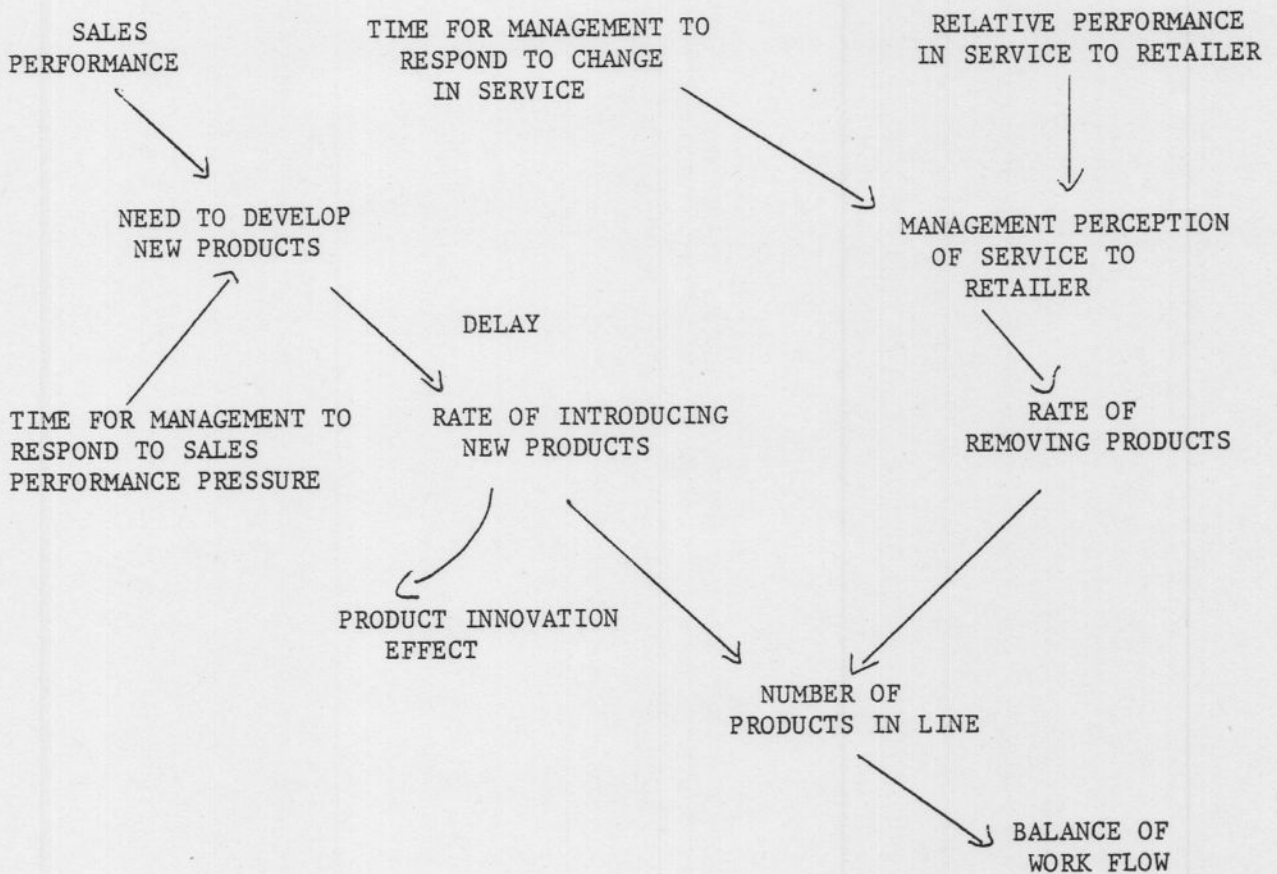


FIGURE 4. PRODUCT LINE INFLUENCES

has been to put more of a load on the plant in terms of problems of controlling the production and distribution end of the business. More product items imply more production runs with fewer items in each run.

however, before the results of these actions can be felt. It is possible that the initial problem might grow worse in the interim. In a situation where factors continually depress the balance of work flow, management's efforts to improve can continually lag behind, sometimes resulting in production control barely holding its own at a relatively poor level.

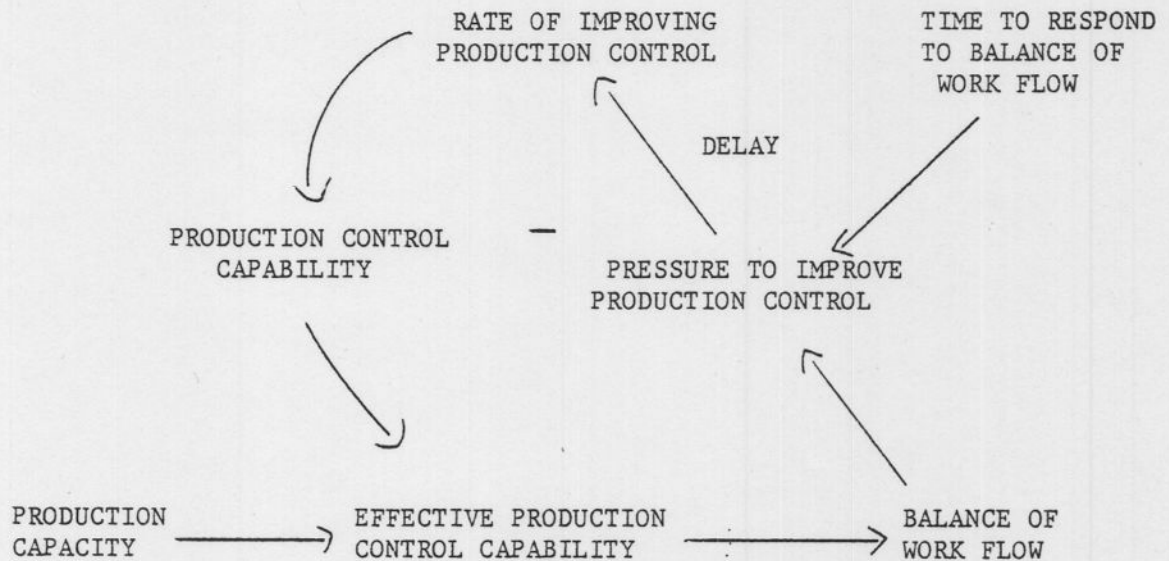


FIGURE 5. PRODUCTION CONTROL LOOP

Labor Sector

Because of the piece-rate payment system used in the apparel industry, the balance of work flow situation in the Everdry plant can have a serious effect on employment stability in the firm. A worker receives wages only for the number of bundles on which she has actually

worked. The union agreement provides that management must pay a minimum wage equivalent to four hours work each time a worker is called in. But when work is not available, management either tells her not to come in or sends her home half-way through the day, resulting in a corresponding cut in her wages.

