

The Actuary As Product Manager In A Dynamic Product Analysis Environment

By Richard Stein

ABSTRACT

The financial performance of P&C insurance products are vulnerable to a variety of complex social, economic, legal, and operational forces. Unfortunately, traditional ratemaking methods do not fully capture these dynamic elements of the insurance system. Insurers who develop advanced pricing techniques can better anticipate these dynamic issues and thereby enjoy competitive advantage. This paper addresses how an actuary can develop rates in recognition of these dynamics and play a leading role in the management of the insurance product.

This paper presents concepts regarding dynamic ratemaking, which, compared to traditional pricing, is more comprehensive, utilizes more advanced technology, and more fully addresses company operations and insurance market issues. The Dynamic Product Analysis (DPA) model is introduced as a means for driving the exhaustive product review required by dynamic ratemaking. This paper also describes the Product Management concept and recommends its application to insurance products. DPA and product management are complementary systems which can optimize the scope of the pricing analysis and capitalize on its conclusions in order to direct insurance products. It is argued that the actuary assume the role of product manager and thus take responsibility for managing the operational and financial facets of the product.

The product management team creates the DPA model by evaluating, and making hypotheses about, a range of product issues and environmental forces. The data required in this model is wider in scope and more detailed than that used by traditional pricing methods. There is a reluctance to merely use historical averages for making projections; instead, underlying distributions are to be evaluated to identify meaningful patterns or unanticipated correlations. DPA also specifies continuous analysis of the company's operational systems and expenses.

As product manager, the actuary leads the effort to build the DPA model, develop strategies, execute business plans, and provide hands-on leadership. In this environment, the actuary's role is expanded beyond the narrow boundaries of traditional ratemaking.

BIOGRAPHY

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INTRODUCTION

Casualty actuarial science has developed a variety of ratemaking methodologies designed to determine appropriate insurance rate levels and to create equitable rating plans. However, these traditional approaches have serious limitations. As static methods, they are unable to direct ratemaking strategies because they fail to model all the costs and systems associated with the sale of the insurance product. A more realistic pricing method would model the complexities associated with a competitive insurance market, the company's internal operations, and the range of exposures and risk environments to be insured. These considerations are dynamic in nature because they are constantly in flux as they react to other elements of the insurance system.

In order to price an insurance product so that these issues may be recognized, the actuary must develop a dynamic ratemaking system which anticipates real-world complexity. Of course, the creation of such a sophisticated and comprehensive system would be a test of his craftsmanship, passion, technical ability, and vision. However advanced this model, it would be of limited use if it did not become an integral part of managing the insurance product. The pricing actuary's goal should not be limited to crafting new ratemaking methodologies, but also to providing a framework for comprehensive product analysis, and contributing to strategic development and business planning decisions. This paradigm represents an evolution of the actuary's business role and culminates in suggesting that the actuary take the lead in managing the insurance product.

In this paper, I focus primarily on the management structures and organizational issues associated with building a dynamic pricing model. Because of this emphasis on business considerations, I provide only an overview of the mechanics and ingredients involved in developing these models. Since many of the practices described here are to be applied to analyses which are company- and product-specific, this paper focuses on general processes and does not involve actual data or the development of formulas. As a result, my use of the term "model" generally indicates the use of paradigms, constructs, and systems. My hope is that any issues not included in this paper may be addressed by current casualty actuarial practice, actuarial literature, or from other papers which may appear in this volume.

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DYNAMIC RATEMAKING

The goal of ratemaking is the development of insurance rates which will adequately cover all of the future loss costs, expenses, contingency loads, and profit requirements associated with a particular insurance product. The resulting rates should not be excessive, inadequate, or unfairly discriminatory for any individual exposure. The CAS's "Statement of Principles Regarding Property and Casualty Insurance Ratemaking" lists 18 considerations to employ in

the course of ratemaking work. While the ratemaking goal is ambitious and the CAS considerations are comprehensive, neither directs the use of specific pricing methods nor provides a litmus test against which to grade the quality of the pricing analysis.

Dynamic Processes

Actuarial pricing methodology generally consists of a collection of forecasting methods, simple economic models, and trend analyses. The factors, ratios, and averages which result are used to generate rates which promote the various financial, operational, and strategic needs of the insurance enterprise.

As theoretically precise as these rates may be, they are tested by the realities of the marketplace, in which macroeconomic, competitive, demographic, and regulatory forces challenge even the most realistic and robust business plans. As a participant in product design and with responsibility for rate adequacy, the actuary must strive to anticipate the effects of these dynamics on the performance of the insurance product.

Dynamic Financial Analysis practitioners also contend with this level of uncertainty. As D'Arcy, et al, point out "dynamic" signifies "active, energetic, forceful," themes which reflect the realities of the insurance environment. These conditions indicate a stochastic or variable model, rather than fixed or static. Given the complexity and comprehensive nature of their task -- to estimate the risk of insolvency for an insurance company -- DFA models are designed to address the dynamics associated with correlations, feedback loops, multi-departmental activities, economic cycles, and all balance sheet items.

Defining dynamical systems as reflecting change, intricacy, and uncertainty helps capture the difficulties facing the pricing actuary. However, there is a field of dynamics which involves more technical analysis. Engineers and scientists use the dynamic paradigm for their work in systems analysis, chaos and complexity theory, and non-linear dynamics. If pursued by the actuary, these areas may provide opportunities to gain greater understanding regarding how to model the dynamics of the insurance system.

An Evaluation of Traditional Ratemaking Techniques

Actuarial science has traditionally pursued the ratemaking ideal by developing simple, but functional, pricing methods. These techniques generally call for a variety of historical premium, exposure, and claims data, allow for the utilization of supplemental industry and competitor information, and rely upon a series of assumptions regarding future development and trends. In using these approaches, however, actuaries limit themselves in four basic ways.

First of all, actuaries tend to rely on historical averages, rarely presuppose correlations between rating variables, and limit themselves to data whose level of detail allows for only one-dimensional rating plan analyses. For instance, a constant rating factor which is applied in all ratemaking calculations implies that the relationship of product costs does not vary under any combination of rating variables. The assumptions underlying these linear models are overly simplistic since they ignore the interplay of exposure issues and the complexity of valuing the claim profiles of insureds.

