# Learning to Manage Growth:
# Lessons From a Management Flight Simulator

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April 17, 1998

## Abstract

Now that the downsizing of corporate America has nearly played itself out, there is a renewed emphasis on growth. But managing growth successfully is very difficult. Not only does it require identifying and managing the growth drivers (investments and other positive feedback loops), it also requires identifying and managing the growth constraints (bottlenecks, resource shortages, and competitive responses that manifest themselves in negative feedback loops). In a world of limited resources, where and when to invest for growth can often be a hit or miss proposition. How can we teach managers to better manage these dynamics?

This paper describes a management flight simulator which focuses on growth in a high-tech development and manufacturing business. Drawing on the results of hundreds of "plays" by management teams and business students, it develops key pitfalls and generic lessons, including:

- mistaking forecasts for reality;
- allowing goals to erode in the face of temporary performance problems;
- difficulties in maintaining functional balance and consistency over time;
- failing to account for competitive responses;
- failing to account for experience and skill dilution; and
- failing to account for delays.

The paper describes how teams learned these lessons during the course of the exercise and the debrief, and what policies distinguished the successful teams from the unsuccessful.

## Introduction

Like most everything, the business world's emphasis on growth moves in cycles. Growth was in vogue in the Sixties and Seventies, though much of it via merger and acquisition rather than "organic" growth. With the inflation of the late Seventies and early Eighties, and the increase in foreign competition, the Eighties and early Nineties saw an emphasis on improving profitability. Now, the period of re-engineering, downsizing, and squeezing out of incremental improvements is ending, and growth is again coming into popularity. Recent books by academics and consultants, for example, Hamel and Prahalad [1994], Gertz [1995], and Buckley [1998], are sure evidence of this!

And much of the current emphasis on growth is of the "organic variety," via

1. Expanding geographically;
2. Taking share in existing markets; and/or
3. Creating new products and markets.

With management and academic attention once again focused on growth, what better time for system dynamics to enter the fray.

Growth is fundamentally a dynamic process, and therefore it is no surprise that since its early days the field has shown an interest in the dynamics of corporate growth. Forrester [1964 and 1968], Packer [1964], Lyneis [1975], and others studied corporate growth in the field's early years. More recently, the People Express [Sterman, 1988] and B&B flight simulators [Paich and Sterman, 1993] illustrate the field's interest in growth dynamics.

In his 1964 article, Forrester identified the range of possible growth patterns (see Figure 1): smooth, steady growth; growth with repeated crises; stagnation; and, decline. These patterns are clearly evident in real life, though they usually require some effort to find as people rarely look at behavior over time. Figure 2 presents some examples.

As system dynamicists have long recognized, managing growth is one of the more challenging tasks. While a few companies go bankrupt while managing themselves through business cycles, most corporate failures result from the crises brought on by attempts to grow. Growth almost always involves an upfront investment with the return far into the future. If that return is delayed or less than anticipated, financial difficulty and forced acquisition or bankruptcy can ensue. So not only are the stakes high, but the management challenges are also. Managing growth entails fostering the positive, re-inforcing feedback loops while simultaneously relaxing the constraining, negative feedback loops.

Are there fundamental lessons that all managers should learn about growth? How can we better teach our managers these lessons? This paper draws on the experiences of hundreds of management and student teams in managing a high-tech growth company using the Executive Training System (ETS),[1] together with the insights from system dynamics research, to answer these questions.

## Structure of the Company and the Flight Simulator

### The Flight Simulator

The Executive Training System (ETS) is a management flight simulator consisting of a system dynamics model of a high-tech growth company (or company business unit), an interface which allows players to input decisions and view results, and a "back-end" analyst which facilitates comparing and understanding performance. The Training System also includes a business case, briefing materials on company structure and management roles, and facilitator documentation.

The model underlying the ETS is a dynamically rich representation of a technology-based company. It is not a model of a specific company, but the structures and parameters are based on several real applications. The simulated high-tech growth company designs, manufactures,

[1] The ETS is a proprietary product of Pugh-Roberts Associates, a Division of PA Consulting Group, Inc.

installs, and services computer-based systems.[2] While the flight simulator can be used individually, in most applications teams of four to five participants manage the business unit in the roles of President, and Vice Presidents of Finance, Manufacturing, Marketing, and Engineering.[3] Each team manages the business unit against a generic competitor built into the model. Teams compete indirectly against the other teams in their session, because at the debrief at the end of the exercise the performance of all teams will be compared.

Before the exercise begins, participants are given a 7-page case description, a set of financial and management reports covering the last 3 years of company performance, and general and functional background briefings of 60-90 minutes. In these briefings, the structure of the market and the company are described.

The Simulation Model

The simulation model represents how the acquisition and management of resources at the company determine sales and profitability. At the heart of the model, the business unit's order rate is determined by market demand and market share (see Figure 3). For simplicity, market demand is specified as an external input. It has growth cycle, business cycle, and random components. Market share is determined by the size of the company's sales force and the attractiveness of its products. By assumption, products in this industry are sold by a direct sales force; therefore, with industry-average products the company's market share would equal its share of the industry sales force. With more attractive products, the company's market share would increase above its share of the sales force, and conversely for less attractive products.

Product attractiveness, shown in Figure 4, is a function of four components:

1. Availability – delivery lead time for the product;
2. Price/Performance – the price of the product normalized for its technical performance;
3. Technology lead – measured by months ahead or behind industry average (industry average technology is assumed to increase at one-year per year of simulated time; the company must invest to stay even and/or get ahead); and
4. Service level – performance on installation and maintenance.

All of these attractiveness components are measured relative to the performance of the competition. They affect attractiveness with different delay times and sensitivities (e.g., price changes can be perceived and acted on relatively quickly, whereas service levels take much longer).[4] Competitor service and technology are not modeled explicitly. However, competitor unit costs, prices, and availability are modeled, as is the size of the competitor sales force. This allows the simulated competitor to react to the actions and performance of the company. Therefore,

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[2] The exact product is not important. Several different cases exist, one involving building-environment control systems, and another video-conferencing systems.

[3] While the flight simulator can be played by only one person, it was intentionally designed with the various functional roles and the potential conflicts that those roles create (in pre-exercise briefings, participants are instructed to be true to their roles and are given role-specific performance measures). In additional to potential functional conflicts, multiple players make the flight simulator more fun and allow "team-building." In some cases, the flight simulator has been used as a vehicle for behavioral consultants to provide individual and team feedback on decision-making and co-operating styles.

[4] Sensitivities can be made to vary with overall market growth rate. For example, in the startup phase, technology and service may be more important, whereas in the saturation phase price becomes more important and technology less.

while all teams face a competitor playing by the same decision rules, the size and cost structure of the competitor will change based on the performance of the company. Competitor unit costs decline based on cumulative volume. Competitor prices respond to these costs and to the company's prices – they are willing to engage in a price war as long as they maintain a minimum acceptable profit margin.

In any given functional area, performance is determined by the capacity to deliver relative to demand (Figure 5). Capacity, in turn, is a function of the number of people and their productivity. For production, capital and parts are also required. Capital must be ordered and has an eighteen-month average lead time. Parts also must be ordered, either from a sister business unit (with shorter lead time but higher cost) or from an outside supplier (longer lead time but lower cost). Both the sister unit and the outside supplier have limited capacity and must also increase that in order to provide for growth.