Because of this basic practice in the apparel industry, poor balance of work flow in the plant can directly affect the weekly wages received by the workers. When the balance is low, some work stations run out of work, resulting in situations where workers only work half days. This lack of employment stability results in increased labor turnover. Workers who need the wages look for work at other apparel firms in the area and, once started, will work for the new firm as long as the work is stable. This turnover of the apparel company's work force has an additional degrading effect on the balance of work flow. The worker who has left for another firm has to be replaced and the delays in hiring and getting a new worker adjusted to her new environment can add to the problems of controlling the plant. Thus the labour turnover caused by the poor balance of work flow worsens the work flow situation. This is particularly true during times of strong economic conditions when other firms nearby are in need of more help. These relationships are indicated in Figure 6, as are those aspects discussed below.

Another factor which becomes important is the generally depressing effect high labor turnover has on the quality of the apparel company's labor force. If other nearby industries offer stable employment they are often able to attract some of the apparel industry's better skilled workers. Thus, labor turnover causes a decline in the average skill level of the apparel labor force as the less qualified workers are left behind and the new ones that can be hired have fewer skills yet. One can discover a trend in the makeup of the company's

work force over time in that it is derived more and more from the lower cultural groups in the community. The effect of this trend is additional reinforcement of the labor turnover problem as worker absenteeism is higher, work skills are not developed, and good work attitudes are frequently non-existent. These factors act through these two sets of relationships to reinforce poor balance of work flow, although at a very gradual rate.

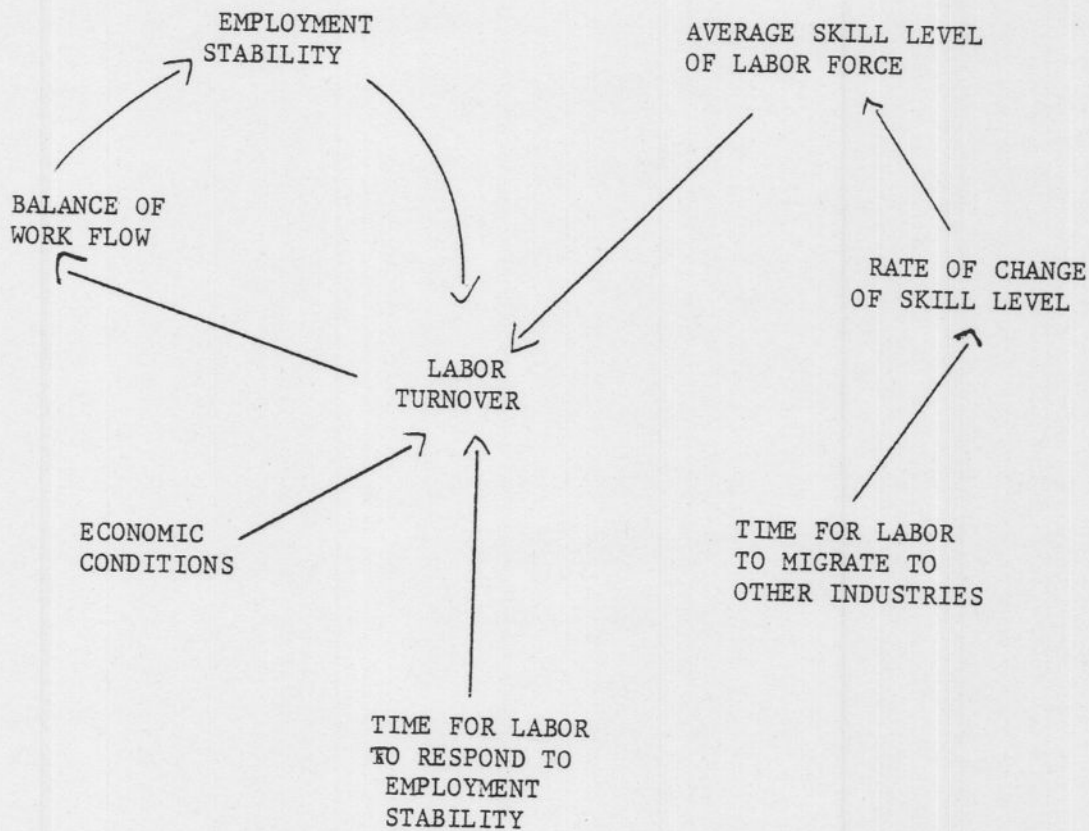


FIGURE 6. LABOR INTERACTIONS

Retailers Sector

The retailers who sell Everdry's product line see the company from two points of view, directly in the way they order and receive their goods, and indirectly when they resell the company's goods to the general public. In the first case, the retailer knows the company salesman and he sees the garments as they arrive from the plant. If sales performance for the Everdry Company has been poor, however, its salesmen turnover tends to be high. The average salesman can accept a slump for a short period but if it persists he decides to work elsewhere, particularly if other portions of the industry appear to be doing well. An increase in salesmen turnover has a detrimental effect on the company's relative performance in service to the retailers. A new man, even after the time required to find him, takes some time to get to know the retailers and to build strong relationships that ensure regular orders each season. Sometimes, a loyal retailer takes the opportunity presented when a salesman changes to experiment with competitive lines. The other company factor that directly affects the retailer is the way in which the orders are processed and fulfilled. If the balance of work flow at the apparel company is poor, deliveries are often delayed, items sometimes are missing and occasionally entire orders can be misplaced. Another serious problem that can arise is a fall-off in the average quality of the garments themselves due to the confusion and pressures in the plant. The combination of the salesman's performance and the way in which the company delivers the goods results in the company's performance in service to its customers. This in turn has a direct bearing on a retailer's decision to continue carrying the company line. Figure 7 illustrates these causes and effects.

