MARKETING SCIENCE
Vol. 24, No. 3, Summer 2005, pp. 313–331
ISSN 0732-2399 | EISSN 1526-548X | 05 | 2403 | 0313

informs

DOI 10.1287/mksc.1050.0133

The 2004 ISMS Practice Prize Winner

Sales Territory Design: Thirty Years of Modeling and Implementation

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Sales territory alignment is the assignment of accounts and their associated selling activities to salespeople and teams. Models, systems, processes, and wisdom have evolved over 1,500 project implementations for 500 companies with 500,000 sales territories.

Optimization models have evolved over time to explicitly consider travel time along road networks and customer disruption. Personal computers with continually increasing speeds and storage capabilities, the Internet, and mapping databases have enabled the development of systems that communicate alignments visually to sales managers. Because of their combinatorial complexity, multiple conflicting objectives, and personnel aspects that touch everyone in the salesforce, the alignment models were unable to completely solve the sales territory alignment issues faced by companies. Consequently, processes that add local managerial knowledge were used to communicate and enhance model-derived solutions, while achieving very high implementation rates.

The territory alignment team gains knowledge with every sales territory alignment. Alignment insights get codified. Alignment experts improve every model-derived solution. This wisdom becomes part of subsequent alignments and triggers further innovation. Over time, the role of processes and wisdom becomes larger than the role of the models and systems.

Key words: salesforce; sales management; sales territory alignment; segmentation; change management; model implementation; pharmaceuticals

History: This paper was received September 15, 2004, and was with the authors 2 months for 1 revision; processed by Gary Lilien.

1. Introduction

There are approximately fifteen million full-time field and retail salespeople in the United States. This represents about 11% of all of the people who are employed full-time. Approximately six million of these salespeople have field responsibility. The number of part-time salespeople is even larger. Avon alone has over one million salespeople in their database. Salesforces represent the largest marketing expenditure category by far. Full-time salespeople in the United States cost their companies more than a trillion dollars every year. This is more than four times what is spent on advertising.

Editor Note: This article was formally reviewed by *Marketing Science*. As is the case with all *Marketing Science* articles, although *Marketing Science* is unable to guarantee the claims made in our articles, our review process employs high standards usually involving the input of multiple reviewers and multiple editors who are considered experts in their fields.

There are many decisions that sales managers make. Some are strategic, such as selling process definition and salesforce design. Others are more tactical, such as hiring, training, performance management, targeting, and compensation. Few of these decisions have the personal impact that the territory alignment decision has. The territory alignment decision affects the workspace for every member of the salesforce. It defines whom a salesperson will call on and who his or her immediate manager will be. It impacts compensation and motivation.

This paper describes thirty years of model, process, system, and wisdom development for establishing good sales territory alignments. In the ten-year period from 1974 to 1984, we built a territory alignment foundation by developing the models, proving the concept, developing algorithms, writing alignment software, perfecting the databases, and creating practical implementation processes. In the next twenty-year period, from 1984 to 2004, we and our

colleagues at the consulting firm ZS Associates have implemented these alignment approaches in more than 1,500 projects for over 500 companies in 39 countries and have designed approximately 500,000 sales territories. We estimate a good alignment can improve sales by 2%–7% over an average alignment. Many companies that use our alignment approaches tend to stay with them for all of their major realignments. More than twenty companies have used these approaches for over fifteen years.

This paper consists of the following seven sections:

- The Sales Territory Alignment Decision
- Territory Alignment Impact on Salesforce Performance
- Sales Territory Alignment Literature Review
- Sales Territory Alignment System Evolution
- Three Significant Components of the Territory Alignment Decision System
- The Pharmacia Salesforce Integration and Sales Territory Alignment Implementation
- Biovail, GlaxoSmithKline, Ethicon Endosurgery, and Allergan Implementations

The first two sections present a general discussion of the importance of the sales territory alignment decision. The third section surveys the literature addressing this decision. The fourth section traces the evolution of our territory alignment approach. The basic premise for this section is that enduring model implementation is rarely static. Models, decision processes, systems, and issue wisdom are enhanced as new technologies, issues, opportunities, and obstacles are encountered and improvement is attained. The fifth section catalogs the key alignment tools and processes that we use. A narrative describing territory alignment processes implemented by five firms appears in the last two sections. Specific model formulations are presented for one of the five firms. These firms highlight the impact of the models, tools, processes, and systems that they employed.

2. The Sales Territory Alignment Decision

Salespeople have the capacity to carry out selling activities. At the same time, customer accounts and prospective accounts have a need for these activities. The assignment of accounts and their associated selling activities to salespeople and teams is called sales territory alignment. Other names for this activity include sales territory assignment, realignment, deployment, districting, and design.

Not all selling organizations specify a territory alignment for each salesperson. For example, many salespeople in the office products, financial services, and insurance industries can sell to anyone with whom they develop a relationship, regardless of the type or geographic location of the customer. The same is true for many direct selling organizations, such as Avon or Amway. A large majority of salesforces, however, specify each salesperson's or sales team's account responsibility, activity mix, and accountability. Within a defined territory alignment, each customer sees a specific salesperson or sales team.

Sales territory alignments are defined within the context of the salesforce structure. Companies with generalist structures often assign each salesperson to a specific geographic area, such as a set of postal codes, counties, or states. Companies with market-based structures typically define their sales territory alignments by specific accounts, in addition to geography. In these alignments, each salesperson covers all the accounts of a particular size, type or industry within an assigned geographic area. Multiple market specialists cover the same geography but do not call on the same accounts. Companies with product-based or activity-based structures define sales territory alignments by product or selling activity, in addition to account and/or geography. In these alignments, more than one salesperson is assigned to cover each account, with each salesperson performing a different activity or selling a different product.

Alignments can get very complex. For example, one office products supplier assigns each account to up to five different salespeople: a telesalesperson who generates and qualifies leads, a generalist who sells office supplies, a specialist who sells furniture, another specialist who sells computer supplies, and a customer service person who facilitates order fulfillment and provides ongoing support. Territories are of different sizes since the number of salespeople varies across each specialization. For each account, a salesperson needs to know which activities and products he/she is responsible for. In addition, the salesperson needs to know which salespeople perform the other selling activities, since coordination between salespeople is important to the success of an account.

Alignments change frequently for most salespeople. It is very rare for a salesperson to maintain his or her same territory for two consecutive years. Small boundary changes go on all the time. New accounts, account relocation, and demographic shifts require small boundary changes. Major realignments happen less frequently. However, a major realignment is a certainty whenever a salesforce changes its size or structure, whenever mergers and acquisitions occur, market conditions change, new products are launched, and when a new salesforce is created. To add even more complexity, the alignment definition frequently expands to include decisions such as who should leave during a downsizing and who should relocate during a merger. An alignment has to be in place before any salesforce can call on customers to drive company sales.

3. Territory Alignment Impact on Salesforce Performance

Territory alignment has a cascading impact on company performance. There are primary, secondary, and tertiary effects. These effects are frequently subtle. Figure 1 presents an influence flow that shows how the sales territory alignment decision can impact salespeople, their activity, and consequently, customer satisfaction and company results. A sales territory alignment defines the workspace for everyone in the salesforce. Compact and equitable alignments imply fair performance evaluation, equitable workload, and controllable travel time, which typically are a precondition for high levels of morale and motivation. Next, salespeople's actions and behaviors are affected by how they feel about their territories and how they are treated by the company. Highly motivated and energized salespeople spend their time in the most appropriate way, treat customers properly, and as a result, drive higher levels of sales. We estimate that the difference between a good sales territory alignment and an average territory alignment is 2% to 7% of sales. This section discusses how a good alignment can enhance salesforce morale, improve salesforce activity, and drive higher sales and profit.

3.1. What Is a Good Alignment?

A good alignment can be defined in terms of the three constituents described in Figure 1: salespeople, customers, and the company. Table 1 provides a list of some of the things each of these constituents desires from an alignment. A good alignment is one that comes closest to meeting the needs of all constituents.

3.2. Good Alignments Promote Fair Rewards and Boost Morale

The management at a medical devices company thought something was wrong with their salesforce compensation plan. The extremely wide range of incentive payouts across the salesforce did not accurately reflect true performance differences. As the graph in Figure 2 shows, the "best" salesperson in the salesforce received over six times as much incentive pay as the "worst" salesperson in the salesforce. The top ten salespeople earn four times as much incentive pay (averaging $116,000) as the bottom ten salespeople (averaging $28,500). An analysis revealed that nothing was wrong with the current compensation plan; instead, poor territory alignment was the major cause of the undesirable variation in incentive payout. The high payout territories had disproportionately higher market potential than the low payout territories. The company was paying incentives for territory opportunity and not for salesperson performance. There is high correlation across firms and industries between territory potential and territory sales. Territory potential is often a better predictor of territory sales than is any characteristic related to the salesperson, including experience, ability, or effort.