Secondly, these traditional pricing methods overlook changes in the internal business environment and oversimplify fundamental market economic forces. Some of the issues which should be modeled include: risk selection, changes in the nature of the exposure environment,

demographic and economic trends, internal company operations and processes, a comprehensive accounting of all the expenses, and the segmentation and volatility of the insurance market. By not explicitly addressing the dynamic forces and processes which affect the financial performance of the insurance product, these pricing methods unrealistically posit the existence of an equilibrating or steady-state insurance environment.

Although consideration of qualitative, operational, procedural issues are recommended in the actuarial literature, sensitivity to these issues is difficult to incorporate into practice using traditional methods. In addition, aside from an overall profit margin, the rates produced by these methods may not support the company's other financial goals, such as cash flow, leverage targets and IRIS ratios, and capital accumulation. Other financial issues may also be modeled insufficiently, such as budgeting, investments, cost accounting, and reinsurance.

A third problem with traditional ratemaking is that although the accuracy of pricing forecasts is essential for product profitability, the fact is, actuarial literature on forecasting is rudimentary. [Cummins and Derrig, p. 429] One symptom of this problem is that pricing practice rarely includes a formal feedback loop for assessing the performance of the ratemaking model. As a result, actuaries may not even be aware of the biases and oversimplifications of the pricing models they use.

Finally, traditional models are simple in part because the information technology which was available when these methods were developed was very basic. Mainframe terminals and primitive spreadsheets did not allow for the level of analysis associated with a dynamic ratemaking model. Today, however, data warehouses, industry databases, and electronic communications make available a variety of comprehensive computer-readable data sources while artificial intelligence, sophisticated statistical packages, simulation software, and modeling applications provide the means to extract and evaluate worthwhile information. The actuary's task is then to develop sophisticated pricing models which harness the power of these advanced tools.

This is not to say that traditional ratemaking methods do not serve a worthwhile purpose. When the insurance market and economic conditions are stable and company processes undergo only moderate change, these models probably produce sound results. In addition, they are simple to use and to explain to upper management and field personnel. Even in more volatile circumstances, it may be that these pricing approaches constitute a legitimate start for building a dynamic business model. However, steps should be taken to make the model more realistic through identifying dynamic forces and adding greater detail to the analysis.

Practical Dynamic Pricing Considerations

The ideals suggested by the goals, methods, and discipline associated with dynamic analysis may be more formal or complicated than can reasonably be expected of an individual run-of-the-mill ratemaking analysis, at least initially. However, if insurance pricing processes are at least sensitive to these concepts and ideals, they will provide a vision of what may be expected of a fully dynamic ratemaking system.

There are several fundamentals which an actuary should consider when developing a dynamic pricing system. These issues embody the spirit and lessons of the dynamic concept. While these issues have been recognized by actuarial science, traditional ratemaking methodology does not currently provide techniques for specifically accounting for them. Employing these considerations may lead to implementing changes to a pricing system's information flows and

decision rules. The most important issue is that dynamic pricing strategies such as these give an insurer an advantage in pricing its products competitively in worthwhile markets and in otherwise “skimming the cream.”

- There may be direct and indirect correlations between a wide variety of exposure and rating variables. The rating plans associated with these variables measure relative differences in pure premium among insureds. If developed and applied linearly and non-dynamically, without regard for these conditional probabilities, the exposure differentials arising from the rating plans may be exaggerated, understated, or otherwise distorted. In addition, the loss costs associated with particular sets of insureds can only be understood with respect to (or as a function of) the company’s underwriting and marketing strategies. As a result, efforts should be made to include these issues in the model.
- There are many forces external to the insurance company -- economic trends, demographic shifts, the agendas of independent agents, the activities of competitors, and the expectations and price sensitivity of the insurance market -- which affect the premium volume and profitability of the product. Not only should these forces be identified in the development of insurance rates, it should be recognized that most of them will change in response to pricing actions taken by the insurance company. These reactions may take many forms, are often complex and nonlinear, are unpredictable in magnitude and form, and may not take place immediately.
- Quantitative measures such as underwriting expenses, loss adjustment expenses, and the magnitude of loss development are all affected by the nature of internal company operations. As a result of changes in technology, economic conditions, and management practice, it is likely that using historical averages to estimate expenses and loss development may be an oversimplification. Significant effort must be expended to identify how the internal and external environments have changed over time, in order to bridge the gap between historical data and future coverage periods. This perspective devalues the predictive value of past results in even a moderately changing insurance environment.
- Managerial policies affect and perpetuate dynamic behavior. Often these company measures are implemented in reaction to company and environmental variations, which are themselves dynamic. The intent of these policies is to mitigate undesirable deviations and capitalize on beneficial variations. However, managerial interventions may not produce the expected effects -- instead, these policies may be based on incorrect assumptions, may conflict with or counteract other measures taken at the company, may be incorrectly calibrated in terms of the power of the corrective action, or may be ill-timed due to implementation lags or the delay before the policy (fully) takes effect. Compounding the dynamics of internal variations and external shocks with those arising from these management activities result in a complex dynamic system which will elicit a variety of other dynamic reactions in response.
- The mathematics used in developing the dynamic rate system must be sophisticated and ambitious. The pricing analysis should not be limited to linear relationships and discrete numbers. Secondly, in recognition of the interrelation of the rating and exposure variables, conditional probability distributions should be used. Finally, it is not enough to use the central expectations of these distributions; higher moments and the shape of the probability curve are also important to analyze.