The other factor that affects the attitudes of retailers is the way the product is received by the public. Each retailer has an idea of what volume of business he can expect to do with a type of product. He sees reports of industry volume in the trade papers and he is actively aware of his competitive position in the local community in which he does business. If his year to year figures for an item decline when it does not appear justified by other factors, he tends

to blame the particular brand of the product he is carrying. This is confirmed if his floor salesmen report difficulty in selling the merchandise, a situation that appears to have been prevalent in the rainwear industry in recent years as the promotional images of some brands have become strong enough to have customers ask for them by name. The retailer soon begins to develop an idea of the company's relative performance with the public. If he feels that it is not sufficient to give him the amount of business that is warranted by

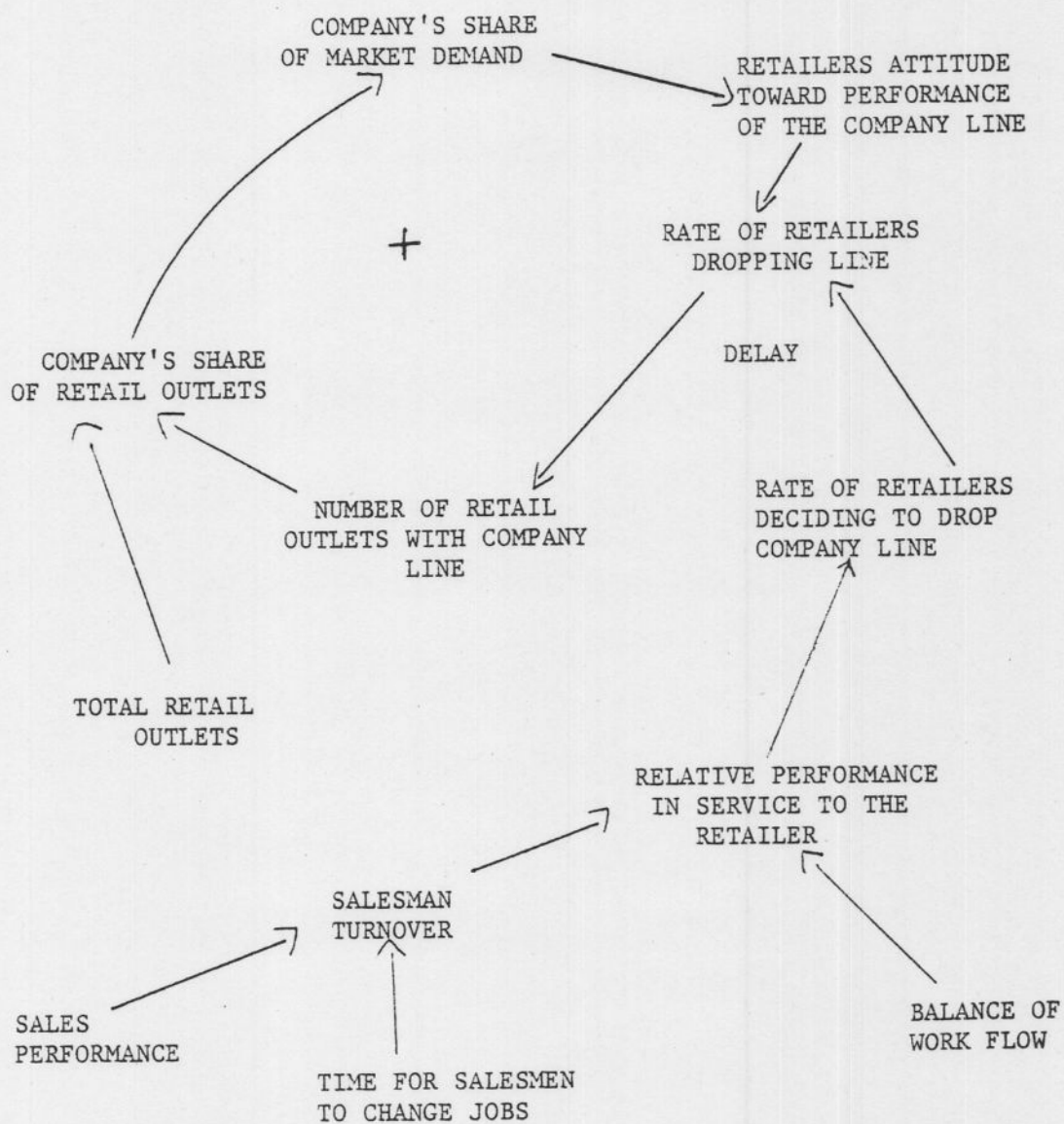


FIGURE 7. INFLUENCES ON RETAILERS DROPPING COMPANY LINES

More time is spent on set-up effort, on changing an operator from one type of stitching job to another. Balancing Everdry's plant so that all work sections have enough to do becomes a very difficult problem. Also, storing the goods before they are shipped, picking the orders just prior to shipment, and knowing what is on hand that can be shipped all become more difficult requirements. More items in the line also increase the likelihood of running out of a particular size and being forced to delay the shipment of an order. All these effects have been included in what is called balance of work flow. In its simplest form, an increase in the number of products in the line results in a corresponding decrease in the balance of work flow.

Production Control Sector

The production control sector of the model describes how management reacts to improve the balance of work flow described in the previous sector. When work flow is seriously impaired and it becomes apparent that it is more than just a temporary problem, steps are taken to improve production control. Usually some portion of the plant is studied for potential improvements. Occasionally changes are made that affect work flow throughout the firm, such as a new application on the company's data processing system. In either case, the delay before improvements begin to affect the system is of the order of 48 months. If Everdry's capacity were increasing at the same rate as the firm's ability to control the plant, effective production control would remain constant. As improvements in control capability come on line without corresponding increases in capacity, the effective production control capability of the firm increases and directly affects the balance of work flow, improving the situation. This sector, as shown in Figure 5, is an example of a single negative feedback loop in which a problem situation creates management actions which work to improve a problem situation and bring it back to a more normal level. Note that significant time passes,

the size of his retail outlet, he begins to plan change lines. This is not something that is done quickly, however. Sometimes the goods in inventory have to be worked down, or delays arise in getting a new line on board, or possibly just plain inertia affects the retailer's actions. On the average it appears that a retailer takes at least two years to close-out one line and take on a replacement. When such a change occurs, the number of retail outlets carrying the Everdry Company's goods are correspondingly decreased, as is Everdry's share of the total number of retail outlets available. This, in turn, has an effect of reducing the sales the firm makes in the basic market, that portion of the market where customers are not particularly brand conscious, but where purchases of the garment occur because of its physical characteristics or because of the retailer's reputation.

Thus we have closed the full circle of relationships by which the various portions of Everdry and its market are related. Next we shall examine the effect of these interactions on the overall performance of the firm during recent years.