Closing the loops, as illustrated in Figure 6 for marketing, productivity changes over time and is strongly affected by the decisions of the team. Productivity depends on morale, overhead support, training, experience and changes in the size of the salesforce. For example, hiring (controlled by the team's decision) reduces average salesforce experience and increases the size of the sales force. Both of these work to reduce productivity from what it otherwise might have been.[5] As a result, the size of the effective salesforce may not grow as planned, and market share may fail to keep pace with targets, thereby adversely affecting morale and further reducing productivity. Teams can "invest" to mitigate the impacts of growth by spending on training and overhead support. Investments in training directly reduce productivity by taking time away from the direct work. However, training increases the speed at which experience is gained and therefore improves productivity in the long term. Overhead support improves productivity, but with diminishing returns. Of course, both of these investments cost money which could have been spent elsewhere!

Morale is of critical importance, as it can act as an accelerator of trends within the function and business unit. For marketing, morale is determined by:

1. Product attractiveness – morale improves the better the products the sales force has to sell;
2. Market share – if market share is increasing, morale improves, and conversely, if market share is decreasing, morale declines (which acts to reduce productivity, effective sales force, market share, and morale further);
3. Commission rate – as commission rate increases, morale increases.

Note that morale also affects attrition, such that a drop in morale can further accelerate decline through the loss of experience.

Marketing ties in with production at the left of the diagram. Market share drives order rate and order backlog. The amount of finished inventory and production rate determine shipment rate and delivery time. Delivery time, relative to the competition, is one component of product attractiveness, thus completing the loop to market share. The other functions interact with marketing through product attractiveness as well.

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[5] In addition, the faster growth, the worse experience is hit because there is assumed to be a limited pool of available hires, and the experience of new hires falls as that pool is depleted by hiring.

Figure 7 provides a complete overview of the model. Each of the functions is conceptually similar in that "capacity" is determined by number of staff and by their productivity. The list of factors affecting productivity are the same for each function. The key difference is the drivers of morale – each function is affected by unique morale effects.

In summary, the teams must manage the business unit while contending with:

- variations in market growth rate
- actions by competitors
- suppliers with limited capacity (in the short-term)
- resource constraints (both internal, and from the labor markets)
- trends in technology

Format of a Typical Session

In a typical session, four to six teams manage the company through six to nine years. At the time the teams take over management of the Business Unit, market share has been stagnant for 3 years at about 8 percent, but profitability has been good. They are tasked with:

1. Developing a leadership position within the industry;
2. Gaining market share aggressively, while remaining profitable; and
3. Improving profitability as market share objectives are achieved.

Depending on how the flight simulator is being used, after the introductory briefings, the teams are asked to analyze the position of the Business Unit, to set market share and profit objectives, and to develop a positioning strategy to achieve those objectives. The teams can decide to be a technology leader or follower, to be a service leader or just average, to be the low cost producer, or any combination. However, they have limited resources and cannot do everything! The flight simulator is designed such that any strategy can be successful if it is implemented well.

The objectives and strategy are reviewed by "Corporate" and revised/approved. The teams then manage the Business Unit for 6 years, although in some situations teams have gone for 9 years. Each function (with the exception of finance which works as the assistant to the president) has approximately 8 decisions to make each year, for a total of 32 decisions. The decision inputs are all linked to an internal spreadsheet which computes the impact of potential decisions on the income statement. When the flight simulator is played by full teams, it can take up to 8 hours to get through all 6 years. While some of this time is required to review and interpret the information provided, much of it is devoted to analysis, debate, and decision. I have found that teams take this seriously, and devote considerable thought and effort in trying to get it right. Consequently, the flight simulator is rarely played more than once and most of the real learning comes in the debrief. When the flight simulator is played by only 1 or 2 people, it goes much faster and several plays in a day are possible.

**Results and Lessons**

As with the Beer Game, most teams find themselves in reactive mode. They start in somewhat of a hole with a shortage of parts and resultant production constraints. Most teams manage to sort this problem out quickly, but then create other crises as a result of their strategy and/or the way it

is implemented (though they usually blame it on market demand or competition!). The flight simulator is capable of producing the full range of typical growth patterns, as illustrated in Figures 8 and 9 for market share and revenues.

In a typical debrief, after a presentation by each team describing what they did, how it worked, and what they learned, the facilitator presents a summary.[6] I always start with a summary table produced by the ETS, which compares how the teams did and, at the surface level, why (see Figure 10). The top several lines in the figure give the results for the end of 6 years and are the "bottom line" results for market share and profits. The next 3 lines tell something about the teams strategy – their ending price, service level, and technology lead – from this you can tell generally what they tried to do, and more importantly was it consistent (although important trends in strategy can only be seen by looking at the simulation output). The third block of lines gives the cumulative expenditures each team made over the 6 years in each functional area (staff salaries, training, and overhead), as well as total capital investment. Summed, the "Gross Investment in Productive Resources" is the amount of money the teams spent over the period. As we will see, this is a key indicator of performance. When divided by share points gained, we have a measure of the efficiency of the teams in achieving their performance objective (gaining market share).

At this point I give out awards. There are awards to the winners – highest market share, most profitable, most efficient. And there are awards for the "losers." Sometimes this takes some imagination, but good choices are awards for: "Clinton Award for doing the most for employment in the country;" or "Greenspan Award for lowering prices the most;" or "Most dynamic market share pattern;" "Taking the most resources from Corporate."

Now the learning begins. The next step is to graph the teams ending market share, first as a function of Gross Investment in Productive resources, and then against average profitability. I usually do this for the four teams, and then overlay the results for teams from prior sessions. This is illustrated in Figures 11 and 12 for over 50 teams of managers from a high-tech computer company.[7] These graphs contain some powerful messages.

First, one needs to spend money to grow. As indicated in Figure 11, those teams that "invested" the most in people and capital, on average, achieved the highest growth. Partly this is related to objectives, and partly to implementation.

Second, the money needs to be spent wisely. For any given level of investment, there was a significant difference in the growth achieved. This is also indicated in Figure 12 where there is at most a slight negative correlation between ending market share and average return on sales, whereas one might expect a significant negative correlation. Figure 12 shows that nearly any market share level is consistent with any profit level – if the execution is done well, growth need not be achieved at the expense of profits.[8] If the strategy is internally consistent (e.g., low cost

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[6] With four teams, the preparation of a debrief which draws heavily on the results of the teams takes 1-2 hours for a very experienced facilitator. Hence, a schedule which works well is late afternoon briefings and strategy sessions; play flight simulator next day through dinner; then prepare team and facilitator debriefs to be presented the next morning when all are fresh.

[7] These managers typically had 5-10 years of business experience and would just be moving from functional management into more general management roles. The results from students show similar patterns.

[8] The profit figures shown here are operating profit, and do not include depreciation or financing of capital investments. The model computes and can also report these figures.

and low price, vs. high tech and low price), and well implemented, growth and profits are compatable.

Spending money wisely is, in essence, the successful management of the dynamics of growth. Growth is produced by positive feedback loops. Figure 13 illustrates the key positive feedback loop operating in most growth companies: the company forecasts sales based on forecast demand and target market share; resources are acquired based on forecast sales; those resources improve the company's performance (e.g., increased sales force size, more new products, etc.); improved performance increases market share, which in turn leads the company to strive for higher levels of share. Successfully managing growth means avoiding or controlling the negative feedbacks which constrain the positive loop(s), and accounting for the secondary effects of actions.