Lissack (p. 24) recognizes that “under diminishing returns, static analysis is sufficient: the outcome is unique, insensitive to the order in which choices are made, and insensitive to small

events that occur.” On the other hand, a dynamic pricing system is careful in its attempts to quantify internal company activities, interactions among rating variables, and external market reactions to company conduct. There are several miscellaneous but important methodological issues which should be considered in the development and use of a dynamic ratemaking model:

- In order to model a system’s behavior, the pricing actuary must seek an understanding regarding why it behaves as it does. This involves trying to identify its internal processes and testing assumptions and conclusions against actual dynamic behavior. Consistent with this idea, the actuary should take care that no methods or software be employed without careful consideration of the inputs, the methodology, and the applicability of the outputs.
- The actuary must recognize that all insurance statistics -- ratios, factors, and amounts -- are random variables and that the underlying parameters of the distributions which describe them are likely to be in flux. This suggests that the actuary should occasionally review fundamental pricing relationships, models, and assumptions in great depth.
- Single parameter models distort the complexity of the business. No variable exists whose parameters can change without affecting other business considerations. This, however, is the case with static rating plans which are utilized with the assumption that they can adequately capture significant exposure issues one-dimensionally.
- Continuous classifications better reflect differences in loss costs than do discrete numbers of territories, classes, or vehicle codes. For instance, continuous age rating factors or continuous (longitudinal and latitudinal) territory models promise more precision in evaluating loss costs. Products priced using this approach should also be less susceptible to adverse selection.
- Data quality is fundamental to a dynamic pricing analysis since data is the lifeblood of actuarial-based ratemaking. Quality in this case transcends the absence of coding errors or internal inconsistencies. It refers to the suitability of the data, the associated level of detail, and the flexibility of queries. In addition, consideration should be given to many aspects of the input process, the familiarity of input technicians with the data system, the purpose of collecting the data, process stoppages and backups, differences in data field definitions, incentives for bypassing the system’s design, and the use of default values. All these impact the credibility of the data. As a result, the role of internal auditing is important in evaluating the accuracy of both quantitative and categorical data.
- As important as insurance statistics and measurements are for actuaries and financial managers, it must be recognized that these numbers are generated by a wide variety of operational systems and processes which are driven by qualitative, relational, and categorical standards, in addition to quantitative measures.
- Actuaries must recognize the limitations of using the premium ratio metaphor, under which they determine how a hypothetical dollar of premium would be split between losses, expenses, and underwriting profit. This model ignores the real world effects of, and reactions to, nontrivial changes in premium volume.

As an example, consider the effects of a direct insurer’s decision to increase its share of a particular market. All things being equal, as premium volume increases, the following may occur:

- The commission and acquisition expense ratio is likely to rise if a sales incentive system is in place

- Greater efficiencies and economies of scale will lead to lower ratios for loss adjustment and underwriting expenses
- The contingency margin requirements, as a ratio to premium, may be relaxed
- Looser underwriting guidelines lead to higher loss ratios
- Sharp increases in acquisition expenses and unearned premium reserves will put pressure on policyholder surplus
- If more reinsurance coverage is required, the expected net results could be worse than the gross.

It remains to be seen whether underwriting profits would improve under these conditions. Of course, it is the actuary's role to determine the extent to which "all things being equal" applies. Although not traditionally the actuary's function, consideration should be given to other effects of increased market share -- competitor reactions, greater customer service demands, financial results and ratios, regulatory scrutiny -- and whether these responses are consistent with the company's strategies and plan.

In order to capture these elements, a dynamic ratemaking system may utilize an extensive amount of detailed data, a variety of qualitative information, sophisticated expense allocations, an increase in the number of rating plan classifications, and significant computer power and artificial intelligence algorithms.

In addition to these considerations, there are other issues distinguishing how dynamic ratemaking differs from traditional ratemaking. In order to capture the requisite complexity of the insurance system, dynamic ratemaking also incorporates more considerations and expands the number of issues which should be evaluated in the ratemaking process. A more sophisticated dynamic model requires a more intense and comprehensive ratemaking analysis in which issues are explored at a deeper level while also covering a wider scope of topics. As a result, more data must be explored at a greater level of detail. In addition, nontraditional and qualitative information must be incorporated in the model to allow for more informed judgment and a more global model. Ultimately, all aspects of insurance enterprise must be considered for inclusion in the dynamic pricing model.

Example: Applying Dynamic Sensitivities to the Development of a Rate Level Indication

The insurance company relies on the ratemaking actuary to maintain the profitability of the insurance product. This involves determining the appropriate overall rate change and allocating this indication within each rating plan. The traditional approach to this process ignores many of the dynamic considerations discussed thus far. Appendix A presents a series of exhibits in which a Rate Level Indication is developed for private passenger auto using traditional methods. In order to illustrate the application of dynamic considerations to ratemaking, a variety of questions are raised throughout this process.

Applying Dynamic Ratemaking

The dynamic sensitivities outlined above may be applied to practically any line of business or coverage, for virtually any risk-retaining entity. Those organizations with large volumes of data, a wide variety of supplementary information, sophisticated statistical tools, and considerable computer resources will find that implementing these concepts is straight-forward, if multi-faceted. Entities without these resources will also be able to apply dynamic sensitivities to their ratemaking processes. However, the actuaries for these organizations should concentrate their efforts on analyzing industry data, internal operational studies, and theoretical economic models, and applying their conclusions by making adjustments to the

data, pricing formulas, or results (via actuarial judgment).

This process is as time-consuming, laborious, and comprehensive as the actuary wants to make it. As long as their selection is not terribly biased, the identification of any dynamic system structures or loops and the inclusion of any models of these processes will only improve the precision of the insurance company's rates.

The next two main sections of this paper address more sophisticated organizational models for promoting dynamic pricing ideals. If, however, these new approaches are too ambitious for the actuary to implement, the material discussed so far constitutes a useful call to action for the typical pricing actuary.

DYNAMIC PRODUCT ANALYSIS

Dynamic ratemaking expands the scope of the pricing function to require consideration of a comprehensive set of insurance product costing issues. A system is required in which the interplay of an insurance product's design, operations, market position, growth, customer service, and financial results may be exhaustively modeled and evaluated. Such a system can provide a bridge between the traditionally narrow scope of ratemaking work and more global corporate financial and operational activities, such as planning and strategic analyses. The system proposed here to play this function is the Dynamic Product Analysis (DPA) model.