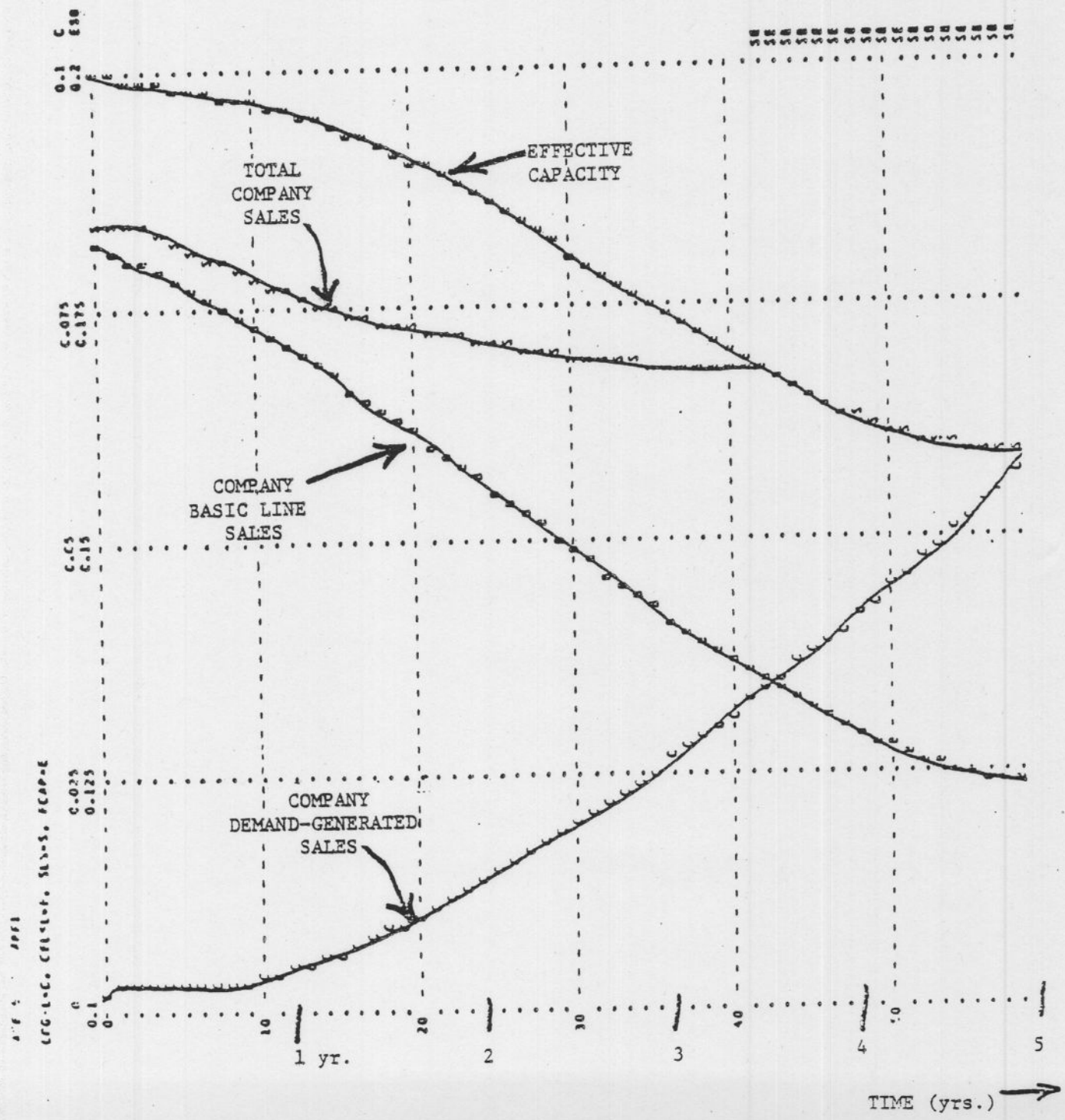
MODEL SIMULATION

The completed company model was simulated on a large-scale computer using time rented from a local computer service bureau. The total computer rental costs in the study amounted to approximately \$1000, making these costs insignificant to the total effort. Some of the computer results for a five-year test run are shown in the next several figures.

Total Company Sales

Figure 8 illustrates the basic Everdry Company situation of declining sales over the period of the simulation run. Sales (S in Figure 8) represent the total sales of the firm, the sum of both the company's demand-generated sales (C) and the company's basic line sales (B). The increase in demand-generated sales is not enough to

FIGURE 8. COMPANY SALES DETERMINANTS



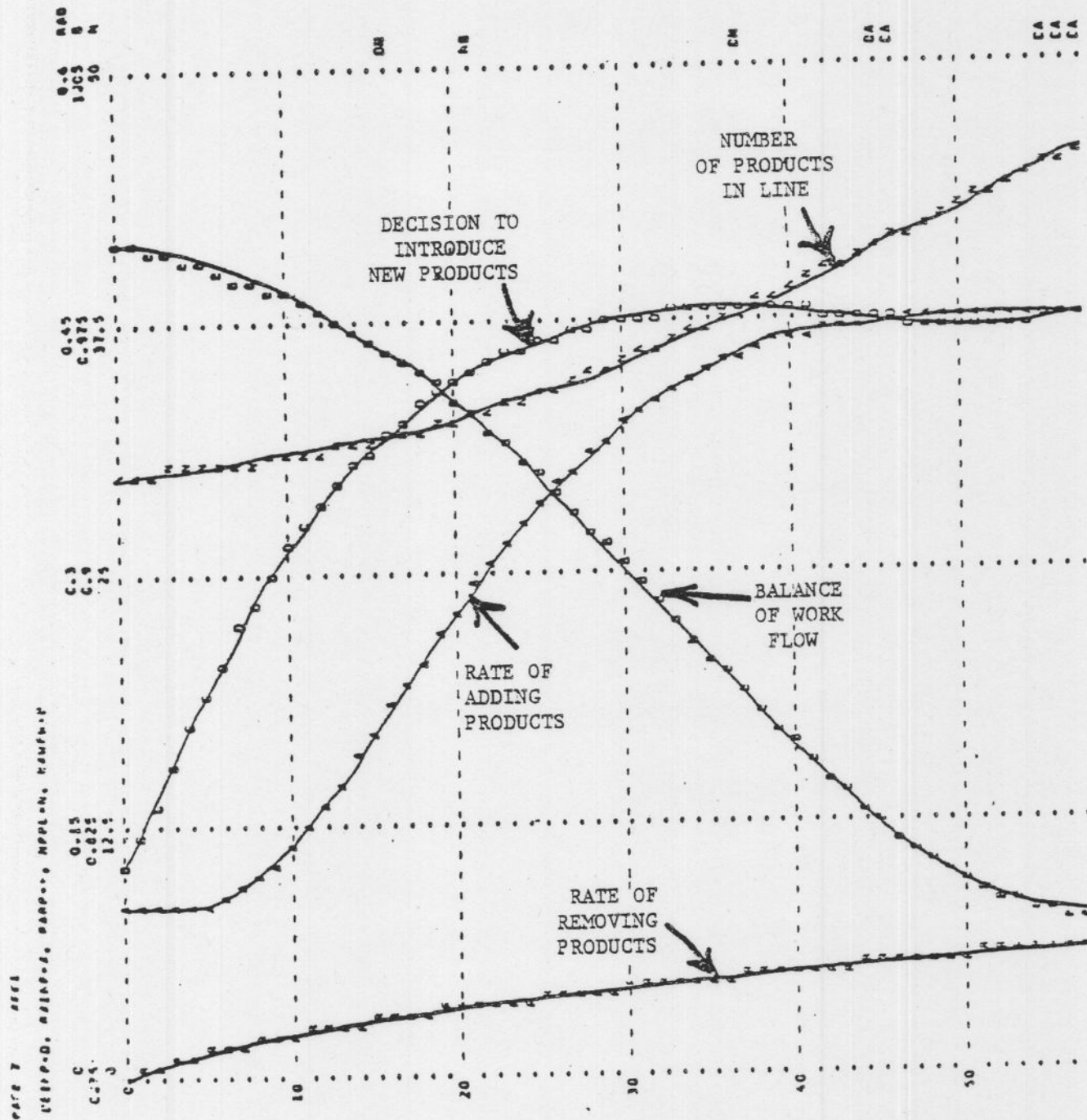
compensate for the rapid decline in the basic line sales, the company's original business. It does slow the decline, however, so that the decline in total sales in the first three years is approximately 16,000 units as compared to a decline of 40,000 units in basic line sales. The difference is the growth in sales of the new higher priced coats.