In managing the business unit, unsuccessful teams seem to make common mistakes. From this, we can draw a number of lessons about successfully managing growth.

***Lesson 1: You won't achieve what you don't try for.***

> ***Corollary 1: Don't mistake forecasts for reality.***
>
> ***Corollary 2: Provide sufficient buffers and contingencies.***

Lesson 1 is clearly illustrated in Figure 11: those teams that invested the most money on average achieved the best performance. In most cases, investments were directly related to the teams objectives: those teams that tried to achieve the most market share did. For example, Figure 14 shows the market share achieved by two teams.[9] Team "BS1A2" achieved significantly higher share than Team "NEMAWSH." In large part, as indicated in the figure, this is because Team "BS1A2" was trying to achieve a higher share.

Lesson 1 is tied to the "self-fulfilling prophecy" nature of most forecasts. Its operation is illustrated in Figure 15. Within reason, actual sales will adjust to the resources acquired based on forecast sales. For example, suppose that market demand is higher than forecast, or, the market responds more favorably to company performance, and market share increases more than expected. Then, actual sales will exceed the resources acquired for the forecast, and performance will deteriorate until actual sales equals the forecast. If market demand is lower than forecast, then within reason performance will improve and market share increase to cause actual sales to increase to forecast sales.

Hence Lesson 1. If a team is timid in setting market share targets, then they will achieve timid growth performance. Forecasts are not reality – they are not real demand nor potential sales. Forecasts become reality only when the company does not provide sufficient buffers and contingencies to prevent undesired constraints from limiting growth (as opposed to the desired constraints – see Lesson 3 on "managing limits".) The appropriate use of buffers and slack resources is discussed in Chapters 11 and 13 of Lyneis [1980].

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[9] In this paper, I have selected results from a number of different sessions with the ETS. In most cases, I have little difficulty illustrating the lessons with results from the 3-5 teams in a particular session. In the results shown in this paper, the teams started making decisions at the beginning of year 1993, and then annually thereafter. Only two years of "history' are shown here. The ETS allows any starting year.

Many companies are not careful in their use of the terms “shipments,” “orders,” and “demand,” and as a result fall trap to the “self-fulfilling prophecy” phenomena. Many companies with which I have worked use the terms orders and demand synonymously. This was highlighted early in my career when we were working with a major manufacturer of motor cycles. We generated a plot which compared simulated orders to company data for “orders.” They did not match. In fact, the data were for forecast shipments (which were consistently constrained by capacity) – the company equated forecast shipments to orders. When actual orders were plotted against simulated, they matched much more closely. Yet by calling capacity-constrained shipments “orders,” the company tended to acquire resources sufficient only to support the existing capabilities.

Evidence of forecasting gone wrong are often in the business press. For example, “Just three weeks after announcing its new Aptiva home computer line, IBM is sold out through the year end and can’t fill all of its holiday orders. The shortage, which IBM attributes to conservative forecasting, means the company could forego tens of millions of dollars in revenue …” [Wall Street Journal, October 7, 1994].

Of course, just wishing for higher share or more sales will not necessarily make it happen. What we are trying to avoid here is the unintended self-limiting of performance through inappropriate policies.

***Lesson 2: Avoid the temptation to reduce objectives in the face of performance problems.***

Lesson 2 follows from Lesson 1. Many teams and companies experience performance problems that can cause market share to fall below objectives in the short term. A natural tendency is to reduce target market share in response (the “drifting goals” archetype). But as illustrated in Figure 16, reducing target share sows the seeds of even worse performance in the future. Many teams which play the flight simulator fall to this temptation. For example, Figure 16 compares two teams from the same session. Both started with the same ending objective of 25% share (this is not shown on the plots, but was taken from notes of the corporate review sessions). Team “BS2A”, however, when faced with poor performance, grew its share target more slowly and eventually reduced it (before going crazy at the end). In contrast Team “BS2B” maintained its objective in the face of problems and ended up achieving a far better performance.

This is particularly a problem for companies with high market share, faced with often new and aggressive competition. In these situations, the desired share of all competitors is often greater than 100%, and the company most likely to reduce its share objectives as performance deteriorates is the high share company (sometimes referred to as the “General Motors” problem). We have worked for several companies in this situation. By setting objectives which are based at best on maintaining recent market share, they end up losing share to more aggressive competitors. In this situation, only by trying to gain share can they even hope to maintain their current position.

***Lesson 3: In a world of limited resources, something must limit growth. Proactively managing these limits is a key factor affecting performance.***

***Corollary: Maintain consistency and balance across functions, and over time.***

In the “attractiveness principle” clearly stated by Forrester in Urban Dynamics [1969], people will move from one supplier (city, business) to another, more attractive one, until the formerly attractive supplier become “average,” generally because its resources are no longer able to cope with the

higher demand. In a world of limited resources, something must constrain growth. Managing those constraints over time is the key to efficient achievement of objectives.

In the ETS, as in most business, growth is constrained by some combination of sales force, delivery time (production capacity), price, technical lead, or service quality. Managing limits, i.e., attractiveness, involves first, setting a consistent set of objectives and strategy (you can't be all things to all people), and second, keeping resources in balance across functions and time so that the company can grow and be constrained only by the limits it chooses.

Many teams have a hard time with this. While we try to give them guidance in the Corporate review, when they actually get into the heat of the battle they make several mistakes:

1. They ***try to do everything***. For example, they invest heavily to build a competitive lead in service and/or technology, and then get into a price-cutting war! Ultimately, they begin losing money and must cut back on spending, which constrains growth in ways they did not intend. For example, as illustrated in Figure 17, Team "BS3C" adopted a strategy of improving service level and building a technology lead, but at the same time reduced prices (until the very end). As a result, while the team gained share, their average profitability was negative 1.9%.
2. They ***try to solve a symptom***, rather than the problem, or they go for the quick fix. In particular, they often use price to solve other problems (e.g., at the beginning when they have no production ability, they cut price!). For example, as illustrated in Figure 18, Team "BS1C2," in spite of a shortage of inventory which limited sales, steeply reduced prices in the first simulated year. While this increased the attractiveness of the company's products from price, it worsened performance in terms of availability. As a result, the company's sales were no higher, just less profitable and the teams average return over the six years was negative 0.9%.
3. Even when they try to stick to a consistent strategy, teams often ***react to problems and crises rather than proactively managing*** to desired targets. This can usually be seen in the way teams acquire resources, particularly people – they are not consistent over time or across functions. For example, in Figure 19, Team "BBG" did relatively little hiring in 1993 (year 1), and as a result attractiveness and share continued to erode. They then hired a lot of customer service engineers, and stopped hiring manufacturing staff (1994).[10] With the improvement in service and share, they then dramatically reduced the hiring of service engineers and increased the hiring of manufacturing and sales (1995). Market share growth slowed, so they increased the hiring of sales staff (again reducing the hiring in manufacturing). This fluctuating hiring continued through the rest of the simulation. The team was not consistent over time, or across functions.