Sales managers frequently do not place enough emphasis on differences in territory potential when they evaluate, compensate, and reward salespeople. When managers underestimate the importance of these differences and treat salespeople as if their territories were identical, salesforce morale suffers. Few salespeople will be content with what they consider to be inferior account assignments while their colleagues collect more money and recognition with less effort simply because of superior territories. Territories with low potential, intense competition, or too many small accounts with a high quota are virtually guaranteed to lead to low job satisfaction and low motivation. For

Table 1 The Three Constituents and What Each One Wants for the Sales Territory Alignment

Salespeople look for the following from their alignment:	Customers look for alignment to contribute the following:	The company looks for the alignment to contribute the following:
• Opportunity to succeed • Sufficient income opportunity • Keep favored accounts • Equitable workload • Low travel time • Good manager assignment	• Minimal disruption • Keep favored salesperson • Receive appropriate salesperson attention	• Motivated salespeople • High salesforce retention • High sales • Low expenses • High profits

Figure 1 The Sales Territory Alignment Decision Has an Impact on Salespeople, Customers, and Company Results

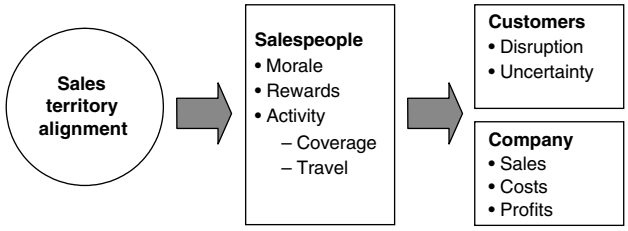
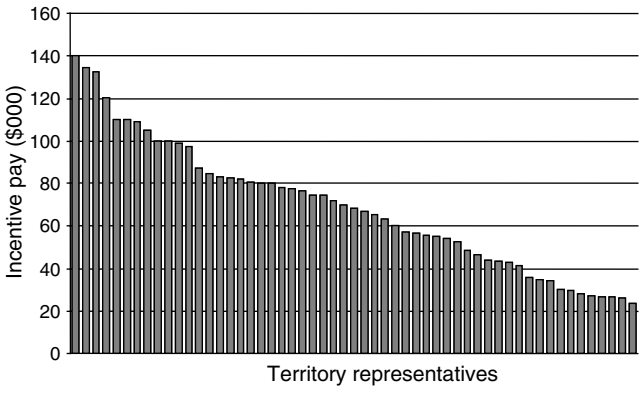


Figure 2 Range of Incentive Pay by Salesperson



this reason, unbalanced sales territories often lead to salesperson turnover. A territory alignment balanced on workload or opportunity is defensible when presented to a salesforce.

3.3. Alignments Affect Salesforce Activity, Which Produces Higher Sales

Well-designed territories increase sales because customer and prospect coverage is improved. A salesperson in a territory with too much work cannot cover all the customers and prospects effectively. The salesperson's time is spent calling on easy accounts, leaving no time to cover more challenging but potentially profitable accounts. As a result, the company misses out on important sales opportunities. At the same time, a salesperson in a territory with too little work will spend a disproportionate amount of time making nonproductive calls, such as calls on low-potential customers. The sales generated from these low-potential customers are likely to be much less than what is possible from the accounts not covered in a heavy territory. This is the argument for balancing sales territories.

Figure 3 shows the extent to which customer coverage needs and salesforce capacity are mismatched in a cosmetics company's 200-person salesforce. This salesforce performed merchandising duties at retail stores, including stocking shelves, setting up displays, and taking inventory. Based on the type and size of store, the company could fairly accurately estimate how long these tasks would take. They tried to create territories where store workloads matched the capacity of a full-time salesperson.

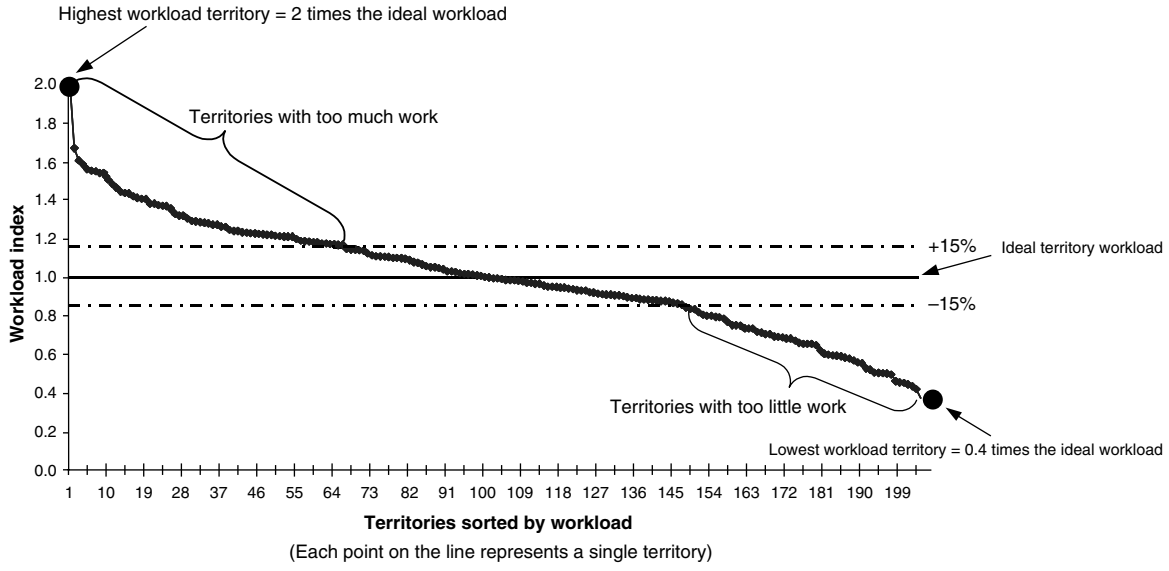
The actual store workload in each territory was calculated and indexed on the vertical axis. The territories are sorted from highest to lowest workload and each territory is plotted as a point along the curved line on the graph. The "ideal territory workload" line on the graph represents the average workload capacity of one full-time salesperson. Territories with indices that are significantly above 1.0 have too much work for one salesperson, while those that have indices significantly below 1.0 have insufficient work for one salesperson. By comparing the points along the curved line representing actual territory workload with the horizontal line representing ideal territory workload, it is possible to see the extent to which store needs and salesforce capacity are mismatched.

No salesforce can expect to have an alignment in which every salesperson has exactly the ideal workload. Due to geographic constraints, salesperson differences, trade area considerations, and data imperfections, some variation in workload across territories is inevitable. For this salesforce, management felt it was reasonable to expect almost all sales territories to fall within a range of plus or minus 15% from the ideal workload. Approximately 60% of the territories have workloads that deviate by more than 15% from the ideal for the cosmetics salesforce in Figure 3. Our experience shows that this level of imbalance is the norm (Zoltners and Lorimer 2000).

3.4. A Good Alignment Impacts the Company by Keeping Travel Time and Costs Under Control

Many companies have successfully reduced salesforce travel time through realignment. Travel reduction has a positive impact on salesforce morale, especially when realignment distributes travel requirements fairly across salespeople. Less travel also reduces the firm's costs and allows more face time with customers.

Figure 3 Mismatches in Salesforce Capacity and Customer Coverage Needs for a Cosmetics Salesforce



The following travel time reduction and profit calculation measured by W. W. Grainger, a large industrial distributor, is representative. The company observed a 13.7% reduction in salesperson travel time after a realignment. This translated into an almost $1 million savings in travel expenses. In addition, the travel-time reduction enabled the salesforce to increase selling time by 2.7%. The company estimated that this increase in coverage would result in over $15 million in additional annual sales and over $3 million in additional annual profits.

3.5. A Good Alignment Increases Company Sales and Profits

The sales impact of a balanced alignment can be observed from the alignment data generated in most alignment studies. Figures 4, 5, and 6 show the relationship between territory opportunity and territory sales for several companies. The best regression fit to the data usually has diminishing returns to opportunity. The reasons for this phenomenon were described in §3.3. Since the regression fits are concave, the sales lost due to territory opportunity reduction are less than the sales gains resulting from a territory opportunity increase, and so the organization will increase its sales by moving toward balance. Figures 4, 5, and 6 are representative. Looking across a large sample of implementations we have observed that most of the balancing impacts fall within a 2%–7% improvement range.

Figure 4 Pharmaceutical Example of the Sales Benefit of Territory Balance

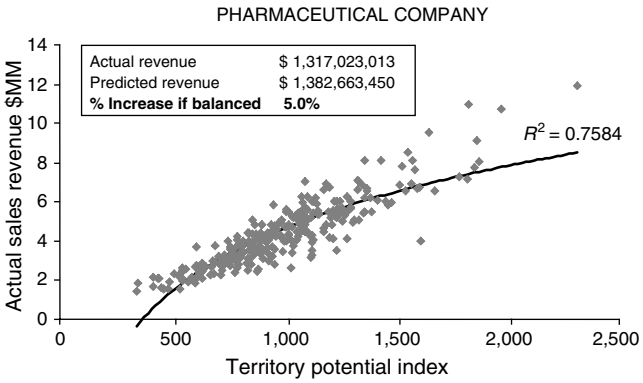


Figure 5 Consumer Health Care Example of the Sales Benefit of Territory Balance

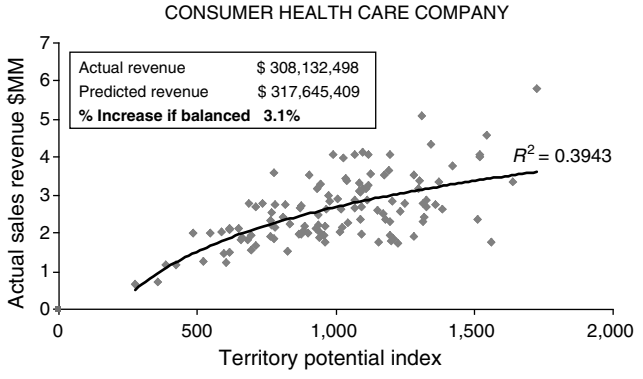
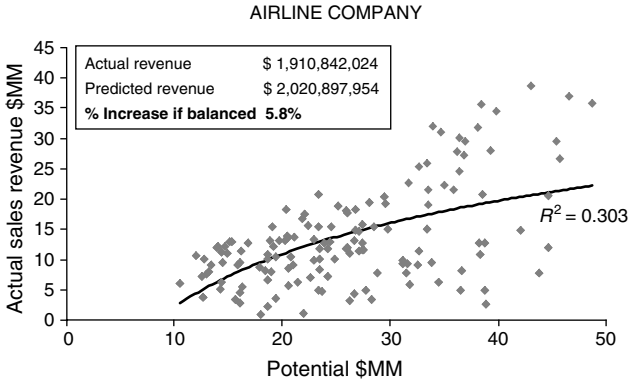


Figure 6 Airline Example of the Sales Benefit of Territory Balance



Experiments demonstrating the value of a good alignment are rare. Companies do not have time to advance science when they are worrying about achieving their sales goals. One company, The Upjohn Company, actually did conduct an experiment to test the financial impact of adopting a model-based approach for alignments. A single sales region with sixty six sales territories was selected as a test region. The test region used the approach described in this paper to realign sales territories to match capacity with coverage needs. Regions in the rest of the country, containing a total of over 600 sales territories, continued to use traditional "seat-of-the-pants" approaches for making territory boundary changes. One year later, sales results in the test region were compared to sales results for the rest of the country.