Not only is the DPA paradigm geared towards coordinating dynamic ratemaking, it provides a mechanism for exploring all aspects of the insurance product, building an extensive model, developing strategy, and creating a business plan. This broad scope requires eschewing traditional departmental roles for a more centralized and comprehensive analysis. DPA is intended to be a tool through which nontraditional variables and qualitative inputs may be integrated into the pricing process. Expanding the analysis in this way is required in order to develop a ratemaking procedure for anticipating changes between historical and prospective periods. Finally, the DPA model explicitly refers to the product as the basis of the ratemaking analysis, which constitutes a shift from pricing individual coverages to recognizing (if not developing) product costs on a policyholder level, in anticipation of market dynamics and economic trends.

While traditional ratemaking and simple dynamic ratemaking may provide basic methodologies which may be utilized industrywide, the parameters and form taken on by a particular DPA model are likely to be company- and product-specific. This is the price of gaining the precision which accompanies sensitivity to company operations, local market dynamics, and individual product identity.

Defining the Insurance Product

Traditionally, an insurance product has been defined as a monoline coverage or service provided to customers, or a package of coverages or services offered under one contract. Within a line of business, it is common to further define the product geographically. However, for the purposes of Dynamic Product Analysis, management has significant discretion in determining what constitutes a product. For instance, in the case of auto insurance, the product could be limited to particular territory-coverage-driver classification combinations. Other nontraditional approaches to identifying products may involve subdividing a single line of business (to recognize different geographic markets within a single state for auto insurance), targeting a specific demographic for several lines of business (targeting Baby Boomers for all

personal insurance), focusing on a specialty within a profession for Professional Liability (General practitioners for Medical Malpractice), or specifying particular industries for Products Liability. Other divisions may be defined by distribution channels or groups of insurance agents.

By identifying these groups of insureds as individual products, this paper is not recommending that statutorily defined lines of business should be ignored for financial reporting purposes nor that the company unfairly discriminate against particular markets. Nor is the credibility of statistical data to be ignored. Rather, the product convention is meant to provide a means to identify a particular market with the intention that this market will be treated with a well-defined and unique set of assumptions and strategies by more than one of the insurance company's functional areas. Once established, a particular product may be targeted for growth, more sophisticated ratemaking analysis, stricter underwriting, or termination.

Determining what constitutes a product requires a balance of the level of precision attained by developing very specific rates and operating systems for tightly defined markets, versus the strategic benefits and efficiencies associated with utilizing more loosely defined parameters.

Credibility Issues

DPA is likely to result in the analysis of smaller subdivisions of data than those evaluated under traditional ratemaking methods. First of all, DPA emphasizes potentially narrowly-defined individual products. More importantly, dynamic pricing techniques are likely to be applied to a series of small, homogeneous groups of data. The scope of these activities obviously poses credibility concerns.

However, credibility is a function not only of the volume of data available, but also of its homogeneity, integrity, and relevance. Because the goal of DPA is to identify patterns in the data and adequately evaluate the operational and external environments, it is sensitive to all of the credibility issues associated with data. Unfortunately, commonly used credibility models do not include consideration of all these issues in pricing work. DPA practitioners will need to consider how to develop appropriate credibility measures.

The Role of the Actuary in the DPA System

As a DPA practitioner, the actuary can expect his role to change. By using the insurance product as the base, the actuary is able to look at the subject of the ratemaking analysis more holistically, as an interrelated association of coverages, exposures, and contracts; policies, markets, and demographics; services provided and expense streams; workflows and operational processes; and financial ratios and benchmarks. It enables the actuary to adopt different perspectives for his pricing work -- for instance, those associated with the public (insureds, claimants), business partners (brokers, vendors), field operations (sales force, claims adjusters), the home office (marketing, underwriting), corporate functions (human resources, information systems), and upper management (finance, strategy, planning).

The philosophy behind the DPA paradigm is that product decisions cannot be made without an awareness of business conditions. The results of the DPA work should be a foundation for comprehensive analysis, strategy development, and business planning for the insurance product.

This presentation of the DPA model is an invitation for the actuary to explore the complexity of the insurance system. The ambitious goals for DPA represent an incredible challenge for the

actuary. In addition to marshaling a comprehensive set of technical skills, information resources, and advanced technology in creating the model, the pricing practitioner must also call upon his passion, vision, and craftsmanship.

How the DPA Model Compares to Dynamic Financial Analysis

It may be easier to describe Dynamic Product Analysis in terms of a model whose concepts will be more familiar to the actuarial reader, Dynamic Financial Analysis (DFA).

DPA is similar to DFA in that both provide global views of an insurance company's book of business. Both systems focus on describing the dynamic interplay of a multitude of insurance processes, particularly with respect to evaluating the risks associated with the insurance enterprise. They readily acknowledge the prospective nature of most insurance contracts and the financial vulnerability to changes in the economy, the exposure environment, loss trends, regulations, and demographics. In fact, the intricacies of these contingencies require dynamic paradigms and necessitate models which are actuarial in nature. Both systems recognize the impact of pricing, underwriting, and business planning to insurance company profitability, and model the response of regulators and rating agencies to the company's financial results.

The recognition of pricing and business planning issues in the development of a comprehensive DFA model have resulted in very extensive lists of considerations. As indicated above, the DPA model is more a set of techniques and attitudes. Both approaches contribute to the actuarial arsenal by promoting approaches for analyzing the dynamics of the exposure environments and financial issues faced by insurance companies.

A few of the differences between these two systems follow. Of course, since both models are still in the process of being developed, this comparison is not final by any means.

1. Purpose

DFA strives to assess how an insurer would be affected by specific economic conditions. DFA models are to be used to recognize companywide financial relationships so that an insurer may select strategies which minimize the risk of insolvency.

On the other hand, DPA focuses on gaining competitive advantage for specific insurance products. It is governed by a market-driven philosophy that seeks to incorporate large volumes of data, in-depth analysis, and innovation to reach strategic product goals. DPA has a proactive flavor which is predicated on the idea that the insurance environment is rapidly changing and requires aggressive analysis. These changes should be recognized in the creation and maintenance of insurance products, rather than being merely identified and commented on. In this way, the DPA system challenges the actuary to increase participation on the product side.

2. Operational Focus

DPA was created to provide a comprehensive, actuarial view of direct insurance products upon which prospective strategies could be based. As such, DPA has an operational focus, in addition to a financial agenda. While DFA encourages actuaries to accept the role of "financial risk manager" [CAS DFA Handbook, cover memorandum], DPA would more likely challenge them to take on the role of "product (risk quantification) manager" and thereby attend to those operational considerations which drive profitability and product success.