This lack of consistency can be seen in other areas as well. For example, the fraction of parts orders from the team's Sister Division. Parts suppliers have a difficult enough time managing the company's growth orders, without also having to cope with the variations caused by shifts in supplier mix. For example, in Figure 20, Team "BS2A" first increased the amount from the Sister Division from 60% to 80% in an effort to improve the parts supply problem, but once this was fixed reduced the fraction back to 60%. Note that this effectively doubles the orders on the outside supplier! Fortunately, the team's sales growth was slow during this time so the increase in delivery

[10] While this did not cause availability problems, it did lead to the need to use significant overtime (not shown here, but available in standard system output).

lead time did not affect production for another year. And then, even switching back to the Sister Division did not help.

One might argue that this inconsistent decision-making is forced on the teams by the annual decision cycles, with no opportunity to adjust mid-year. While this is in part true, it also reflects real business life. Most organizations are on annual planning and budgeting cycles, with little room to adjust mid-year as the situation changes.

In summary, the failure to maintain consistency, to manage the factors controlling growth, is a major cause of poor growth performance. First, it perpetuates crisis management by sowing the seeds for the next crisis (when insufficient resources are acquired for one function); and second, it is an inefficient way of acquiring and managing resources (see Lesson 5 below).

Examples of failure to maintain balance can be found frequently in the business press. Two examples within the last year are:

1. Iomega, maker of the Zip drive for personal computers [*Business Week*, April 13, 1998, page 54-55]. "In just four years since he joined as CEO, Edwards – considered by many the top consumer marketere in the stodgy PC peripherals business – had transformed Iomega from a dying, $140 million outfit into a $1.7 billion highflier that grew 43% last year. At its peak in May, 1996, Iomega has a market capitalization of $7 billion. Today, it's less than a third that…. What happened? Its a classic high-tech story. Edwards simply skimped on the basics – fine-tuning production and tending to customer complaints – in his hurry to put Iomega on the map. Edwards was in many ways a victim of his own success. The more Zip drives consumers snapped up, the more critical became such mundane tasks as customer service and supply-chain management – not his strong suits."
2. America Online's problems in the Fall 1996 – Spring 1997 are well known [*Wall Street Journal*, January 24, 1997, page B1]. Again, with a sales-oriented CEO (Steve Case, former Pizza Hut marketeer) eager for market share, AOL "flooded the market with arresting come-ons and free sign-up software – 'gunning for growth,' as he described it in Wired magazine." At the same time, they changed their pricing structure to one which encouraged extended connection time ($19.95 per month for unlimited usage). Not surprisingly, the number of customers and connect time per customer soared, vastly overloading AOL's capacity, which was not increased in anticipation of this growth. While AOL slowly added capacity over the next 6 months, they continued their aggressive marketing campaign!

***Lesson 4: Make an effort to account for delays.***

Teams often get into trouble because they fail to account adequately for delays in the system. This usually occurs in the ETS with regard to service. The basic dynamics are illustrated in Figure 21. In Figure 21a, engineers are hired to bring service level up to some service goal. In the flight simulator, many teams adapt a strategy involving improved service. Therefore, they aggressively build their service engineer staff early in the simulation. As one would expect, service level improves and may even exceed the team's goals, so the teams throttle back on hiring. However, this decision process ignores a second feedback loop with significant delays (illustrated in Figure 21b) – as service level improves, the company's service reputation in the market improves. As customers and potential customers react to this, market share increases. An increase in

customers increases service workload. This happens just about the time the teams are throttling back on hiring, or even reducing staff through attrition! As a result, service level deteriorates and market share falls. Figure 22 illustrates this behavior. Team "BS2B" set an ambitious target and added staff to achieve it, but then held staff constant and even reduced the target in the second year (1994). As a result, service level plunged.

Successful teams take a longer view. First, they gradually and steadily increase their service targets. Then, they steadily build staff. Figures 23 illustrate this. Team "BS3C" increased its target in a more measured and steady fashion, and staffed accordingly. They thereby minimized the effects of the market feedback loop.

We all learn the lessons about delays in the Beer Game. It is easy to account for the consequences of delays when they are tied to physical flows. In other circumstances, it is more difficult but just as important.

***Lesson 5: Account for morale and experience dilution in resource decisions.***

Different teams managing the Business Unit often achieve the same market share levels with significantly different staffing levels in a given function. Some teams can get into a downward spiral around experience and never seem to recover. The dynamics are illustrated in Figure 24. An example of typical behavior is shown in Figures 25 and 26. Often, teams initiate a problem by aggressively expanding staff in a function. Team "BS2C" in the figure expanded the sales force in essentially two spurts (1994-5 and 1997), whereas Team "BS2B" grew the sales force more steadily. As a result, the experience of Team "BS2C's" sales force fell significantly, and never recovered. Because of the negative effect of this on sales force productivity, the market share that Team "BS2C" could achieve with its sales force was only slightly greater than the steady Team "BS2B", in spite of having approximately 40% more sales staff!

Slow and steady growth is much more cost effective than growing in spurts. Further, it is better to build experience in a smaller staff that to add more, inexperienced bodies.

***Lesson 6. Account for likely competitor responses in taking actions.***

Many teams operate as if they are in a vacuum, seemingly ignoring the likely response of competitors in taking their decisions. For example, Figure 27 shows the Baroque team cutting prices, only to be followed down by the competitor.

In real life, we see this in the price wars of the airlines and the churning wars of Telecom operators. Price reductions by one carrier are quickly matched by the others. No one gains any share; everyone has lower profits. In the US, the long-distance telecom operators (especially AT&T and MCI) offer incentives for a competitors customers to switch to them. Every one is doing it – the customers you gain are nearly equal to the customers you loose. Your customer base remains the same, but everyone's profits are lower.

**Teaching Managers to Manage Growth**

In spite of all these problems, some teams manage to get it nearly right. An example is the team "BS1A2." Figures 28 through 30 illustrate their performance:

- they set aggressive share targets and increased them steadily;
- their strategy called for investments in service and technology, while maintaining price above average (but even they could not resist the temptation to lower price at the end, without which, their financial performance would have been much better)
- they were steady and consistent in hiring, and as a result, sales force and product attractiveness grew smoothly

Flight simulators like the ETS contain many valuable lessons. And, since they are fun, non-threatening, and relatively low cost, there is a high likelihood that many managers will use them. However, I am not sure that one session with a flight simulator does much more than impress upon managers the importance of "systems thinking" concepts, and the general lessons outlined above. Certainly, repeated plays of the simulator can build these lessons into the mental models and reactions of managers. However, the simulator is often not based on a model of the manager's specific company.[11] Therefore, like flying a 747 after having trained on a 737 simulator, there are risks that the lessons are not completely transferable. Moreover, simulators do not offer the full power of tailored simulation models:

- confidence that the model accurately reflects the structure and parameters of the real business;
- ability to really understand the relationship between structure and behavior through repeated, quick-turnaround simulations;
- the ability to do scenario planning, i.e. to incorporate uncertainties in market and competition; and
- the ability to design an organization

Therefore, while flight simulators are a good beginning, they are only a beginning.