The Upjohn Company analyzed the experiment and reported the results shown in Table 2. A sales growth-to-market growth ratio was used to measure sales success. A ratio over 1.0 means the company's sales are growing faster than the market, while a ratio below 1.0 means sales are growing slower than the market. The higher the ratio, the better the company is performing relative to the rest of the market.

As Table 2 shows, the test territories dramatically outperformed the control territories in the year following realignment. Upjohn attributed much of this

Table 2 Territory Alignment Experiment Results—Sales Growth to Market Growth Ratios

	Control territories	Test territories
Before realignment*	0.9	1.0
After realignment**	1.1	2.1

*Before realignment data is for the 12 months prior to the test region realignment.

**After realignment data is for the 12 months following the test region realignment.

success to the better deployment of salespeople made possible by the structured alignment process implemented in the test region. Better alignment allowed better coverage of customers, which translated into significantly higher sales growth.

Companies would like their salesforce decisions to maximize profits. This is realized by increasing sales and reducing costs. The previous discussions showed how balanced alignments can impact both the sales and cost sides of the equation. A number of authors have argued that companies should implement profit-maximizing territory alignments (see §4). Profit-maximizing models inherently rely on a sales response mechanism to specify the activity that the salesperson should perform as well as the geography that should be covered. Depending on the model, the sales response mechanism may specify how many calls a person should make on each account or customer segment, the number of trips to certain geographies, and how many over-nights they should take. These models derive theoretically appealing solutions. However, these solutions are also practically challenging. It is a practical reality that no salesforce anywhere will fully implement a headquarters' derived profit-maximizing call plan. Customers won't see you. Snow blocks roads. Competitors win accounts. Customer data is not available, is incomplete, or is incorrect. Vacant territories need coverage. The salesforce likes empowerment. Sales leadership worries more about how the field will react to the alignment decision than it does about profit maximization. Territory balancing is appealing to salespeople and their managers.

That said, some of our modeling does attempt to incorporate aggregate-level profit-maximizing workloads into the balancing scheme. We do this in industries where management feels that they have good data and that they need to control activity. Merchandising and detailing salesforces are good examples of where this kind of model has been applied. This approach is presented in §7.

4. Sales Territory Alignment Literature Review

Early articles addressing the sales territory alignment problem date back to the early 1970s. Hess and Samuels (1971) built on the original political districting research to develop the first models for territory alignment. The Hess and Samuels model was a linear programming model that basically rounded the LP solution to construct compact territories that balanced a key alignment attribute such as market potential or workload. The intuition was that balanced sales territories were good for the reasons specified in §3. Other authors quickly followed with model enhancements or alternative solution approaches. Shanker et al. (1975) conceptualized the problem as a set-covering integer program. Lodish (1975), Zoltners (1976), Beswick and Cravens (1977), and Glaze and Weinberg (1979) introduced profit-maximizing formulations. Good reviews of these models appear in Zoltners and Sinha (1983), Vandenbosch and Weinberg (1993), and Skiera and Albers (1998).

Little additional research was published on the alignment problem since 1983 until Skiera and Albers (1998) published their profit-maximizing model called COSTA. The authors drew a clear distinction between balancing models and profit-maximizing models and emphasized the need to profit-maximize when aligning territories.

Profit-maximizing models are theoretically better, but they come at the cost of solution complexity. The balancing approach requires one algorithm: the assignment algorithm. The profit-maximizing approach requires two algorithms: one for assignment and one for salesforce effort allocation. Consequently, profit-maximizing formulations are inherently much more difficult to solve. Early authors did not pursue their optimization approaches, while Skiera and Albers relied on "reasonable" assumptions and a heuristic algorithm to solve moderate-sized problems.

While Skiera and Albers argue that profit-maximizing is theoretically better than balancing, we believe the balancing/profit maximization distinction has low practical value. We observe that the alignment problem is too complex for any single model or approach to produce a complete and workable solution. Table 1 describes several aspects of a good alignment. All of these criteria are impossible to incorporate into a single decision model. Furthermore, as was described in the last section, salespeople are not going to implement a model-based effort allocation recommendation anyway. This level of control is very unpopular with salesforces. So the very basis of optimality (that the optimal effort allocation will be implemented) is unrepresentative of reality. Processes and systems, as well as a library of realistic models, are needed to derive solutions that are going to change salesforce behavior and be implemented. The next section reinforces this view by describing how our approach has been adapted repeatedly over time as existing models proved impractical and as technology enabled enhancements.

5. Sales Territory Alignment System Evolution

5.1. The Early Years: Models Meet Reality

It was 1976 and we were aligning our very first sales territories for Eli Lilly, a large pharmaceutical firm. We used a specialized integer programming algo-

rithm, based on our earlier work on the multiple-choice knapsack problem (Sinha and Zoltners 1979), on an IBM mainframe computer to partition over 30,000 zip codes into 500 sales territories. The territories were designed to minimize a Euclidean measure of compactness to model contiguity. The output was 500 pages of 11" × 14" computer fanfold paper.

The modeling was finished; the algorithm was run; all territories were within 5% of balance on sales potential; and we were pleased with our accomplishment. We felt ready to win a ISMS Practice Prize. Not so fast. Joe McDonough, the company's alignment expert (who probably knew every zip code in the country!), wanted us to map the territories. Get out the acetate (transparent paper) and the grease pencil. A meeting was convened to assess the modeling effort. After we displayed a dramatic improvement in territory sales potential balance, Joe immediately noticed and pointed out that our balanced territories ran up and down mountain slopes and across nontraversible waterways. The alignment was not implementable; oh well, it was just another academic exercise. This was the beginning of a history of improvements and innovations that dealt with practical challenges presented by diverse selling organizations and which exploited opportunities created by evolving technology and expanding data. It took several key breakthroughs and almost five years before the approach was able to successfully solve a real territory alignment problem and get it implemented.

We retreated to Northwestern University with the Joe McDonough challenge. With the help of some focused part-time help, we digitized all the major roads in the United States within two months and developed a road-based optimizer for sales territory alignment (Zoltners and Sinha 1983). We returned to Joe with an answer that solved the practical challenge of contiguity and accessibility by using the road network to calculate distance and ensure that if any zip code was assigned to a territory center, all zip codes on the shortest road path between that zip code and the center were also assigned to the center. However, a major obstacle to implementability remained: an expert such as Joe or a sales manager could not visualize the optimized solution so as to accept it. Technology created the opportunity to meet this challenge.

In order to visualize an alignment solution, the list of 30,000 zip codes and their territory assignments had to be mapped. The typical approach was to overlay an acetate on a map and draw the boundaries with a grease pencil, a daunting task with so many zip codes and the whole country to cover. In addition, errors in data (miscoded customer accounts and latitude-longitude errors) and algorithmic bugs typically led to errors in the algorithmic solution. Whenever a sales manager stumbled onto a data-based error, confidence in the entire approach was fatally eroded.

Fortunately, the personal computer was just beginning to find some business use at this time. We quickly put mapping on the Apple II+ computer and were able to display the optimizer results. We called our software MAPS®, an acronym for Manpower Allocation and Planning System. A MAPS® user could also modify any alignment—optimized, current, or any other—and quickly see the consequences of his or her changes. In retrospect, we were trying to do with MAPS® what Joe would do with paper and pencil, just a lot quicker. Joe's constantly flowing ideas and suggestions influenced the design of MAPS® greatly. The advent of MAPS® quickly transformed our hitherto unsuccessful territory alignment implementation efforts into a practical success: multiple companies began using MAPS®. They appreciated their new ability to customize and quickly design their own alignment. Many of the first users of MAPS® actually found the tool to be more valuable than our optimization capability. However, it was a process breakthrough that took the success of the evolving alignment system to another level.

We observed that salespeople frequently complained about headquarter-developed alignments, whether they were the result of an optimizer or manually derived. There would always be a number of salespeople and sales managers who did not like their revised workspace. Their immediate supervisors usually acquiesced to their complaints because an efficient process for reviewing and appraising alternative recommendations did not exist. This arbitrariness led to suboptimal alignments.

Generally speaking, sales managers are reluctant to change working territory assignments. They are wary of the potential dissatisfaction that can arise among salespeople. They value a highly motivated salesforce. Furthermore, salesforce changes usually get sidelined when a company is focused on achieving its sales goal, which is almost all of the time.