In the 41st month a new factor comes into play. The effective capacity of the plant (E) has been declining throughout the simulation run and at this point it becomes the limiting factor. Despite the growth in sales of the higher priced coats, the company cannot deliver due primarily to problems in plant control. The balance of work flow has deteriorated to a point where enough orders are cancelled due to delivery delays that the plant is not producing (and delivering) its normal capacity. Normal capacity has been set at 200,000 units per year. Effective capacity continues to limit sales during the remaining months of the simulation resulting in a total sales rate of 160,000 units per year. The decline in effective capacity that was caused by production control problems has levelled out by the end of the run, however, and it appears it will turn up in the near future.

Product Line

In Figure 9 management's decision to introduce new products (D) represents a response to the pressure to do something about the poor sales performance situation. It builds up to a steady flow of product plans by the end of the second year, masking the fluctuations in sales performance because of its slow response to changes. The rate of introducing new products (A) follows from this directly, although an average delay of one year is required to design and select the items for the new line. The product innovation effect is directly dependent on this rate and generates an increase in the company's share of the promotional market.

FIGURE 9. PRODUCT LINE MANAGEMENT



Management is also removing products from the line (R) both due to obsolescence and to pressures on the plant because there are too many product varieties. As shown in the simulation, this was a small product outflow compared to those that were being added. The number of products in the line (N) at any point in time is simply the accumulation of the new products being added less those that are being removed. It has been on a dramatic climb throughout the five year period, resulting in a detrimental effect on a key plant variable, the balance of work flow (B). As was explained in the model description, an increase in the number of styles or even items in the product line makes it difficult to keep all sections of the plant balanced, to keep plant throughput time down, and to keep track of the outstanding orders in all parts of the system. Balance of work flow declines throughout the simulation run, although near the end it has begun to stabilize at a low level.