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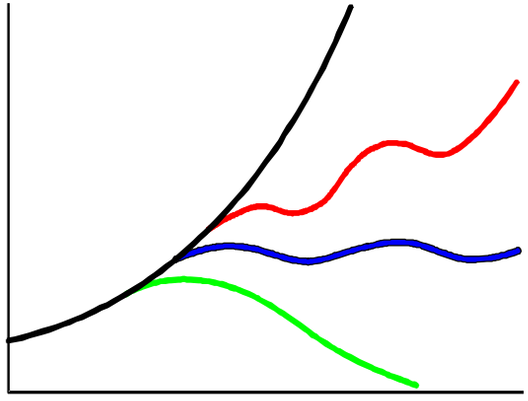
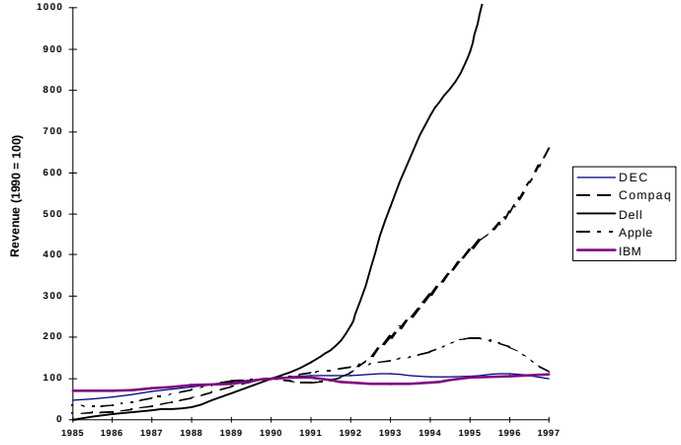
[11] Although clearly this can, and has been done, but at much higher cost.

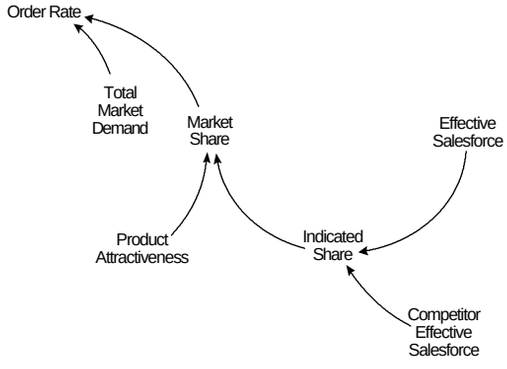
## Figure 1 Growth Patterns



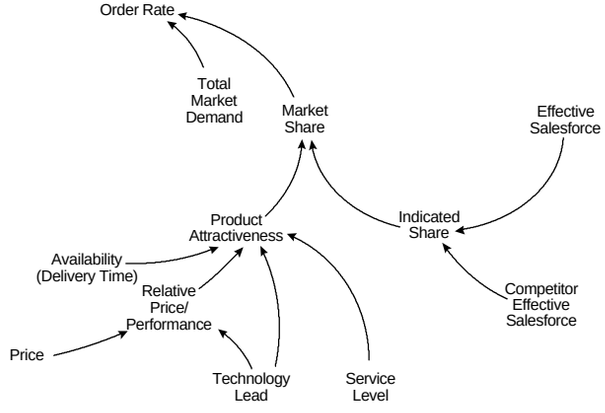
## Figure 2 Growth Patterns In Real Life



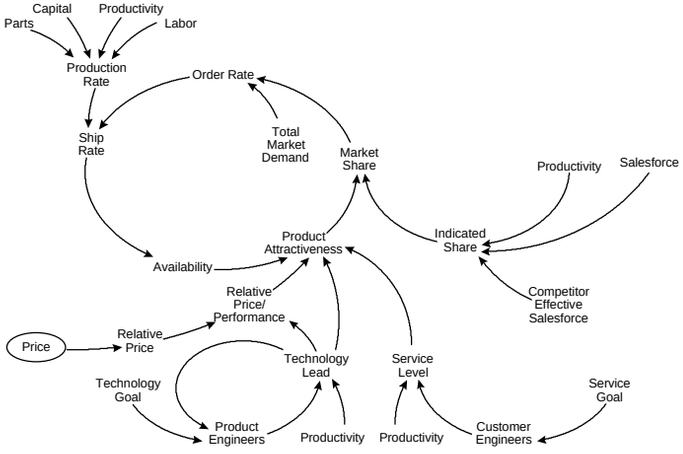

## Figure 3 Determinants of Order Rate



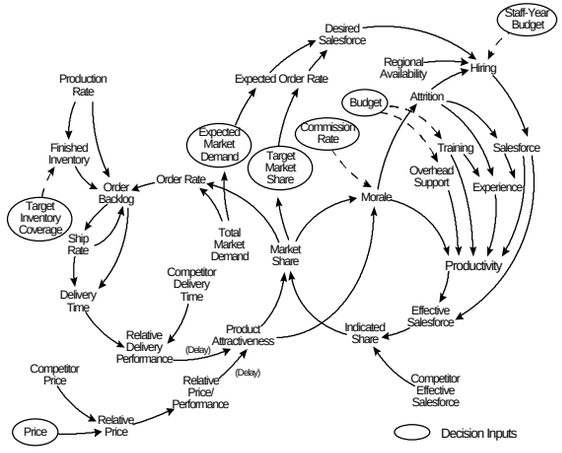

## Figure 4 Components of Product Attractiveness



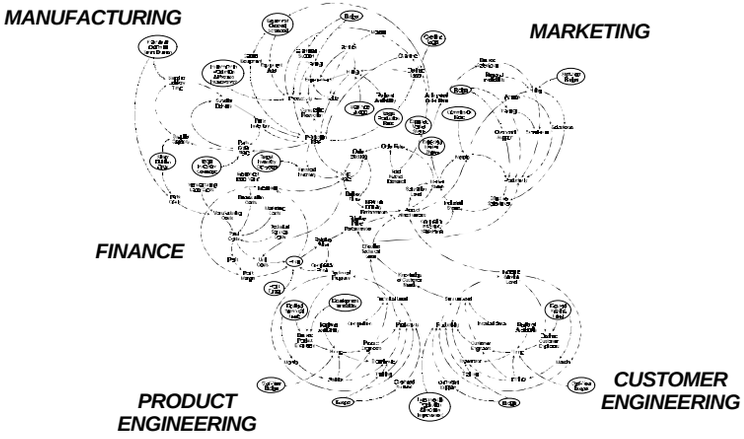
## Figure 5 Functional Performance is Based On Demand Relative to Capacity