We observed that the optimizer produced good alignments—ones that equalized the workload, ensured customers would get appropriate coverage and increased sales—but usually produced some practical concerns as well. We also observed that sales managers liked the change and assessment capabilities that MAPS® provided. They created territories that they liked and accepted. We decided to combine these dual strengths into an alignment process that developed good alignments from the company's perspective and enabled local sales managers to override a centrally derived result if local conditions suggested that a better solution was available. Good initial alignments were developed using an alignment opti-

mizer or a combination of judgment and some modeling. The sales managers used MAPS® to modify the initial alignment.

A key element of the process is the "rollout" of a centrally derived alignment. At the rollout event, each sales manager works with an alignment expert who understands the data and the technology. Using the MAPS® system, they fine-tune the alignment to consider local conditions such as maintaining important salesperson-customer relationships and keeping market areas intact that need to remain together. The power of this step is that it simultaneously enhances the model results and creates buy-in. Incomplete answers because of data gaps are completed, local nuances are considered, errors are fixed, and each sales manager leaves the session with a good understanding of how his or her sales team will cover the customers in each territory.

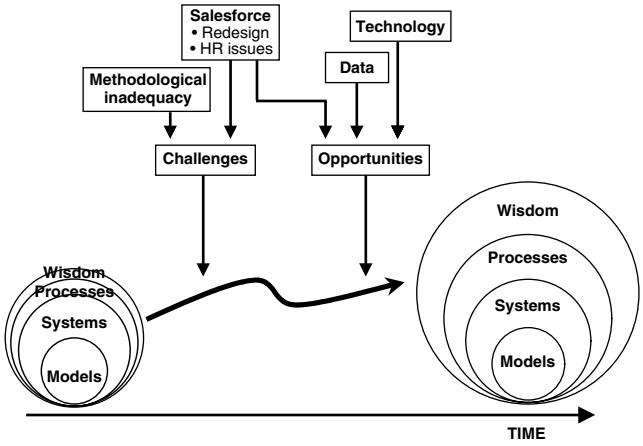
5.2. From Models to Insights

Sales territory alignment is a hard problem. It is a synthesis of combinatorial and personnel decisions. There are a huge number of potential alignments, in fact m^n, where m is the number of territories and n is the number of accounts, geographic units, or sales activity bundles. The alignment decision also defines each salesperson's immediate workspace. In addition to specifying all aspects of where and with whom the salespeople will spend their days, it can include decisions such as: where to place salespeople, who to relocate and where, who stays and who leaves in a downsizing, and who will become each salesperson's immediate manager. It is almost impossible to build a normative decision model that can accommodate all of these likely considerations. Joe McDonough demonstrated the weaknesses of our original integer programming model. To date, a sizeable gap exists between any normative territory alignment decision model and the needs of a heterogeneous set of selling structures with their differing territory alignment needs. All of our subsequent optimizers have only been able to narrow the gap. Systems, processes, and model-user wisdom are the tools that enable the model-user to bridge the gap.

Figure 7 conceptualizes how models, systems, and processes that are designed to address a specific business decision evolve over time as new challenges and opportunities arise. The evolution enables the solution to a broader and broader set of salesforce situations and environments. Any modeling effort will stagnate unless these challenges are addressed and opportunities are exploited. A dynamic modeling system emerges that is comprised of a library of models, systems, and processes that are highly useful.

Joe McDonough's challenge to the geographic feasibility of our original models required a modeling enhancement. The need to visualize any alignment solution, together with the microprocessor breakthrough in technology, led to MAPS®, a systems enhancement. Finally, the need to get input and agreement from various salesforce constituents before an alignment can be implemented led to a change-management process improvement.

Figure 7 Evolution of the Alignment Approach



The territory alignment team gets smarter and smarter with every sales territory alignment. Each modeling, system, and process enhancement accelerates their growth even further. A territory alignment vocabulary emerges. Team members use a common language and common concepts. Principles and theories arise. Alignment experts spot the right answer even before applying the model. Territory alignment wisdom emerges, manifesting itself in knowledge, experience, and perspective. This wisdom becomes part of subsequent alignments and frequently triggers further model, system, and process innovation. Over time, as shown in Figure 7, the role of processes and wisdom becomes larger than the roles of the models and the systems.

A Recap of Key Developments. Table 3 provides a short history of our modeling, system, and process development over a 30-year period. The models, systems, and decision processes have grown in use within companies and across industries and have successfully avoided obsolescence by a continuous series of enhancements. More than 20 companies have used the models, systems, and processes for over 15 years.

6. Three Significant Components of the Territory Alignment Decision System

Our territory alignment implementation success relied on three core components and their evolution

Table 3 Sales Territory Alignment Model, System, and Process Evolution

Event: Opportunity or challenge	Solution type	Solution and reference	Year
Asked to solve an alignment problem with 30,000 zip codes and 500 sales territories.	Model	Specialized integer programming model that designed territories to minimize a Euclidean measure of compactness using zip code adjacency to model contiguity.	1976
Model-derived territories did not consider geographic obstacles and travel times.	Model	Inclusion of a road network to calculate distances and modeling contiguity by ensuring that if any zip code was assigned to a territory center all zip codes on the shortest road path between that zip code and the center were also assigned to the center (Zoltners and Sinha 1983).	1978
Sales management and sales operations were unable to visualize and assess an alignment with 30,000 zip codes for 500 sales territories.	System	500 pages of 11" by 14" fanfold computer printout was replaced by mapping district-level alignments on an Apple II+ computer using MAPS® (Manpower Allocation and Planning System). The PC version of MAPS® was developed in 1982 after the launch of the IBM personal computer in late 1981.	1982
Incomplete and error-prone account and geographic data resulted in errors in territory optimizer solutions.	System & Process	The capability to change an alignment was added to MAPS® so that users could fix errors, modify incomplete solutions, or realign and see the consequences of the change on the alignment criteria and the geography of the territories.	1982
Model-derived answers did not incorporate local market knowledge and lacked buy-in from sales managers and salespeople.	Process	A sales territory alignment process was developed. It is described in detail in §6.	1984
Major sales territory alignments occur infrequently. Sales managers do not have a frequent need for the models.	Process	Alignment consultants, providing strong technical skills and alignment knowledge, become a integral component in the alignment process. Sales managers do not need to be skilled at using the software. A 3-way interaction between model, manager, and alignment expert led to implementation success.	1985
Sales managers working separately on their own district alignments create conflicting assignments with neighboring districts.	System & Process	Develop "GLUE": a system to highlight inter-district conflicts and to help sales managers resolve these conflicts.	1985
Sales leaders want to determine the ROI of a territory alignment model and process before adopting it.	Wisdom	A 660-territory experiment demonstrates significant sales improvement due to a better alignment process. See Table 2.	1985
Instead of using territory balancing criteria, some companies want to use profit maximization criteria. Alignment experience suggests that the best way to do this is to develop estimates of the optimal time required to cover different customer segments.	Model & Process	Develop sales response functions for each significant customer segment using historical data, improve the estimate using judgmental data, optimize to determine segment workloads, and apply optimized workloads to individual customers.	1987
Alignment models need to maintain complex relationships between multiple selling teams that call on many common customers.	Model & System	Enable software to create and enforce relationships between multiple sales forces calling on common customers. Many pharmaceutical firms employ "almost identical" sales territories for multiple overlapping selling teams. They call these structures mirrored structures.	1996
Require multiple managers of different selling teams to work together concurrently to make alignment changes.	Process	Utilizing multiple video monitors or even large screen projection, an alignment expert works remotely with 2–11 managers who are all in charge of the same geography but sell different products with some customer overlap. It requires a disciplined process and a primary focus on achieving overall company objectives.	1996
Minimal customer disruption and territory balance are usually conflicting objectives when salesforces are aligned. The question of the best trade-off occurs frequently.	Model	Develop measures of disruption and balance so as to provide criteria for optimization and metrics to assess the impact of alignment changes by sales managers and alignment experts. Pareto optimal solutions can be mapped.	1996

Table 3 (Cont'd.)

Event: Opportunity or challenge	Solution type	Solution and reference	Year
Need to understand impact of customer disruption.	Wisdom	Sales trends for customers before and after a salesforce realignment were compared to understand the financial impact of disruption on different customer segments (Zoltners and Lorimer 2000).	1998
Experience suggested that the sizing and alignment decisions are intertwined for small salesforces (less than 200 in the US).	Model	A specialized simultaneous sizing and deployment algorithm was developed that finds the best territory locations and their surrounding territories realizing that there will be only selective coverage of the entire geography. The algorithm is called SmartSize™ and will be described in more detail in the next section.	1999
Some companies wanted to continuously evaluate metrics such as territory profitability and missed opportunity when making manual alignment changes.	Model	Utilize a deployment algorithm to evaluate the current alignment and any changes to the current alignment on a dashboard comprised of profitability and lost opportunity metrics.	2000
Systematize the process of assigning personnel to sales territories.	System	Move from ad hoc Excel-based tools to a system that consistently and objectively applies business rules to assign salespeople to territories. The tools also enable the evaluation of different sets of decision rules and document model-generated placement decisions. The tool is especially useful during salesforce downsizing and mergers and has been invaluable in demonstrating fairness in lawsuits by displaced salespeople.	2000
Sales managers want access to models and alignment experts remotely to save travel time.	System	A Web-enabled alignment system, eMAPS™, was developed providing functionality such as being able to update an alignment, perform "what-if" analyses, view and print maps and reports, and review and approve changes.	2001
Companies in many industries do not have sales potential data for accounts, market segments, and/or geographies.	Model	Sales potential measures were developed by examining the distribution of sales performance across customers in each market segment and using performance percentiles to estimate account-level sales potential for the alignment process (Zoltners et al. 2004, pp. 69–71).	2002
Coverage variations in territories with too few or too many customers.	Model	A model was developed that predicts salesforce coverage patterns for territories that are too small and too large, thus estimating and comparing the lost opportunity in the large territories with the incremental sales gain in the small territories. These calculations help establish the impact of a balanced alignment.	2002

over time. These components are optimization models, a software system, and an alignment process.