DFA was developed primarily in response to the impact of such recent financial issues as interest rate volatility, the development of new capital markets, more frequent and severe catastrophes, surplus notes, demutualization, the CIGNA reorganization, investment performance, new econometric measures, the international flavor of insurance, and mergers and consolidation within the industry. In his discussion of DFA's goals and history, Garven concurs with this emphasis on financial issues. While DPA has a basic interest in such financial trends, it is less sensitive to some of these newly emerging insurance issues since it emphasizes traditional fundamentals such as product design, expense issues, and competitive forces.

DPA is to be applied to individual products. On the other hand, DFA is more likely to address corporate-level financial issues such as solvency, revenue streams and cash flows, balance sheet items, and monetary trends. Again, while these are significant issues, DPA is more likely to focus on operational measures such as the combined ratio, premium growth, expenses, and the policyholder portfolio.

3. The State of Actuarial Knowledge

Both DFA and DPA look to actuaries to lead in the evaluation of insurance systems. However, DFA's focus is to build an extensive financial model which represents a new application of traditional actuarial sensitivities. On the other hand, DPA challenges traditional actuarial ratemaking methodology to become more sophisticated, dynamic, and general before it is comprehensive enough to be extended to productwide issues.

DFA looks to apply actuarial approaches more widely to new tasks; DPA seeks to deepen the sophistication of common actuarial practice. DFA assumes that actuaries already have the knowledge to opine on operational issues while DPA challenges them to increase their know-how in order to develop the specific tools which are appropriate for each individual task.

Stated another way, the DFA actuary seeks to simplify a range of issues so complex that they have not fallen within the actuary's set of responsibilities. Under DPA, the actuary is challenged to add layers of complexity to traditionally simple ratemaking models.

4. Universality

The DPA model is opposed to the facile use of historical or industry averages for forecasting future financial results. Because DPA recognizes operational issues specific to an insurance company, there is less interest in employing industry statistics. This same sensitivity makes it unlikely that a single DPA model could be created for the entire insurance industry.

On the other hand, DFA is considered much less company-specific. In fact, consulting firms are developing DFA models to be marketed widely to insurance companies. Although these models will utilize company data, their construction is likely to reflect industry averages and common structural themes among insurers.

5. Quantitative Issues

DPA attempts to systematize what we know, what can be measured, what can be tracked, and what is beyond us. As will be explained later, it calls on the use of a series of hypotheses to explain trends and changes in insurance statistics, rather than relying on averages and fitted lines.

DFA employs scenario testing, stochastic simulation, and sensitivity analysis in order to assess the financial impact of various outcomes. None of these methods are specifically prescribed by DPA. DPA is less likely to evaluate the likelihood of acceptable outcomes. Simulation may not be appropriate for DPA since not all relationships are numeric and statistical, and much of the model reflects both qualitative and quantitative issues which are company- and local-market specific. However, DPA may be used to evaluate a limited number of scenarios in order to assess the extent to which each may promote business strategies and targets.

6. The Role of the Actuary

The biggest differences between the roles prescribed for the actuary by DFA and DPA are attributable to several of the issues already discussed. DFA directs actuaries to become financial managers who evaluate the big picture by working with comprehensive actuarial models. DPA places actuaries in the trenches, working with individual insurance products, assessing mundane operational issues and market details, and contributing to strategic development and the product plan.

The skills required for a DPA actuary include a wide variety of general business knowledge and greater statistical and computer skills. Meanwhile, the DFA practitioner is likely to become more specialized and gain in financial know-how.

Given their differences in purpose and emphasis, these systems should not be seen as competitors. Instead, under some instances the DPA approach could perhaps be used as the pricing module of a DFA model.

Applying DPA

The actuary's transition to DPA work is marked less by the acquisition of new technical skills as by the adoption of new attitudes. The DPA actuary is still a pricing actuary, but one whose conclusions are more meaningful to upper management. While DPA does require a product focus, this is no different than the scope of projects which pricing actuaries typically work on.

DPA requires that the actuary avail himself of the non-statistical information which pervades all insurance companies. By listening to these issues, the actuary will be able to identify information which may supplement, or necessitate the replacement of, his ratemaking formulas and models. Some actuaries may see this information as poisoning the purity of actuarial practice. However, actuaries must remind themselves: straight data-driven methodologies are not pure or precise; instead, they just feature an unbiased ignorance of real-world issues facing the insurance product.

Adopting DPA may be done incrementally, on projects which are of the greatest interest. It requires no change in reporting structure nor the purchase of special software. It does require that pricing actuaries broaden their communication with operational functions and field offices.

The general knowledge and broad set of responsibilities required of the actuary by the DPA system are of limited value without a sufficient level of communication and integration among insurance company functions. This level of coordination will enable the ratemaking process to not only comprehensively capture the essential product issues, but also to play a role in explaining and anticipating them. Therefore, it is in a product management environment that the DPA model may be most effective in producing comprehensive product pricing analyses

and meaningfully contributing to strategic development and business planning.

PRODUCT MANAGEMENT

Ratemaking need not be practiced dispassionately. In addition to the traditional actuarial focus on issues such as consistency and accuracy, there are wider company agendas to which pricing methods may contribute. These include premium growth, the avoidance of adverse selection, product differentiation, productivity, competitive advantage, and profitability. There is a passion to these ideals which reflect the best aspects and most invigorating feelings associated with operating in a free market economy -- market domination, innovation, quickness to market, outpacing the competition, wealth.

These issues are strategic and not particularly quantitative. However, because they embody the spirit and goals of management, they need to somehow be captured as decision-making policies in the dynamic system's controller sector. In order to strive towards this state of affairs, the organizational structure must accede to a system which can actualize both the dynamics of the insurance system and the comprehensive scope of Dynamic Product Analysis. The Product Management concept fits that description.

The Concept of Product Management

Product management describes a system in which all aspects of a single product are managed centrally, usually by an individual manager. This product manager leads a product management team which coordinates a comprehensive set of development and lifecycle issues for the product. These product activities include design and implementation, pricing, sales and distribution, market research, product positioning and advertising, budgeting and financial analysis, planning and strategy, innovation, and customer service.