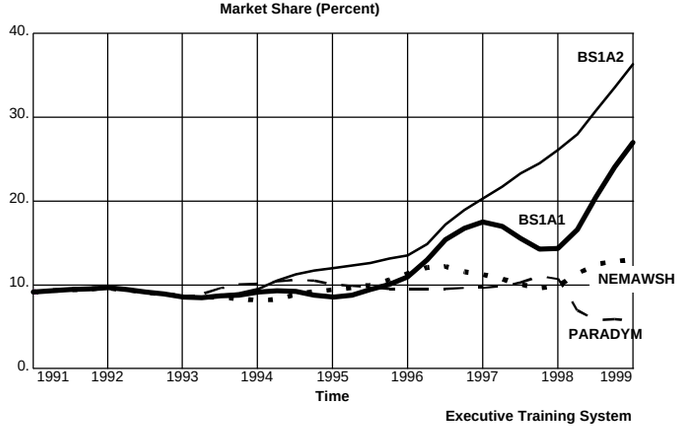

## Figure 6 Determinants of Productivity



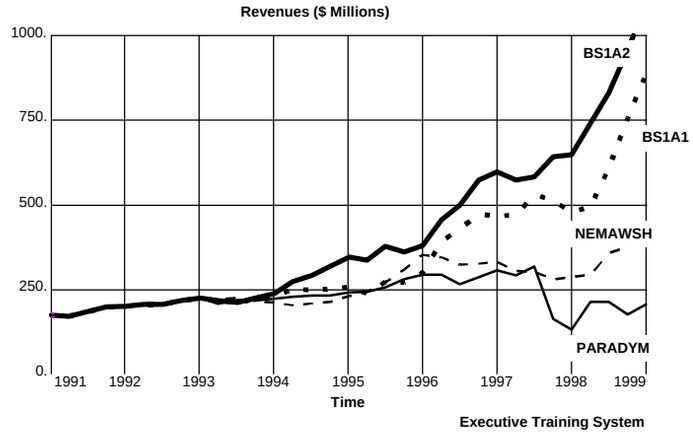

## Figure 7 Overview of the Model




## Figure 8 Range of Growth Patterns Produced By Flight Simulator



## Figure 9 Range of Growth Patterns Produced By Flight Simulator

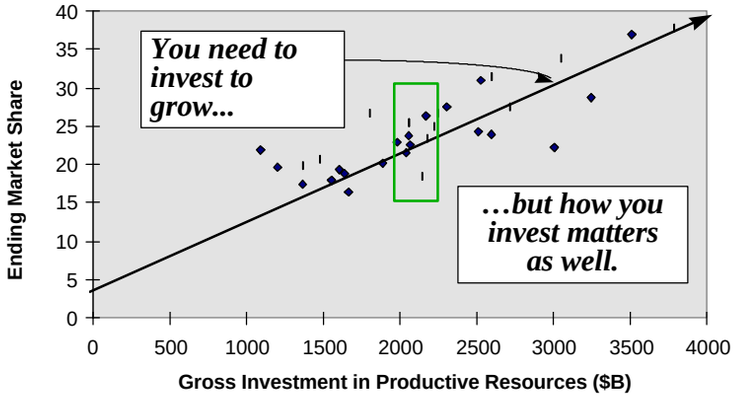



## Figure 10 Summary Report

**Comparison Report**

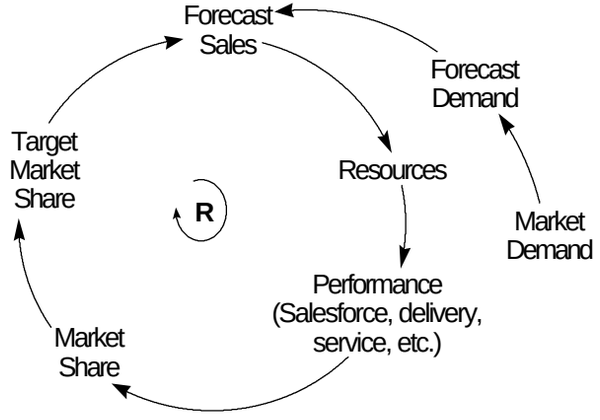
| | BAROQUE | LUDITE | NEMAWS | BBG |
|---|---|---|---|---|
| Market Share after 6 Years (%) | 16.0% | 12.9% | 12.9% | 24.8% |
| 6-Year Avg. ROS (%) | -4.2% | -10.2% | 3.1% | -4.3% |
| 6-Year Avg. ROA (%) | -3.9% | -7.3% | 2.4% | -3.2% |
| 6-Year Profit ($M) | -80 | -170 | 52 | -83 |
| Total Employment | 1622 | 1879 | 1541 | 2626 |
| System Price ($000) | 106 | 118 | 95 | 74 |
| Service Superiority (%) | 37% | 103% | 80% | 42% |
| Technology Lead (months) | 1 | -7 | -9 | -1 |
| Total Functional Expend. ($M) | 1,384 | 1,276 | 1,110 | 1,304 |
| Capital Investment ($M) | 231 | 430 | 448 | 895 |
| Gross Investment in Productive Resources ($M) | 1,615 | 1,706 | 1,558 | 2,199 |
| Gross Investment per Share Point Gained ($M) | 216 | 395 | 357 | 135 |

## Figure 11 Market Share as a Function of Investment

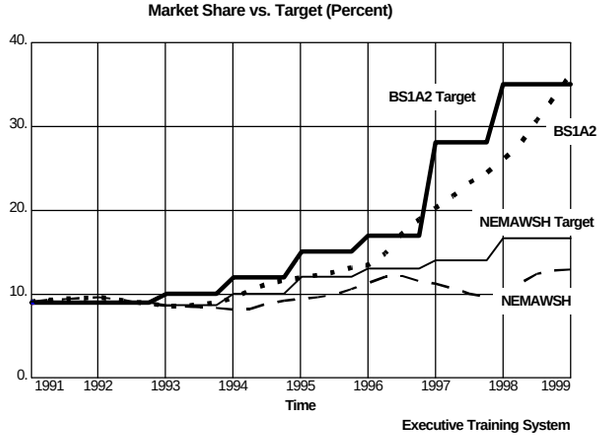



## Figure 12 Relationship Between Profitability and Market Share

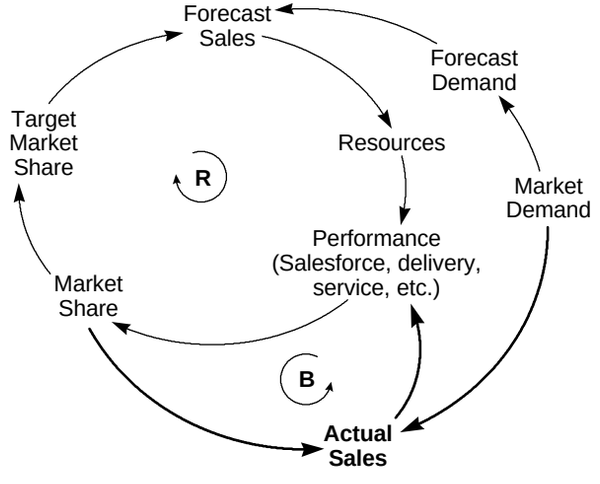
## Figure 13 Growth-Generating Feedbacks