6.1. SmartAlign™—An Optimization Algorithm to Design Sales Territories

SmartAlign™ designs sales territories by dividing a set of sales coverage units (SCUs), such as accounts, zip codes or salesforce activities, among sales territories. The simplest formulation of the optimization model appears below.

$$\text{Minimize} \quad \sum_i \sum_j w_j d_{ij} x_{ij}$$

subject to:

$$\text{(i)} \quad l_i \le \sum_j w_j x_{ij} \le u_i \quad \text{for each } i,$$

$$\text{(ii)} \quad x_{ij} \le \sum_{p \in A_{ij}} x_{ip} \quad \text{for each } i,\ j,$$

$$\text{(iii)} \quad \sum_i x_{ij} = 1 \quad \text{for each } j,$$

$$\text{(iv)} \quad x_{ij} = 0 \text{ or } 1 \quad \text{for each } i,\ j,$$

where

j is the index of sales coverage units (zip codes)

i is the index of sales territory centers

x_{ij} is the decision variable which takes on the value 1 if zip code j is assigned to territory center i, 0 otherwise;

d_{ij} is the distance of center i from zip code j;

w_j is the workload in zip code j;

l_i is the lower bound for the total workload for territory center i;

u_i is the upper bound for the total workload for territory center j;

$p \in A_{ij}$ is the set of zip codes that immediately precede zip code j in the shortest path to territory center i.

The objective function is the sum of workload-weighted SCU distances from the territory centers and helps ensure compact territories. Constraint set (i) is the balancing criterion, and set (ii) ensures contiguity of sales territories.

The essence of the solution algorithm is as follows.

Each iteration of the algorithm consists of the following steps:

- Generate the "greedy" solution; i.e., each zip code is assigned to its closest territory center via its shortest path;
- Calculate the violation of the workload balance constraint set (i);
- Modify distances from each zip code to each center in such a way that the "light" centers, i.e., those with insufficient workload appear closer to each zip code than at the previous iteration, and "heavy" centers appear further away.

This process is repeated with diminishing distance adjustments at successive sets of iterations as described in Zoltners and Sinha (1983). The process ends when adjustments are below a set tolerance limit. In order to set up the contiguity constraints, the shortest paths from each zip code to each of its potential territory centers are calculated. To facilitate this step, we have developed a cross-zip code distance database that makes this calculation a simple table lookup. With experience from a large number of implementations, we have an a priori sense for the assignments that are feasible, and so we store only a small fraction of the elements in the distance matrix that would be required if it were exhaustive.

The original version of SmartAlign™ operated on an IBM mainframe computer in 1976 and used Euclidean distance. Subsequent versions on the mainframe incorporated road networks. SmartAlign™ differs from the Hess and Samuels (1971) approach because it explicitly models contiguity and the solution algorithm solves the integer programs using subgradient optimization, as opposed to rounding the linear programming solution. Today, SmartAlign™ works on Windows® computers.

SmartAlign™ is particularly useful for large salesforces where a manual process to create a starting alignment is too cumbersome or when a firm wishes to create several alignment scenarios with multiple salesforce structures or sizes before deciding which one to implement.

Controlling disruption tends to be a key goal of the realignment when SmartAlign™ is used to enhance existing alignments. Disruption is defined as the percentage of SCU work that is covered by a different salesperson following realignment. Handling disruption fits naturally into the solution algorithm. A constraint limiting disruption can be incorporated into the objective function using a Lagrange multiplier. A higher multiplier will make a salesperson's currently assigned SCU appear closer and result in lower disruption than if the multiplier is low. We solve the problem parametrically using varying Lagrange multipliers which in turn yields solutions with different overall levels of disruption.

Alignments generated by SmartAlign™ are rarely implemented directly for existing salesforces. Alignment experts are usually needed to polish its output so as to include geographic, market, customer, and salesperson factors that are not captured in the model. SmartAlign™ solutions are usually quite good for new salesforces.

6.2. SmartSize™—A System to Design Sparse Territories

SmartSize™ simultaneously decides on a salesforce size and an alignment for salesforces that are too small to cover the entire country. In these situations SmartSize™ helps determine territory headquarter locations and selects accounts that should be covered by the salesforce. SmartSize™ begins with a list of accounts, the time required to cover the accounts, and the return expected by covering each account. It also creates a set of possible territory centers and the travel time from each possible center to each account. At each step, it builds territories around remaining possible territory centers using a greedy heuristic. It then picks the best city to locate the next salesperson based on the estimated profitabilities of the possible territories. Different starting points and look-ahead heuristics reduce the risk of developing poor solutions because of bad initial city selections. The greedy algorithm usually returns excellent alignment solutions because good solutions are easy to find when salesforces do not have enough salespeople to cover the whole country. Managers typically use SmartSize™ to generate alternative coverage scenarios with different salesforce sizes, and then use additional judgmental criteria to select among the scenarios.

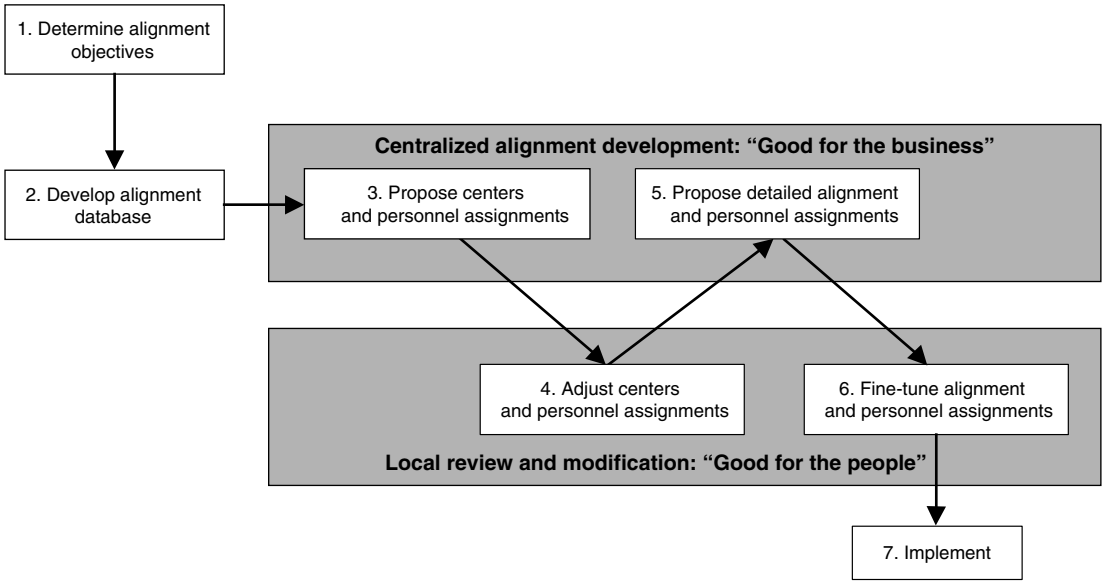
6.3. MAPS®—Manpower Allocation and Planning System

MAPS® was the first territory design system on a personal computer, created and used in early 1982 on the Apple II+ computer. At that time, data for one sales district consisting of 500 to 1,000 zip codes and 10 territories was loaded onto the computer and MAPS® had the ability to visualize the territories on a very basic map using proximal zip code shapes. MAPS® also enabled the alignment designer to change territories by moving zip codes between territories using a joystick. The alignment designer could assess the impact of the changes for all sales territories in the district using additive alignment criteria such as customer workload and sales potential.

MAPS® migrated to the new IBM personal computer platform in late 1982 and has continuously evolved as challenges and opportunities have arisen. MAPS® today incorporates the following key capabilities:

- Map sales territories based on account locations or geographic shapes such as zip codes;

Figure 8 A Process for Realignment—Centralized Alignment Development with Local Review



- Evaluate sales territories on criteria such as customer counts, workload, potential, profitability, and disruption;
- Change territories and assess the impact of the changes on key alignment criteria;
- Compare alignment scenarios on key measures;
- Predict the coverage implications of any alignment (coverage is defined as the percentage of targeted accounts that will actually be covered by the salesforce);
- Print reports and maps to familiarize salespeople with their new coverage responsibilities;
- Provide these capabilities stand-alone or using a Web browser.

Designed for alignment and not just mapping, the system is able to handle generalist (or geographic) salesforces as well as more complex selling structures such as vertical selling teams, mirrored salesforces, and specialty overlay salesforces. The system inherently understands constructs such as management levels, team selling, disruption, and customer coverage ratios.

6.4. A Process That Works: Central Alignments with Local Adjustment

We have found that the best process for developing implementable sales territory alignments uses a combination of centralized and decentralized activities. The centralized activities produce an overall alignment that is "good for the company." Alignment optimizers or alignment experts using objective data develop these alignments. A consistent logic for determining staffing locations across the entire country is employed. The centralized alignment is based on quantifiable measures against which any changes can be evaluated. Field sales managers participate in the decentralized activities. They provide judgment and information on local conditions to ensure that the alignment is "good for the salespeople and customers." The process of incorporating local input not only improves the alignment but also facilitates acceptance of realignments by the entire sales organization.

Figure 8 illustrates a seven-step process for realignment. In Step 1, alignment goals such as "distribute workload equitably" and "do not allow disruption to exceed 20%" are specified.