The product management paradigm was developed in the 1930s by Proctor & Gamble in order to increase the market share of its consumer package goods products. This system, which is also known as brand management, is employed in the service industry as well as manufacturing, and by government agencies and non-profit organizations.

The organizations which benefit the most from a product management system are those which

1. Derive their operating profits and cash flow from competitive products
2. Offer a variety of products which vary in terms of their strategic importance to the company
3. Must coordinate corporate activities across functions and locations in order to maintain and manage their products
4. Require a multi-disciplinary approach to managing markets or technology
5. Want to balance a variety of operational capabilities, strategic goals, regulatory mandates, and market realities in the management of the product
6. Strive to avoid inter-functional competition, short-term departmental crises, periodic sales manipulation, and widespread miscommunication
7. Seek to manage product markets by tracking and anticipating competitor responses to technological change, user needs, market dynamics, and operational productivity
8. Require skillful product differentiation and market segmentation
9. Maintain international operations, distribute products globally, or compete against multinational companies
10. Want to improve the productivity of their knowledge workers by better coordination of information, planning, technology, and effort. [Handscombe]

Every insurance company features at least several of these items in their relationship with their products. Larger, international insurers may find that all ten characteristics apply.

The Product

One of the most fundamental aspects of the product management system is its focus on individual products. The product is identified as having strategic meaning worthy of significant resources, widespread corporate attention, and dedicated management personnel. In consumer goods, the product is usually defined as a tangible brand which services a specific set of consumer requirements. Of course, the product may also be defined as a service, such as risk financing and third-party administration in the case of the insurance industry.

While these definitions correspond to the consumer's needs or perspective, the product may also be identified by the company as a set of brands, line of business, or distribution channels. In addition, the product may be defined based on the identification of individual market segments; under such a customer franchise management approach, the focus may be on particular geographical areas or targeted demographics.

The important issue is not the identity of the product but how corporate goals may be met. In the product management system, the definition of the product merely recommends a specific internal organization and management structure which will optimally support these efforts.

Coordination of Effort

The product management system's focus on the individual product (no matter how it may be defined) simplifies the coordination of a wide range of product-based activities. It allows management to concentrate on long-term product issues in order to manage the product's lifespan. This perspective is necessary if, over time, the same management team is to coordinate a variety of product activities: developing the new product, bringing it to market, maintaining it as a mature product, and managing the rollout of product upgrades or enhancements.

Alignment of product activities enables the management team to aggressively monitor product performance. The product management system focuses on developing a proactive, dynamic, customer-driven management team. This team focuses on both operational and financial performance, and engenders better internal alignment and communication, while sidestepping turf and political issues.

Coordinated product management plays a significant role in managing market share and product placement issues. The team's concentrated attention supports market segment management and engenders an acute sensitivity to market conditions. In addition, this system allows for quicker responsiveness to consumer needs and the marshaling of activities quickly, purposefully, and efficiently in response to changes in market conditions.

The product management team serves as a clearinghouse of all product activities. These include planning, production, finance, operations, design, human resources, marketing, pricing, and customer relations. This coordination results in a well-articulated strategic purpose, coordination of operational and financial responsibilities, and full management support for the product.

The Product Manager's Role

One of the most important features of the product management system is the existence of dedicated management personnel who champion all aspects of the product. In most industries, these professionals are typically led by an individual product manager who has a background in, and reports to, the Marketing department.

The product management system is designed to support a cadre of capable product champions who maintain a steady and proactive focus on the individual product. Product managers are responsible for coordinating home office, field, and international product activities; encouraging practical, integrative, and strategic solutions to business problems; and engendering a profit-, customer-, and opportunity-oriented management culture. It is believed that the dedication of specific managers to particular products is essential for the development of breakthroughs in product competitiveness, quality, customer satisfaction, and profitability.

In addition to more efficiently providing resources to the company's individual products and markets, the product management system also develops a cohort of capable, experienced managers. When they are later called on to assume new corporate roles -- as general managers, regional officers, department heads, change agents, or task force leaders -- they will have developed the skills required to lead market-savvy activities, coordinate the efforts of a variety of departments, develop strategy, and perform planning activities.

Each company has to determine the corporate support, organizational structures, and resources to be made available to its product management practitioners. In general, the product manager has a high degree of responsibility for ensuring that product goals are met. Product managers differ in authority, knowledge, and experience from organization to organization. They may be assigned primarily administrative tasks -- which focus on operational activities, report generation, and maintaining basic communication -- or may play a leadership role which requires a more dynamic, future-oriented, big picture mindset. In addition, their titles may vary; these professionals may also be called "product group manager," "brand manager," or "product market manager." However, whether they work alone or with a handful of assistants, they must exhibit the leadership skills necessary for motivating the activities of personnel employed throughout their companies.

Product managers are most effective when they have been appointed by upper management, are accepted companywide, and can call on a wide range of resources in the conduct of their work. In these positions, they are empowered to play the role of change agents, project coordinators, and product champions. Their dedication to a single product is essential to building and maintaining a competitive and profitable product, and allows them to be proactive and strategic on its behalf. In a low-growth, mature economy (as exists in the US), only companies with product managers directing their products can consistently identify ways to grow profitably.

How Product Management is Employed in Banking

In banking, product managers are responsible for particular markets which may be defined as specific types of loans, services, or customers. The scope of their duties will generally include pricing, sales strategy, new product design, marketing R&D, planning, and coordination with operational and administrative groups. They are judged on how well they guide their products to market and capture market share. Individual product managers may report to a group product manager, who in turn reports to the head of product management or marketing. In other organizations, product management is a specialized, centralized function which is

leveraged through several branches who may each have some discretion to adjust the financial products for the specifics of the local market. All told, the product management function is designed to feed the bank's business strategy and management system. [Franzoni]

Applying Product Management to P&C Insurance

Product management is an organizational structure which is very compatible to the practice of Dynamic Product Analysis. Those shifts in hierarchy and authority which accompany the implementation of a product management system will also reinforce the focus on individual insurance products, consumers, and markets. These management systems -- which may be known as "strategic business units," "account management," or "portfolio management" -- are designed to promote alignment of purpose, coordination of effort, improved communication, and integration across functions.