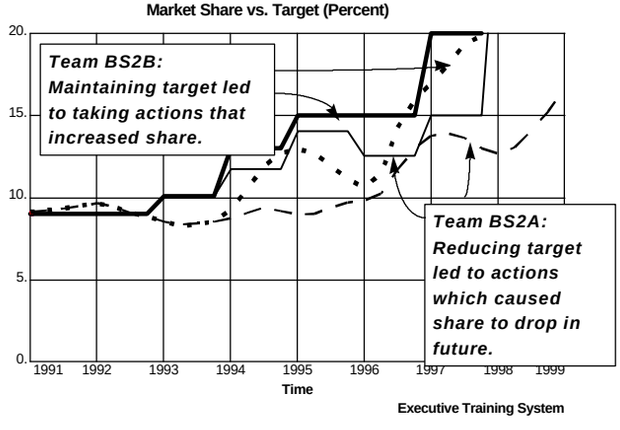

## Figure 14 "You won't get what you don't try for"



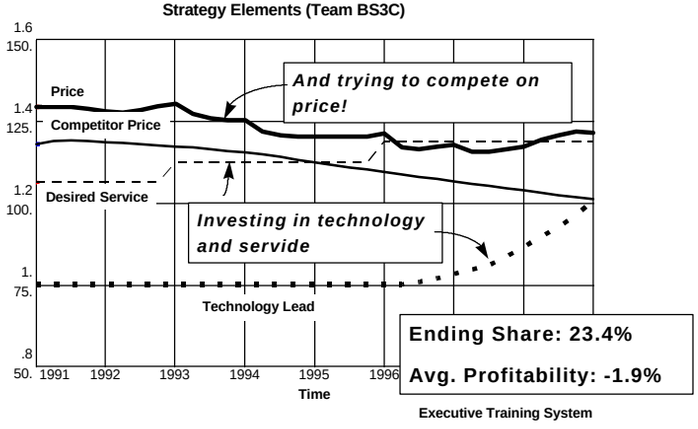

## Figure 15 "Self-Fullfilling Prophecies"



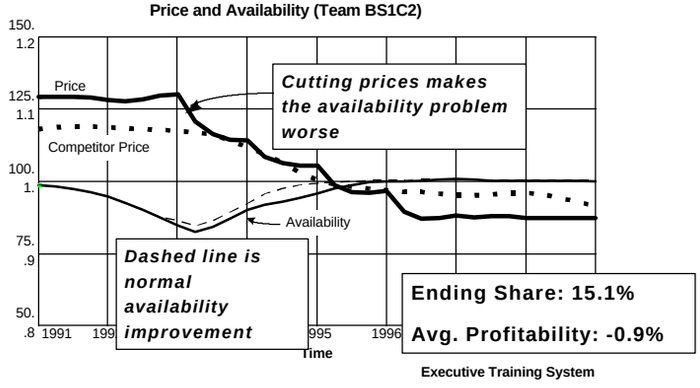

## Figure 16 Avoid the temptation to reduce share targets



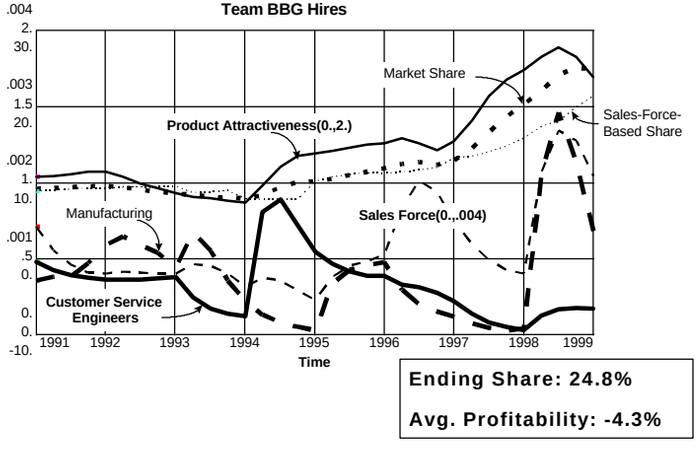
## Figure 17 Trying to do everything reduces profitability



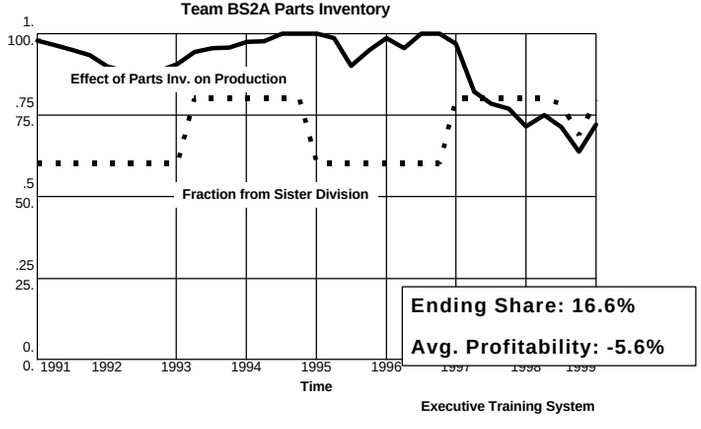

## Figure 18 Solving a symptom reduces profitability



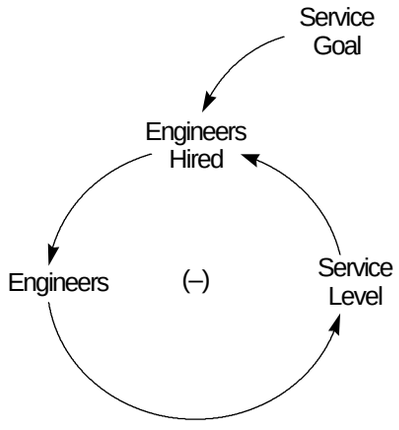

## Figure 19 Reacting to problems leads to resource imbalance across time and function



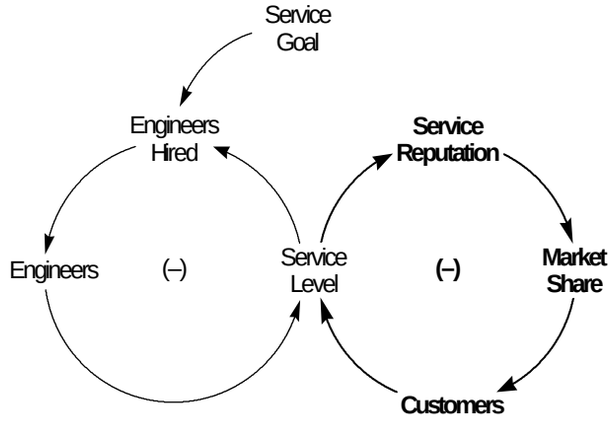

## Figure 20 Inconsistency in parts sourcing creates shortages and reduces profitability



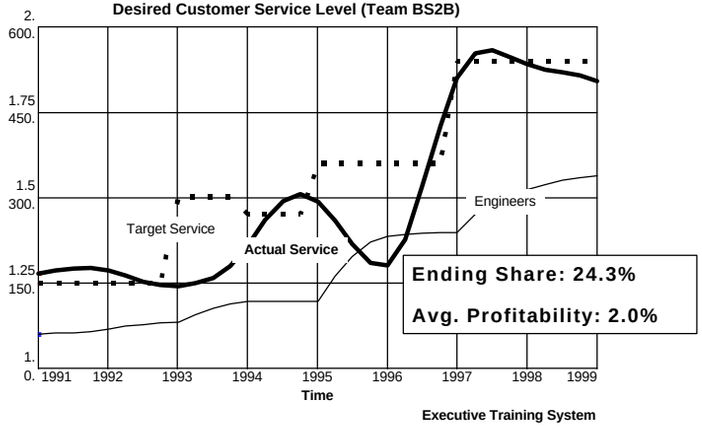
## Figure 21a Failure to Recognize Delays