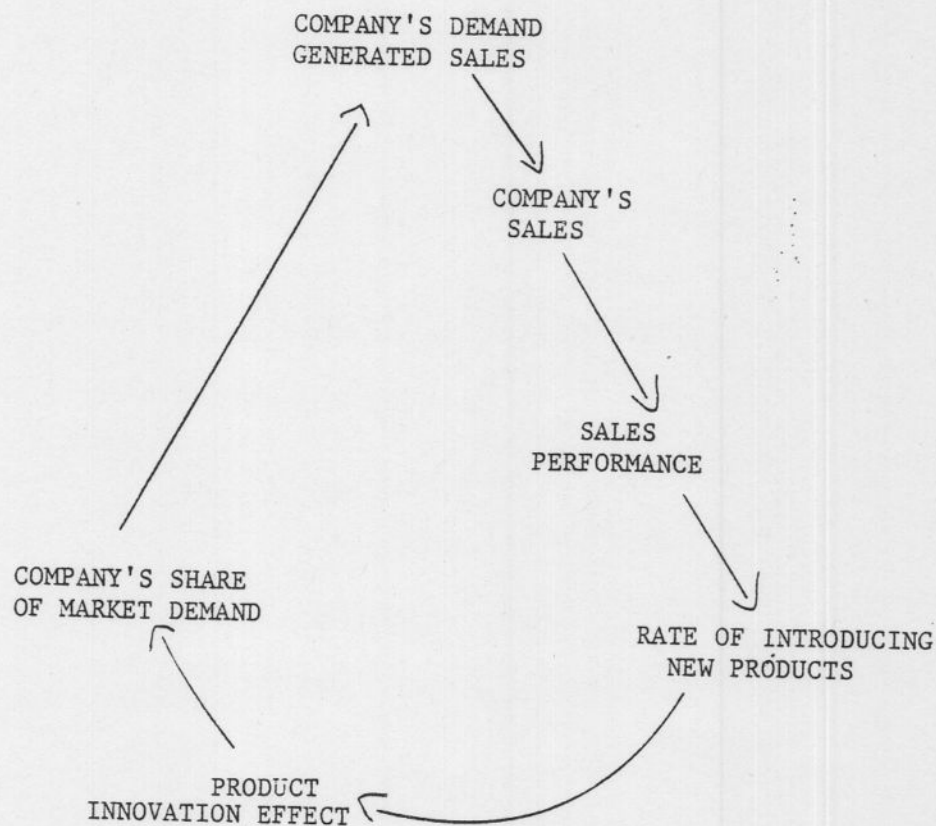
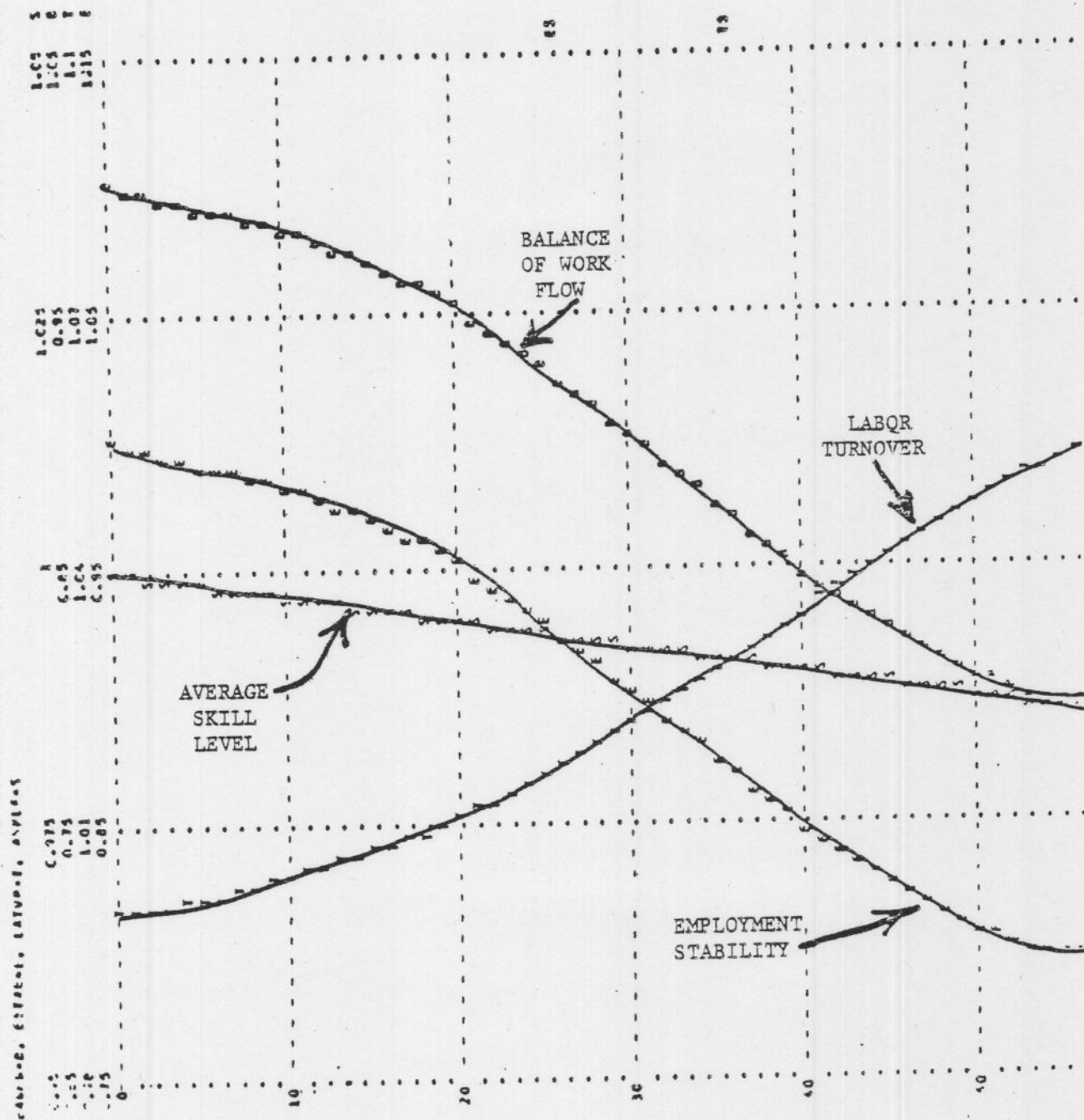


Figure 10. STRUCTURE PROVIDING SHORT TERM CORRECTION OF THE SALES DECLINE

FIGURE 11. WORK FLOW PROBLEMS



Labor Sector

The decline in balance of work flow shown in Figure 9 also has effects on labor conditions that are not readily recognized in an apparel firm. These are indicated in Figure 11. As the workers are paid on a piece rate basis, problems in keeping the work flow balanced result in a decline in employment stability (E). As the employees find their incomes are becoming more and more uncertain, they tend to look for other work and, after the time it takes to find new jobs, leave. The resulting labor turnover (T) reinforces the decline in balance of work flow. It also has a depressing effect on the quality of the work force in the plant. If labor turnover persists, better workers are attracted to other industries and others, less skilled, will be hired to replace them. The resulting decline in the average skill level (S) also, after it has been taking place for a period of time, begins to have its own effect on labor turnover. The lower skilled workers tend to come from lower cultural groups with poorer work habits and less suitability for job training. Thus a process that reinforces itself is triggered by an initial decline in the balance of work flow. And it in turn further reinforces the decline of balance of work flow. Note also that although balance of work flow is being corrected by improvements in production control, the changes in the labor sector tend to be irreversible and, at best, hold steady at their new low levels.

IMPLICATIONS FOR THE FIRM

It is apparent, both in the real situation and in the model, that the Everdry Company is suffering a serious sales decline, despite its efforts to improve its manufacturing plant, its warehousing and its data processing. Its facilities are among the most modern in the industry, yet its business performance does not rank accordingly. As has been shown, the company's basic response of introducing new products at a rate sufficient to keep sales in their new higher-priced line of coats growing has had depressing effects on other parts of the

firm's operation. The continual introduction of new products has resulted in such a number and variety of items being manufactured at the same time that it has become very difficult to produce efficiently and on schedule. This, in turn has had a depressing effect on total sales both directly, in that all the coats ordered simply cannot be delivered on time, and indirectly through the gradual loss of retailers who are handling the company line. The decline of sales further reinforces management's response of introducing new products which, after a delay required for the additions to be made, worsens the situation even more.