Applying product management to insurance explicitly recognizes that insurance products are consumer products. It is no secret that consumer expectations and sophistication have grown over time, honed by the wide range of other products which are marketed to them. In order to survive in the hypercompetitive current U.S. economy, these consumer products have had to keep prices low while maintaining or improving quality and service. As a result, product managers for these products have had to embrace the most advanced marketing, manufacturing, and management techniques. The prospects for P&C products are likely to improve when they are identified as a consumer product and once some of these state-of-the-art practices are adopted.

The product management environment also breeds a set of attitudes which are essential for superior business management, such as entrepreneurship, empowerment, cross-training, market nicheing, and aggressive competitive practices. In addition, once a product management system is adopted, insurance management will find that current business theory is more applicable to their organizations. These business concepts include flexible product development, speed-to-market, product branding, reengineered business processes, value innovation, change management, and modular functional teams. Properly applied, paradigms such as these are designed to improve the company's quality, efficiency, self-awareness, and technology integration, in addition to furthering profitability, competitiveness, and strategic focus.

In addition to these general benefits, product management can address a variety of issues challenging the P&C insurance industry. In a no-growth environment, increasing premium volume requires adding market share which in turn requires activities such as strategic pricing and market nicheing. By providing an environment for improved product costing and support for dynamic ratemaking and DPA, product management gives insurance management the tools to create more intelligent marketing decisions, implement more refined exposure selection, generate lower expense ratios, and strive towards more targeted rating plans. It can serve to bridge the gap between the local orientation and process focus of the company's field operations and the macro strategies and financial goals which are important to the home office and upper management. As a result, a connection can be established by all company functions to a variety of fundamental global issues, not only to profitability and market share, but also to issues related to cash flow, surplus, reinsurance, customer service, and rating agency evaluations. The product manager is also in a position to integrate marketing efforts through different channels -- such as, direct marketing, independent agents, and electronic commerce -- or a variety of different market segments (i.e., preferred auto, standard auto,

nonstandard auto). In addition, the product manager can coordinate company activities to lead to quicker responses to market opportunities and regulatory issues, and to speed the implementation of rate and product changes.

There are several business forces looming against which insurance companies must defend their markets and compete for growth. These include established competitors whose financial strength may be augmented in several ways -- through mergers or acquisitions, the establishment of a direct marketing arm, a presence on the internet, or demutualization. In addition, new competition arises from the development of foreign markets, a growing foreign presence in domestic markets, and from the insurance activities of banks and other financial institutions. In order to respond to this intensification of competition, insurers must marshal their resources, seek better internal alignment, and become more sensitive to consumer needs, while at the same time protecting their profit margins.

As Ramani Ayer, CEO of Hartford Financial Services, recently said, insurers should emphasize specific market segments, create the appropriate supporting systems, build their business processes around the market, focus on providing distinctive service, use technology wisely, and "build competitive organizations that can quickly capitalize on market opportunities." [Winston] To meet these business needs and pursue these strategies, a product management system may be very effective.

Planning and Strategizing for the Insurance Product

Throughout this paper, actuarial contributions to the product's strategy, planning process, and competitive advantage are discussed. Before continuing, it may be appropriate to define these terms. The article by Campbell and Alexander provides a good guide.

Planning

Plans exist to cope with the immediate needs of the corporation which require operating under a timetable and extensive documentation. Planning is all about crisp execution, sensitivity to the feedback loop, and efforts to stay "on plan." How can the company be sure that execution of its plan will result in the achievement of product performance targets?

Competitive Advantage

Every company which is either in the insurance market or planning to enter it must seek competitive advantage. Without this advantage, they cannot attract the capital, customers, suppliers, or employees required to compete. How can a company identify the missions, objectives, strategies, and tactics associated with competitive advantage and product success?

The goals of good customer service and superior returns are not appropriate missions or strategies. These are business constraints which all economic organizations operate under. Competitive advantage requires product-specific targets which recognize the unique position and possibilities of the individual product.

Mission-Objectives-Strategies-Tactics

MOST -- mission, objectives, strategies, tactics -- is an acronym used to describe the classically defined strategy-making process. First, management should choose as the mission the long-term purpose of the organization. Then the short- and mid-term objectives which will propel the organization to its mission may be determined. Strategies are developed to meet these objectives through the use of short-term operating tactics.

While mission statements can be lofty, inspiring, and ambitious (i.e., “to be the largest and most profitable personal lines insurer in all North American and European markets”), objectives, strategies, and tactics must all be grounded in reality. For instance, the insurer may develop a long list of goals to pursue in order to meet the objective. However, unless a specific strategy can be identified to optimize resources or overcome constraints, none of the objectives will be achievable. It is obvious then that both strategies and objectives are intertwined: they must be compatible and the development of neither precedes the other. In much the same way, tactics and strategies are indivisible. Strategies which provide competitive advantage depend on operational tactics and implementation.

Therefore, the advantages accruing to individual strategies and tactics are difficult to distinguish from each other, as are those associated with objectives and strategies. All of these must be developed simultaneously, within the context of others. In reality, they can be distilled to the search for strategic insights.

Insights

Generating strategic insights provides an opportunity for identifying new ways to gain competitive advantage. Management paradigms -- Total Quality Management, benchmarking, empowerment, core competency analysis -- attempt to refocus or organize business to maximize the production of strategic insights. Compared to the planning process, the tasks associated with strategy development are more amorphous and less easy to measure: brainstorming, generating insights, scenario analysis, molding cohesive strategies.

By developing hypotheses, conducting expense analysis, and discovering correlations and patterns in the data, a variety of product insights may be developed. These ideas -- which may concern insured selection, use of technology, outsourcing, human resource management, or value creation -- may provide the product with a competitive advantage.