In Step 2, a database is developed. The database usually includes customer and prospect locations, travel time data and alignment attributes such as market potential, sales, and workload. In Step 3, proposed sales territory headquarter locations are determined centrally, based on business needs. A headquarter location is the city or area from which the territory will be based. This is also called the territory "center." For larger salesforces with several management levels, centers for sales regions and districts are determined as well. This analysis defines where each member of the salesforce should be located in order to cover the market effectively. It is important to determine the best salesforce locations first, before creating territories. Although some of our systems such as SmartSize™ simultaneously determine territory locations and the territories themselves, an implementation process that first improves and socializes the locations with a sales management team can save a great deal of effort downstream. Preliminary personnel assignments are made at this time as well. This gives management a preview of where to start hiring salespeople and managers (if an expansion is

planned), who stays with the salesforce (if a downsizing is anticipated), or who needs to relocate (if several salesforces merge and are integrated). In Step 4, the sales management team audits and adjusts the sales territory centers and personnel assignments. In small salesforces, the leader of the salesforce performs this task, while in larger salesforces a group takes on the task. Alignment acceptance is enhanced when this group includes multiple management levels, such as regional or divisional sales directors and district managers. In Step 5, the territory alignment is developed centrally. Territories are grouped into regions or districts depending upon the sales management structure. Also, the proposed personnel assignments are adjusted once again, since the specific geography and account assignments for each territory are now known. In Step 6, the alignments and personnel assignments are audited and finalized once again with the help of the sales management team.

The input of first-line sales managers is critical at this point in the process. Since these managers oversee the salespeople directly, they are intimately familiar with the needs of local markets and sales personnel. Their input facilitates a smooth implementation of the new alignment in Step 7 of the process.

The process illustrated in Figure 8 facilitates successful implementation of alignment changes. The process builds an alignment that is "good for the business" because the central activity defines consistent, objective alignment criteria that support the company's strategic goals for the salesforce. It also ensures that sales resources are distributed appropriately across the nation. At the same time, the process builds an alignment that is "good for the people" because the input of local management is a fundamental part of the process.

The human resources director at a large pharmaceutical firm summarized the value of salesforce buy-in during a recent realignment: "A lot of people don't realize this, but after an alignment, most of the dirty work ends up in my office. After we aligned poorly five years ago, I received almost 1,000 complaints from the field force. We did it right two years ago. I received only two complaints. We had a minimum of disruption, relocations, and turnover." In another instance, a district sales manager said, "My input was taken into account. Management didn't just give me an alignment and say 'go work it'."

6.5. Role of the Three Components in Typical Alignment Projects

The optimization tools SmartAlign™ and SmartSize™ are typically used when companies create new salesforces or when there are significant salesforce size or structure changes. When the degree of change is small or localized, or when the alignment criteria are not well quantified, the MAPS® system is typically used by alignment experts to design sales territories. Even when optimization algorithms are used, the solutions are always reviewed and polished by alignment experts, and then usually by field managers as well.

7. The Pharmacia Salesforce Integration and Sales Territory Alignment Implementation

In June 2001 Pharmacia had 4,300 salespeople and over $6 billion in annual sales. Products included the category-leading billion dollar brands Celebrex® (Now Pfizer, Inc., New York, NY) for arthritis, Detrol® (Now Pfizer, Inc., New York, NY) for overactive bladders, and Ambien® (Sanofi-Synthelabo, Paris, France) for sleep disorders. Several significant new product launches were planned starting in late 2001. Pharmacia was the union of three organizations: Pharmacia, Upjohn, and Searle. Upjohn was the first to be merged while Searle was a recent acquisition. The selling organizations for Pharmacia and Upjohn had been integrated earlier, but the Searle and the Pharmacia (post-Upjohn) sales teams had been left mostly intact after their merger so that sales would not be jeopardized while the new organization found its legs.

Table 4 shows the sales team sizes for the primary care salesforces before their integration in June 2001. These salesforces focused primarily on office-based general practitioners, family practice physicians, internal medicine specialists, and community hospitals. Additional salesforces covered select physician specialties, hospitals, and managed care organizations, bringing the combined total size of the salesforce to 4,300 salespeople and approximately 500 sales managers. Even though the headquarters organizations had merged, the sales teams were largely operating separately, while sharing some products. Product sharing or co-promotion is common in the pharmaceutical industry. Multiple selling teams will detail the same product to physicians thus increasing the

Table 4 Pharmacia Primary Care Salesforce Structure and Size in June 2001

Before realignment	
Sales team	Size
Searle 1	482
Searle 2	482
Searle 3	466
Upjohn 1	550
Upjohn 2	550
Pharmacia 1	275
Pharmacia 2	275

frequency of product mentions. To be effective, co-promotions require that multiple salespeople coordinate their activities at the physician level.

The Searle territory alignments did not match well with the Upjohn and Pharmacia salesforce alignments. We calculated that, due to the different territory definitions, salespeople in any of the salesforces needed to interface with an average of 8.2 salespeople from the other primary care or specialty sales teams to coordinate product co-promotions. To complicate things even further, a marketing agreement with Pfizer on a key product, Celebrex®, made it necessary to coordinate activities with several Pfizer selling teams as well. "Project Genesis" was launched in June 2001 to integrate the sales organizations into a cohesive structure.

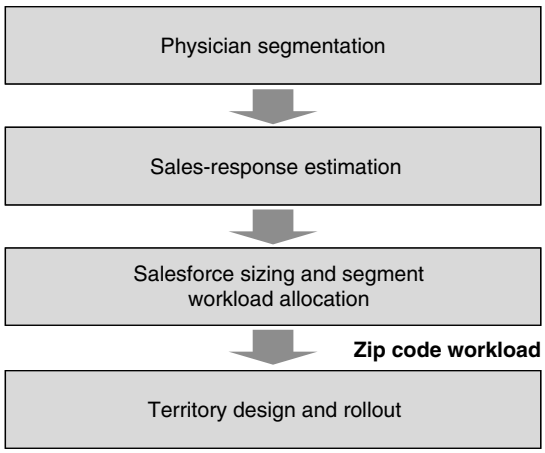
The objectives of Project Genesis were to enhance co-promotion coordination by reducing the number of inter-salesperson interactions required, streamline management coordination across selling teams, increase salesforce capacity slightly, and improve the alignment, which was not balanced on workload. Most sales teams had been operating with the same salesforce alignment for four years, even though the product line had evolved. Figure 9 shows the four-step process used in Project Genesis.

Each of the four steps is described below.

7.1. Physician Segmentation

Pharmacia was able to assemble monthly salesforce call data and prescription data at the physician level for its own products, as well as prescription data for all competitive products in the categories in which Pharmacia competed. Using this data, physicians were segmented along key dimensions for each product. The core segmentation dimensions were: physician specialty, product category usage (total market volume), and market share. In addition to these core dimensions, other segmentation criteria were uncovered by brainstorming with brand teams about product strategy and market dynamics. For example, in one situation where a Pharmacia brand was vulnerable to a recent competitive launch, the share of the recently launched product was used as a segmentation dimension because it caused sales response differences and influenced how Pharmacia intended to shape its message.

Figure 9 Project Steps



7.2. Sales-Response Estimation

Sales-response estimation was done in two steps. In the first step, historical data was used to estimate the historical impact of salesforce effort on sales by segment for each product. In the second step, product and market experts used the historically derived response estimates and other insights on future market conditions to estimate the future sales response using a decision-calculus methodology (Little 1970). Because of the level of detail in the data and the confidence that the team had in the estimation of sales response for most products, the statistically estimated responses were very close to what formed the final input into the resource allocation model. For new products, the estimation was mostly judgmental.

Appendix I describes the sales-response estimation methodology in more detail.

7.3. Salesforce Sizing and Segment Workload Allocation

The response functions served as an input into the objective function of an optimization model that maximized long-term profitability for the Pharmacia portfolio by optimally allocating effort to products and customer segments. The model was run for different salesforce structures and sizes to help the senior management team select the most appropriate structure and size for implementation.

Appendix II describes the resource-allocation model in more detail.

Table 5 shows the final size of the Pharmacia salesforces. Pharmacia decided to mirror all salesforces so that all salesforces had identical sales territory designs with a size of 550, which was the original Upjohn

Table 5 Salesforce Team Sizes Before and After the Alignment

Before realignment			After realignment	
Sales team	Size		Sales team	Size
Searle 1	482		Pharmacia 1	550
Searle 2	482	→	Pharmacia 2	550
Searle 3	466		Pharmacia 3	550
Upjohn 1	550		Pharmacia 4	550
Upjohn 2	550		Pharmacia 5	550
Pharmacia 1	275		Pharmacia 6	550
Pharmacia 2	275			

salesforce size. This had several advantages. First, it was hoped that the territories of at least two teams would not change drastically. Second, the increase in sizes of the other teams provided sufficient extra capacity for all the products in the portfolio. Mirroring the sales territories would enhance coordination across the sales teams. Sales managers were also mirrored, ensuring management coordination.

7.4. Territory Design and Rollout

The segment call effort levels or "workloads" from the sizing and sales allocation model were applied to over 100,000 individual physicians in the United States, aggregated to the zip code level, and then served as an input into the sales territory optimization model. The SmartAlign™ algorithm described in §6 was used to develop the Pharmacia alignment.

The optimized alignments were rolled out to the 500 managers in five cities over a two-week period and involved 75 alignment consultants who assisted sales managers one-on-one using MAPS® to match salespeople to territories and to assess and fine-tune the alignments. Web-based tools were used after the face-to-face meetings to continue the fine-tuning. Maps and reports were generated for every salesperson and manager to help them understand and visualize their new responsibilities.