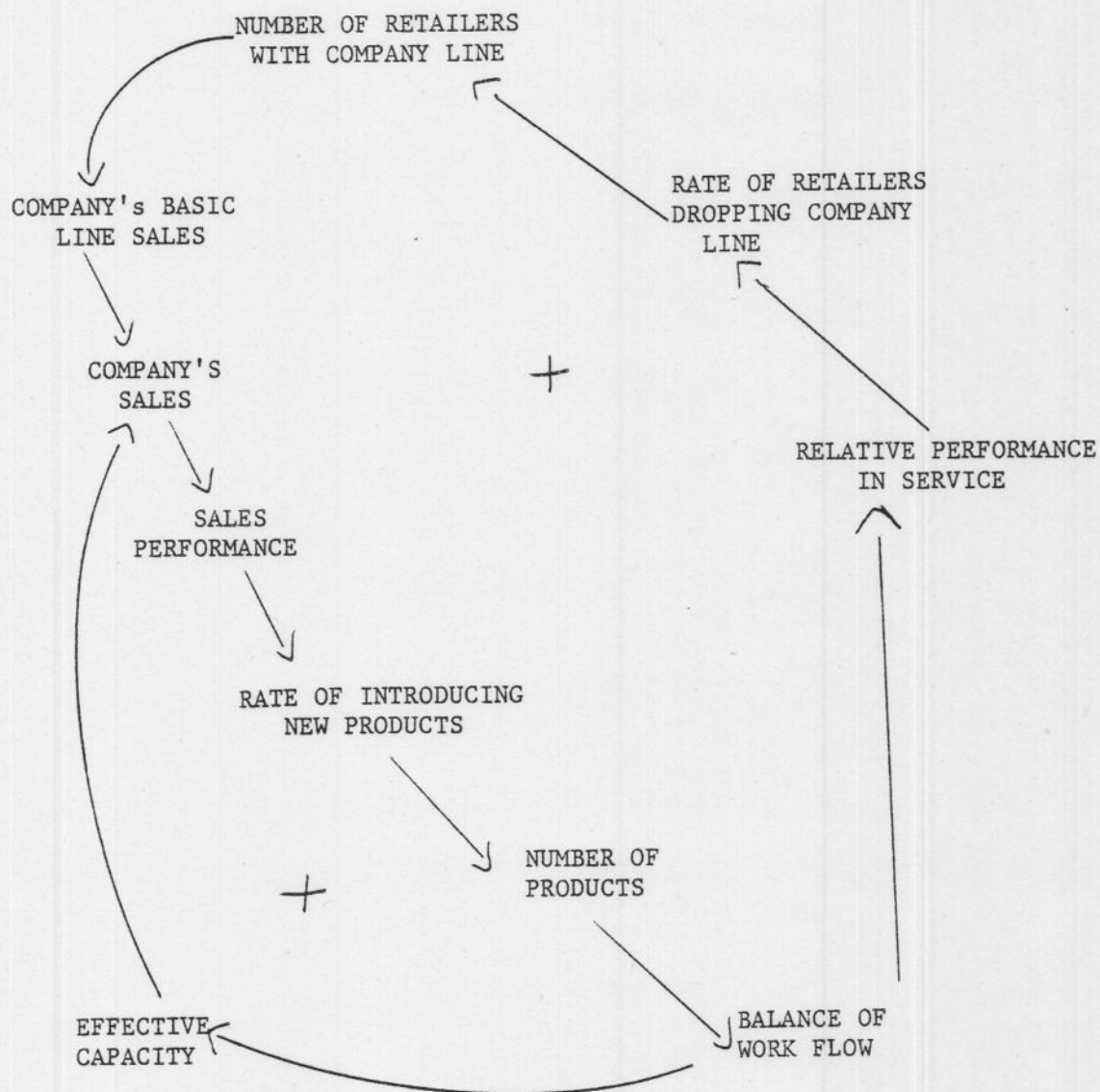
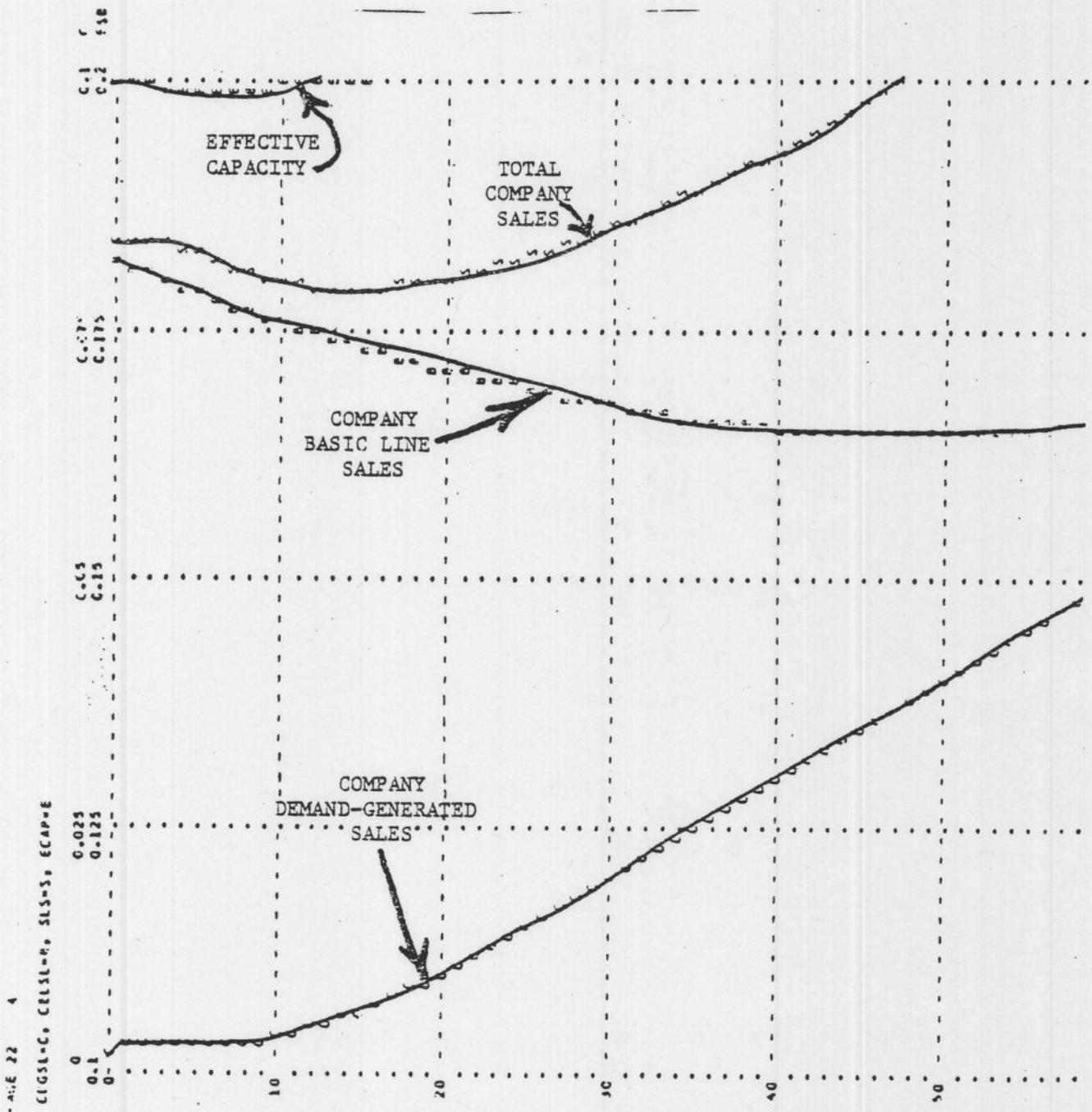