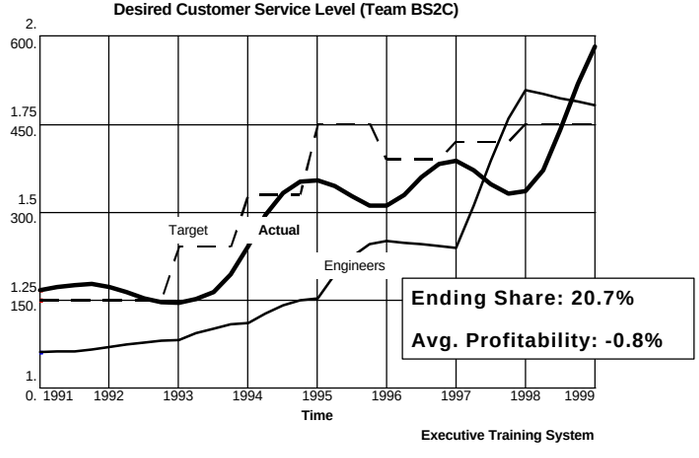

## Figure 21b Failure to Recognize Delays



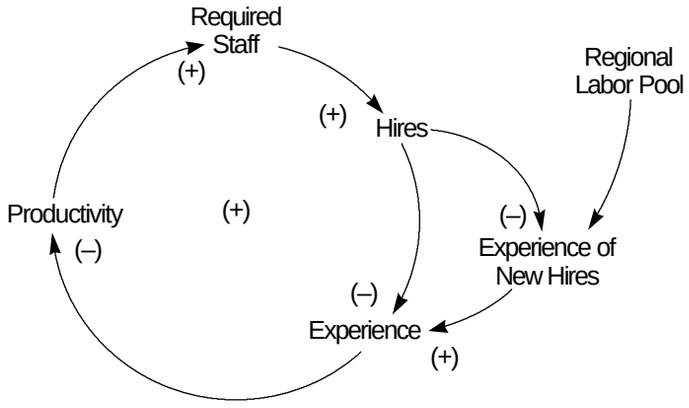

## Figure 22 Failure to recognize delays leads to under-resourcing and decline in service performance



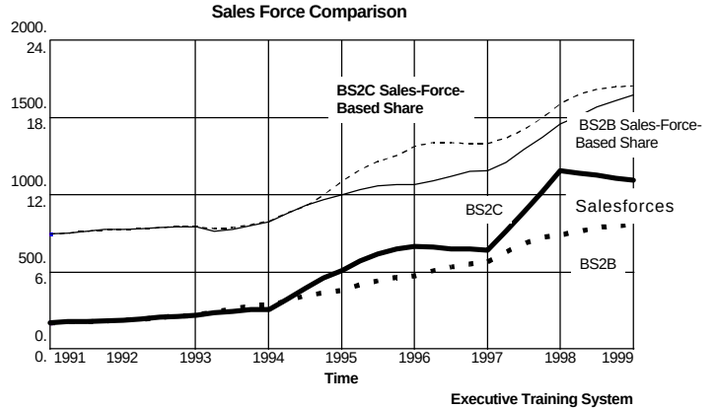

## Figure 23 A steady increase in service targets and resources avoids the crisis



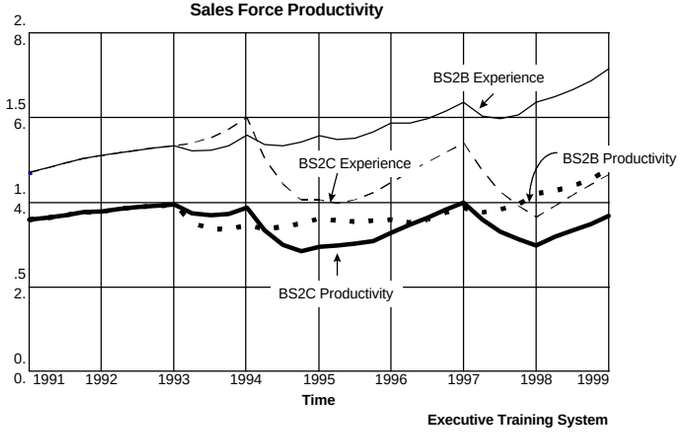
## Figure 24 Experience Spiral



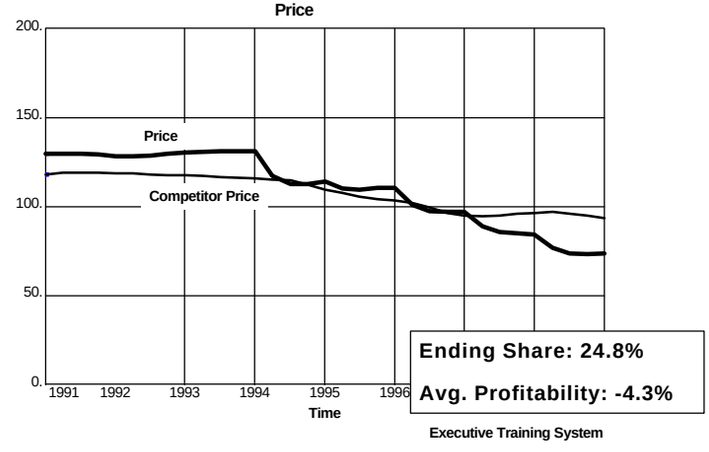

## Figure 25 Hiring in spurts creates experience problems that reduce productivity and potential share



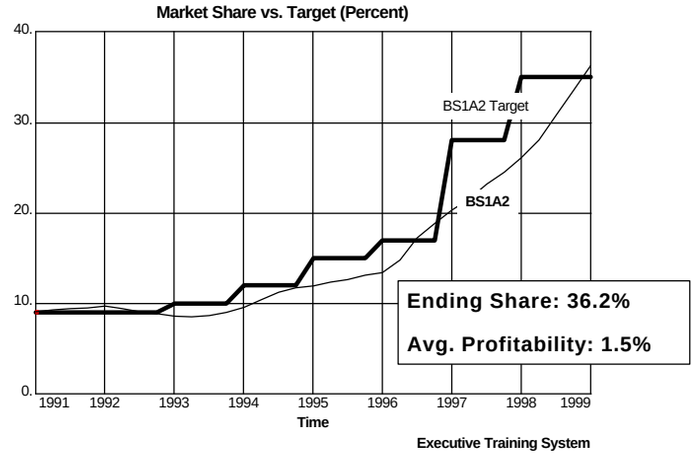

## Figure 26 Experience dilution from hiring in spurts



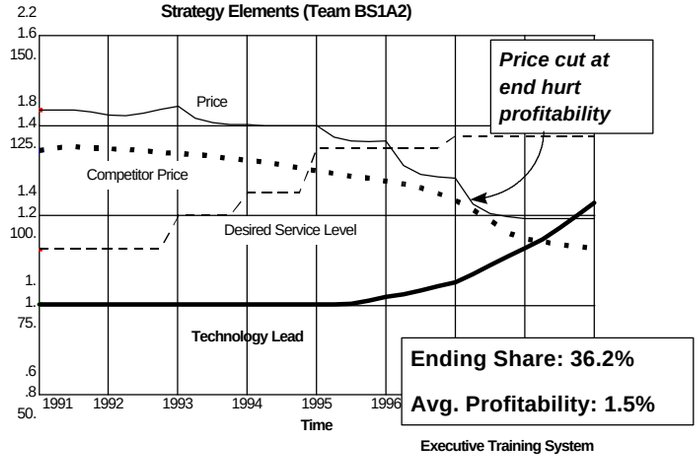

## Figure 27 A price war accomplishes nothing but reduced profits



## Figure 28 Steady and consistent increase in targets




## Figure 29 Consistent strategy




## Figure 30 Implemented consistently