Through the realignment, the average number of salespeople that any salesperson needed to coordinate activities with internally was reduced from 8.2 to 5 as all six teams were deemed to have identical territory configurations. Customer disruption, or the percent of customer-salesperson relationships that were changed, was limited to a manageable 28%. Rick Keefer has seen the ZS alignment systems from the perspective of a Zone Vice President at Wyeth Laboratories, then as Vice President of Sales for Pharmacia, where he headed the 4,300-person sales organization. Here are some of his comments:

> "Fantastic results . . . it was done rapidly, it created buy-in and it produced significant results for the organization."

> "The Pharmacia alignment took four months from start to finish including making the decision to restructure. It would have been six months or more without the models and process from ZS."

8. Biovail, GlaxoSmithKline, Ethicon Endosurgery, and Allergan Implementations

8.1. Biovail

Biovail had a generalist salesforce of 535 salespeople covering the United States. The initial geographic deployment of the salesforce had evolved with good coverage of the Eastern United States but poor coverage of the Western United States. Of the 535 territories, over 300 had either too much or too little workload. The project objective was to match the opportunities across the United States with the deployment of salespeople and to increase focus on cardiologists and dermatologists. The new structure had 475 generalist salespeople and two specialist teams of 60 salespeople each. The starting point for a generalist alignment was created using SmartAlign™, and the specialist alignments were created using SmartSize™. There was a significant geographic shift of resources. For example, the number of salespeople in California was increased fourfold.

Meetings were held with all sales managers in two locations, Princeton, New Jersey and Evanston, Illinois, at which managers reviewed and adapted the optimized alignments and prepared for implementation. The new alignment was put in place on April 1, 2004.

After leaving Pharmacia, Rick Keefer joined Biovail Corporation as the head of sales and marketing. Here are some of his comments:

> "People are waiting to know what the alignment is, and are sometimes wondering if they have a job. The quicker you can do this, the better."

> "The process involves the district manager and creates buy-in. When the district manager has the final sign-off on the alignment, you get a tremendous sense of ownership of the new alignment."

8.2. GlaxoSmithKline Implementations: 1984–Present

Glaxo Inc. began using ZS and the MAPS® system for sales territory alignments in 1984. Over the last twenty years Glaxo has used evolving versions of the ZS alignment tools while their salesforces have grown from 280 salespeople to over 8,000 salespeople. Every salesforce creation, expansion, restructuring, and merger has been assisted by the use of MAPS® for sales territory design. In 1985 Glaxo Inc. used the software for the first big expansion of the single Glaxo Inc. salesforce of approximately 280 territories. Since then, MAPS® has been used for major expansions of the salesforce in 1988, 1990, 1992, 1993, and 1995. There have also been two major mergers of salesforces: Glaxo Inc. and Burroughs Wellcome in 1995, and again in 2000 when Glaxo Wellcome merged with SmithKlineBeecham to form GlaxoSmithKline (GSK). The MAPS® software made the merging of these salesforces very efficient, with as little disruption to the existing sales relationships as possible.

GSK now has ten different salesforces with over 8,000 sales representatives, all of whose sales territories were created, balanced, and are managed using MAPS®.

During the first eleven years of using MAPS®, when GSK needed to expand or restructure its salesforce, district managers and regional directors traveled to Evanston, Illinois, where they worked one-on-one with ZS consultants to fine-tune and balance their territories. The ZS consultants had excellent knowledge of the geographies and were key participants in helping managers create the best territories possible.

After 1995, GSK's expertise using the software increased and GSK was able to internalize the process. When realignments were necessary, GSK managers would travel to central locations where GSK's own staff would serve as MAPS® consultants while working with managers to build and balance the territories. Over a thousand district managers and regional directors have worked with the software to develop their territories and districts.

Kevin Geraghty has worked with MAPS® in different capacities over the past twenty years. He managed the first Territory Operations department at Glaxo Inc. He was responsible for the first purchase of MAPS® for DOS in 1984. For the next eight years his team was responsible for working with ZS on all of Glaxo Inc.'s alignment projects. After taking on different responsibilities at GSK, he was often called back to work as an alignment facilitator whenever GSK had an expansion, realignment, or merger. Three years ago he returned to the Territory Operations department where he again became a main user of the MAPS® system. Here is his comment:

> "MAPS® continues to be invaluable to the corporation, helping us ensure we create the best possible territories. Since the cost of putting a representative in a territory is the largest marketing expense, it is imperative that we have territories that are designed with efficiency in mind to minimize windshield time while ensuring the territories are well balanced based on workload, sales potential, travel time, and disruption."

8.3. Ethicon Endo-Surgery Implementation

Ethicon Endo-Surgery (EES) has used the ZS alignment process and MAPS® alignment system on a number of occasions, most recently in 2003 on the heels of a salesforce reorganization that increased the size of the salesforce and realigned a generalist salesforce into two separate product-focused specialty forces. The size of the resulting selling organization exceeded 350, with over 50 first-line sales managers.

The EES alignment project went well beyond laying out geographic territory boundaries. A significant size and structure change required many additional decisions including the assignment of salespeople to each of the sales teams and territories, decisions on relocation, and the appointment of new first- and second-line sales managers. As a result, over 400 people had their workspace redefined.

The EES salesforce redesign process had two major steps. First, models helped determine the best size and structure for the selling organization with input from both the sales and marketing organizations. Sales-response models were used to determine profit-maximizing workload measures for each market segment that EES sold to. These workload metrics were then applied to the individual accounts that comprised EES's market. The workload measures were combined with other account and demographic data to develop an overall value that was assigned to each account. These metrics as well as the account's geographic location were inputs into the alignment system.

A multi-step implementation process was used. First, meetings were held that enabled top sales management and second-line sales managers to agree on territory locations and the high-level geographic boundaries. Initial alignments were generated using an optimization algorithm. Next, rollout meetings were conducted, one for each section of the country. First- and second-line sales managers reviewed and fine-tuned their new geographies, and also provided input for the old geography they covered before the reorganization. The process allowed sales managers to adapt the initial alignment to incorporate local considerations such as personnel assignments and rep relocations as well as specific rep-customer relationships. The sales managers finalized and took ownership of the alignments and could present the alignment and its rationale to the salesforce.

By considering territory alignment in the context of an overall go-to-market framework, EES ensured that alignment decisions were consistent with upstream strategic decisions such as segmentation, salesforce strategy, sales process design, and organization design. The alignment also provided a link to downstream decisions such as goal setting. Metrics which were developed for the alignment, such as account sales, potential, and workload were also used to establish territory-level sales goals.

These alignment tools and concepts have been used before by the EES sales staff. This was the latest application of a process that is used when new product introductions or markets shifts create the need to modify existing territory configurations.

8.4. Allergan Implementation

As Allergan's business has evolved over the last ten years, there have been several changes in salesforce size and structure including downsizing, upsizing, and the creation of new salesforces. MAPS® and the ZS alignment process have been used to design and implement sales territories throughout this period. Some of the key occasions are described below.

In 1994, the eye care division of Allergan had two salesforces totaling approximately 180 salespeople. One salesforce covered ophthalmologists, and the other salesforce covered doctors of optometry (OD's). The two salesforces were combined and downsized to approximately 130 salespeople with a single salesperson covering both ophthalmologists and OD's. Sales territories were designed using MAPS® and sales managers were involved in reviewing salesperson locations, finalizing personnel assignments, and fine-tuning territories. It was particularly important in the downsizing to maintain key salesperson-customer relationships.

In 1996, with the genericization of an Allergan product, the pediatric audience no longer needed coverage, and there was another downsizing to 100 territories. A similar process as in 1994 was used successfully to help with the territory reconfiguration.

In subsequent years, the eye care division launched several new products, deploying a second and then third team of 100 salespeople each. With each expansion, the territories were adapted for the evolving marketplace. Since then, MAPS® has been used to manage minor territory changes.

With the help of MAPS®, over the past five years, Allergan (Allergan Inc., Irvine, CA) also increased the size of its therapeutic salesforce for Botox® and created and, subsequently expanded, a cosmetic sales team that has approximately 65 salespeople today.

Rod Leird was a Regional Vice President of Sales for Allergan when he first worked with MAPS® for aligning the Allergan eye care salesforces in 1994. He was most recently involved in the expansion of the Botox® therapeutic salesforce, which he now runs. Here are some of his comments:

> "MAPS® has enabled Allergan to take a national deployment strategy and implement it at a very low level (zip code and physician) so that strategy can be executed locally."
>
> "Sales managers are involved on a real-time basis to implement local strategy changes where necessary."
>
> "Process and tools provide flexibility to adjust deployment based on local nuances in easy and quick fashion, making the process simple for sales managers."

9. Summary

The Sales Territory Alignment Problem is a difficult problem meshing combinatorial and personnel complexities. Generalizable approaches become even more difficult when the heterogeneity that exists across industries in salesforce structures, concerns, and available databases is considered. This paper highlights the more significant features of our model, system, process, and wisdom evolution spanning three decades. The high-tech, high-touch approach has resulted in over 1,500 territory alignment implementations for over 500 selling organizations, affecting over 500,000 salespeople in 39 countries driving over $500 billion in revenues. Conservatively, these implementations have increased aggregate revenues over $10 billion for these firms and have saved 14,500 salesperson-equivalents in travel-time reduction in the first year of the realignment implementation.

Appendix I. Estimation of Sales Response

The historical sales response model was estimated by first aggregating physicians into segments for each product by physician specialty, market volume, prior-year product market share, and other product-specific segmentation dimensions within each physician segment. Physicians were further aggregated by the annual product detailing (product mention) frequency that they received. Five to ten detailing intervals were defined depending upon the product. Detailing was measured in terms of primary detailing-equivalents. One to three products are usually detailed on each call to a physician. A priori weights were used to convert second- and third-position details to first-position detail-equivalents. The weights were typically derived from the proportion of time the company wanted the rep to spend on each product. The average primary detailing-equivalents and the average market share change were calculated for each physician detailing-bucket. These averages became the data for the regression model used to estimate the response to detailing effort. Competitive detailing data was not available at the physician level. Figure 10 illustrates how the data was aggregated prior to running the regression model.