FIGURE 12. STRUCTURE REINFORCING THE SALES DECLINE

FIGURE 13. NEW POLICIES: SALES IMPACT



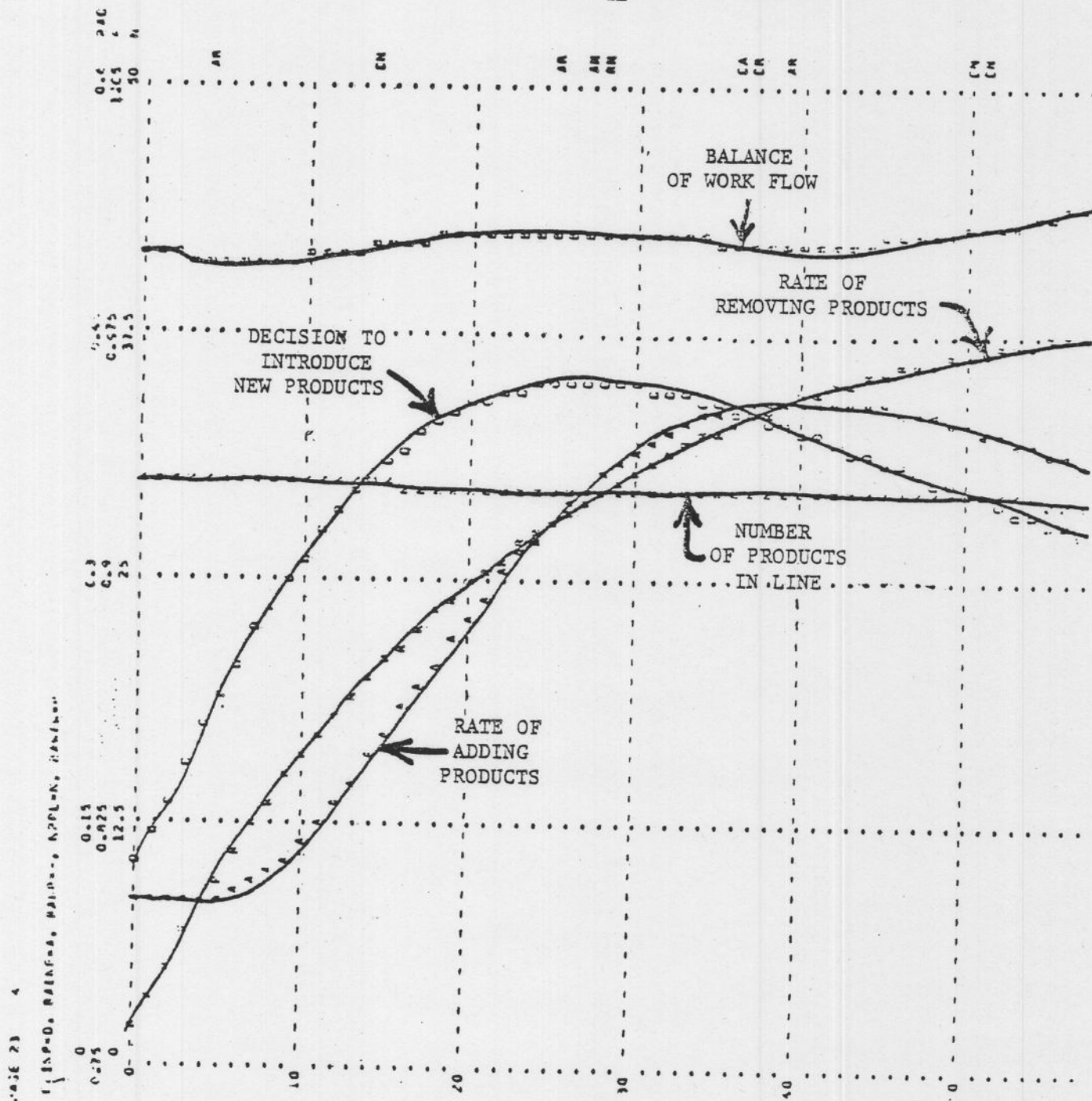
With the computer model accepted as representative of the company's situation, it becomes possible to test alternative policies, using the computer as the testing grounds instead of trying new policies directly on the company itself.

One such policy change that has been tested on the computer is that management becomes more sensitive to the decline in its service to retailers and reacts strongly by cutting products out of its line. Figures 13 and 14 show the changes in sales and other pertinent company variables under these new conditions. Demand-generated sales are about the same as they were in the original run but the decline in the company's basic line sales is held to a fraction of what it was before. Total sales recovers from the decline very quickly and in the last three years climbs to a new high for the company. Effective capacity does not become a limiting factor as it did in the original simulation. Figure 14 shows the change in management's policy on removing products, resulting in as many being taken away from the product line as are being added. Thus, the total number of items on the line remains quite stable and the balance of work flow shows only small variations about its normal value. The resulting improvement in sales performance in the latter part of the run also affects management's need to develop new products, resulting in the decline shown in Figure 14 in the last two years. This policy change is of course but one of many alternatives that might be explored using the company model. And such models can be developed for any medium to large-sized company at readily absorbable expense.

THE NEED FOR BETTER MANAGEMENT TOOLS

A key point that has emerged from this paper is that a manufacturer's management problems are indeed system problems of great complexity. The interplay among company, market, competitors, suppliers and labor force is subtle but crucial in its dynamic implications. Despite managerial attempts to reorient its view toward new market

FIGURE 14. NEW POLICIES: PRODUCT LINE EFFECTS



conditions or to keep abreast of changing materials and manufacturing technologies, the overall managerial burden is great, perhaps overwhelming to the small firm in particular.

In this environment corporate management needs to develop and/or avail itself of existing tools for improving managerial insight and control. Computer data processing methods are but one form of management improvement opportunity that needs further exploitation by progressive companies. Yet such utilization of the computer is but a meagre tapping of the new capabilities provided in recent years. New approaches to management systems analysis, such as outlined in application in this paper, offer wholly new managerial concepts and analysis possibilities. In the realization of these potentials lies significant performance improvement for industry.