The following data is available for each physician segment:

Independent variables	Segment identifier • Prior-year market share • Market volume • Physician specialty • Other characteristics (varies by product) Primary detailing-equivalents • Average detailing in each detailing interval
Dependent variable	Change in market share • Average annual change in market share across all the physicians who fall into the segment defined by the segment identifiers and the detailing interval

The following basic share model was estimated for each product and segment:

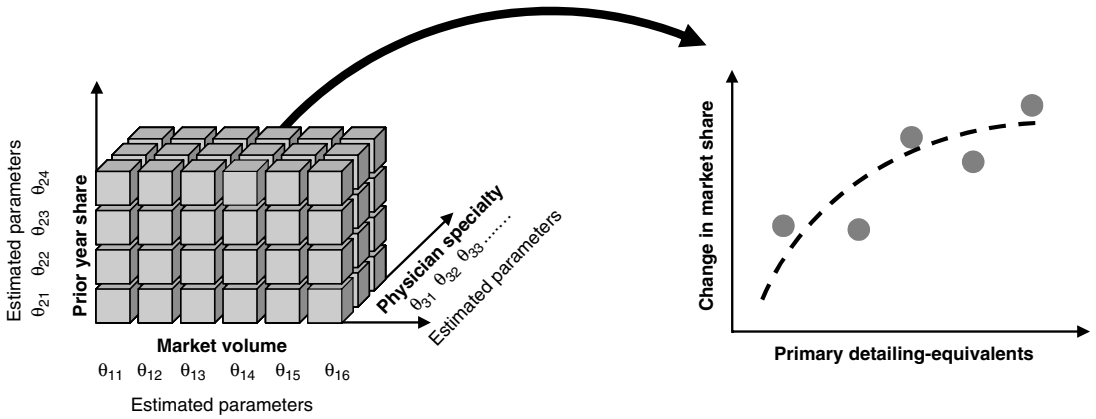
$$\text{Change in Share} = \beta_0 + \sum_i \sum_{j \in S_i} \theta_{ij}\delta_{ij} \cdot \log(\text{Primary Detailing Equivalents} + 1) + \varepsilon,$$

where

β_0 is a constant term,

$i = 1, 2, \ldots, p$ is the index for each segmentation dimension (e.g., physician specialty, market volume),

Figure 10 Aggregation and Estimation Dimensions for Sales-Response Model Estimation



$j \in S_i$ is the set of levels within segment i,

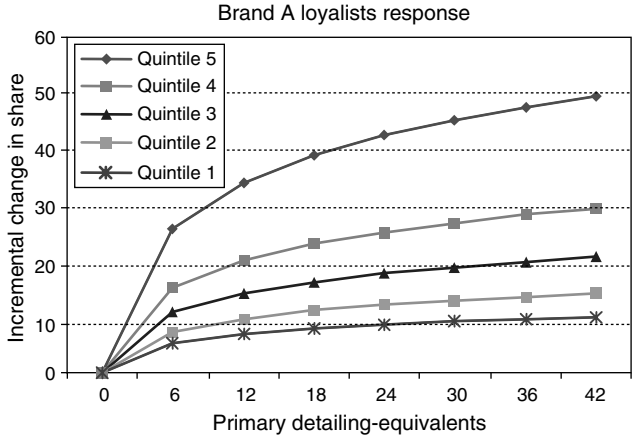
θ_{ij} is the coefficient for level j of market segmentation variable i,

δ_{ij} is a dummy variable which is 1 if the data is from segment i, level j and 0 otherwise.

A single integrated model was run for all segments for each product. This formulation tends to require minimal smoothing as all the data points are used to estimate each segment's response function. In other instances, we have also estimated the model separately for each segment, and then applied some smoothing heuristics. The model can also be run at the individual physician level. However, experience suggests that the results obtained by the Pharmacia-type aggregation are similar to the other methods. Also, the aggregated data is easier for an analyst to visualize and manipulate so as to find the best family of models in any given situation. The typical R^2 for these models is between 0.5 and 0.85. Figure 11 illustrates sales-response functions for five segments for one product. Quintile 5 consists of physicians in the top 20% in terms of market potential; quintile 4 consists of physicians in the next 20%, and so on.

In the second step, managerial judgment was used to adjust the historically derived sales-response function for two reasons. First, each product/segment sales-response function was evaluated for reasonableness. Some typical tests for reasonableness are: Are the coefficients of the right sign? Does the responsiveness vary as expected in favorable versus unfavorable segments? When the number of physicians in each segment is large, the coefficients overwhelmingly have the expected characteristics. When the number of segments is so large that the number of physicians in each segment becomes small, the coefficients begin to behave erratically. Some response functions needed adjustment. Second, sales and marketing managers also adjusted these functions judgmentally when lifecycle effects, product extension launches, and events such as competitive launches and price changes rendered the incumbent function inappropriate.

Figure 11 Examples of Sales-Response Functions for Quintiles of Loyalists for One Brand



The segmentation and sales-response estimation was done separately for each product, but the optimization model needs a common segmentation for physicians across the entire detailed product line. Physicians were re-segmented using the metrics that defined their current product-specific segment memberships. A clustering algorithm accomplished the new segmentation. An example of a derived segment is: (High Product A Market Share, Large Product A Market, High Product B Market Share, Large Product B Market). Since the new clusters contain physicians that resided in different product-specific segments, an average sales response to sales effort was calculated for use in the workload allocation model.

Appendix II. Pharmacia Resource Allocation Model

Sales-response functions were combined with product margins, salesforce costs, and other data to formulate the following selling resource allocation optimization model for any salesforce team-sizing strategy over time.

$$\text{Maximize} \quad \sum_{tpc} w_c f_{tcp}\left(\sum_r \beta_r \sum_k \alpha_k y_{trcpk}\right) - \sum_{trpk} h_{trpk} \sum_c y_{trcpk} - \sum_{tr} C_{tr} z_{tr}$$

subject to:

$$\text{(i)} \quad \sum_c w_c \sum_p y_{trcp(k=1)} \le z_{tr} S_{tr} \quad \text{for each } t,\ r,$$

$$\text{(ii)}\quad \sum_k y_{trcpk} \le \sum_p y_{trcp(k=1)} \quad \text{for each } t,\ r,\ c,\ p,$$

$$\text{(iii)}\quad \sum_p y_{trcp(k+1)} \le \sum_p y_{trcpk} \quad \text{for each } t,\ r,\ c,\ k > 0,$$

$$\text{(iv)}\quad l_{pt} \le \sum_c w_c \sum_{rk} \alpha_k y_{trcpk} \le u_{pt} \quad \text{for each } p,\ t,$$

$$\text{(v)}\quad \sum_{rp} y_{trcp(k=1)} \le m_{tc} \quad \text{for each } t,\ c,$$

$$\text{(vi)}\quad y_{trcpk} \ge 0 \quad \text{for each } t,\ r,\ c,\ p,\ k,$$

$$\text{(vii)}\quad z_{tr}^{+} \ge z_{tr} \ge z_{tr}^{-} \quad \text{for each } t,\ r,$$

where

t is the index for time (years: usually three to five years are used in these models),

p is the index for the products,

c is the index for the physician segments,

r is the index for the sales teams,

k is the index for the product priority position in a call,

z_{tr} is a decision variable that captures the number of salespeople on team r in year t,

y_{trcpk} is the decision variable that captures the number of times product p is mentioned in position k to segment c by team r in year t,

w_c is the number of physicians in segment c,

β_r is relative effectiveness of sales team r,

α_k is the weight that converts details into primary detailing-equivalents,

$f_{tcp}(.)$ is the average physician profit response function for each time period-segment-product combination. It includes carryover to three to five future years,

h_{trpk} is the variable cost of a detail of a product to a physician and includes samples, publications and other marketing collateral,

C_{tr} is the fixed cost of a sales rep (salary, bonus, benefits, marketing materials, administration costs, etc.) on team r in year t,

S_{tr} is the call capacity of sales team r in year t.

Constraint set (i) ensures that the effort allocated does not exceed sales team capacity in each of the years.

Constraint set (ii) ensures that the number of product mentions to a customer segment does not exceed the number of calls to that segment. $\sum_p y_{trcp(k=1)}$ is the number of calls on segment c by team r in year t since a first position detail ($k = 1$) will be made on every call.

Constraint set (iii) ensures the number of product mentions in first position are at least as many as the number of product mentions in second position, and so forth.

Constraint set (iv) sets lower (l_{pt}) and upper (u_{pt}) bounds on the effort against products in each year.

Constraint set (v) can set an upper limit (m_{tc}) on the call frequency to any physician segment in any year.

Constraints (vii) ensure that the optimized team sizes assume values that can be implemented.

In most instances, we model the objective function as a concave function of effort. This permits the objective function to be expressed as a piecewise linear function. We typically linearize the function into six to twelve segments, with the break points determined by what is implementable. For example, Pharmacia divided the year into four planning cycles, and a salesperson was expected to visit a physician either zero, one, or two or three times in each cycle. With three salespeople promoting a product, possible visit frequencies were 0, 4, 8, 12, 16, 20, 24, 28, 32, or 36 times in a year. The problem can then be solved using a linear programming algorithm. Otherwise when S-shaped response functions are used, the problem can be solved using a mixed integer programming algorithm.

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