There are three categories of techniques for developing strategic insights:

- 1) Operational - Using management paradigms (like those mentioned above) to evaluate and improve organizational process performance.
- 2) Futuristic - Gazing into the future in order to identify factors critical to future success, establish critical competencies, and mold the organization so it may attain these capabilities. Using dynamic system terminology, this approach focuses on anticipating external shocks and system instabilities. These methods include competitive strategy analysis, scenario testing, S-curves, and chaos theory applications.
- 3) Behavior & Culture - Recognizing and eliminating barriers to developing insights through the use of data-free planning, organizational learning, and creativity exercises.

DPA and product management are organizational structures whose adoption aims for the development of insights using the Operational approach of generating strategic insights, although activities associated with the Futuristic category may also be employed.

It is difficult to separate strategy from implementation. Operating managers who are to implement product strategies are an important source for strategic insights. Because they relate to tactics, implementation issues are a fundamental part of strategic development.

Given the complexity of aligning objectives, strategies, and tactics simultaneously and the

three schools of thought regarding how to generate strategic insights, managers may attempt to utilize the planning process instead of strategic development. However, this would be a serious mistake. It is essential that any company operating in a dynamic environment have a proactive strategy to optimize the prospects for product success.

Strategy

But which insights are worthwhile to pursue? It is essential to identify the driving forces -- economic, demographic, regulatory, organizational, technological, or competitive factors -- in the company's environment.

In order to identify these factors, product managers must brainstorm with their teams and develop summary hypotheses about their product's situation. There are techniques to employ for establishing causal hypotheses and reaching consensus within the team and company. [Christenson] The role of hypotheses in strategy development and model creation is discussed in the second half of this paper.

Once the driving forces are defined, strategies may be developed to address them. The dynamic aspect of this process involves ensuring that the many individual strategies which are developed in response to the different driving forces do not contradict each other nor lead to unintended consequences.

With the strategies defined, the final challenge is creating a plan that defines the resources to be expended on implementing the strategies. This is an important step because, without solid follow-through, several obstacles may arise. With his focus on the welfare of the insurance product, the product manager can drive the planning process through the minefields of inertia, politics, and miscommunication, and take action to avoid inappropriate resource allocation, prioritization issues, and conflicts between short- and long-term needs. Through the aggregate project planning tool, the product manager can line up the resources needed to execute the stream of projects that will lead each strategic insight to fruition.

While they may be involved in planning, pricing actuaries rarely contribute to establishing competitive advantage or strategic insights. Through DPA, the actuary can provide the tools and insights for generating the strategies which lead to identifying profitable customers and developing products, thereby meeting corporate objectives. Combining Dynamic Product Analysis and product management into one system simplifies the melding of objectives, strategies, and tactics, eases the search for competitive advantage and strategic insights, and improves project execution and product planning.

The Integration of Product Management with DPA

Just as the ideals and potential of dynamic ratemaking are best realized in a Dynamic Product Analysis environment, the practice of DPA is most effective under a product management system. Establishing the more general DPA paradigm allows for the analysis of a comprehensive set of issues which significantly improves the quality of the dynamic ratemaking process. In the same way, the integration of information and coordination of effort which are effected by the product management model allow for the extensive business planning, budgeting, and strategizing associated with DPA.

The product management arrangement can enable actuaries to overcome one of the basic flaws in traditional ratemaking practice: the presumption that all insurance system forces which existed historically will each play the exact same role in the prospective insurance period. Of

course, actuaries know that both external forces (competition, economic trends, demographic shifts) and company changes (integration of technology, internal reorganization, the evolution of underwriting standards, claim practices, and marketing activity) should be reflected in the ratemaking process. Unfortunately, even if the pricing actuary were inclined to complicate his pricing model by accounting for these processes, these changes and forces are not usually well-defined or quantified.

In contrast, the product management model emphasizes the measurement of all costs and vital statistics. In such an environment, additional information regarding the quantification of operational practices would be available for the actuary to include in the pricing process. Under the product management rubric, DPA can also more easily incorporate nontraditional and qualitative issues. Since the DPA model focuses on developing insurance rates which reflect all prospective product costs and business agendas, the product management environment can place the actuary at center stage in the coordination of all strategies, plans, and reorganizations.

For instance, dynamic modeling must incorporate considerations associated with product positioning and market penetration since these affect premium volume, average premium, and expenses. All of these issues are deeply affected by strategy, planning, operational effectiveness, and macroeconomic issues.

In an informational-intensive environment, the actuary can increase the scope, depth, and sophistication of the product analysis work. The actuary would assume the role of expert regarding the quantification and modeling of all insurance processes, which may include:

- quantifying significant product issues
- developing the DPA model
- using model to explain and quantify the impact of insurance forces
- forecasting for the product
- marshaling sophisticated technology and statistical models in support of product management.

In fact, the actuary is likely to play a significant role in cultivating this information. Only by completely accounting for a wide variety of considerations can the ratemaking analysis fully contribute to strategic development, business planning, budgeting, and product marketing.

Current P&C Insurance Product Management

There are plenty of professionals within the insurance industry who are de facto product managers. In general, these positions are similar in that they involve regional vice presidents and MGAs whose roles involve developing local markets by emphasizing growth and service. While their responsibilities are product-based, the sophistication and scope of their work hardly approach that of the product management system outlined above. Without a comprehensive product strategy which is driven by advanced ratemaking, information technology, and advanced product knowledge, these existing professionals are failing to optimize the prospects for their products. Instead of developing proactive strategies and sophisticated plans for product dominance, their limited resources and perspective result in being reactive, production driven, and short-term oriented.

In fact, based on recent advertisements in insurance periodicals, there are insurers advertising for candidates to fill product manager and account manager positions. However, the duties associated with these roles involve regulatory compliance and state filings; underwriting

backgrounds are required. These roles are no doubt important, but they hardly measure up to the product management responsibilities discussed in the prior sections.

However, I have become familiar with one midwestern insurance company which has long employed a product management structure exclusively. The product managers at this company coordinate (but do not have command authority over) the marketing, sales, underwriting, operations, pricing, systems, strategy, and planning functions for each line (or group of lines) of business. In this system, the product manager has a Marketing and/or Underwriting background, is located at the home office, has 5-10 years of experience, is credentialed (typically with the CPCU designation), reports to the Vice President of Marketing and Underwriting, and has a staff of three analysts. He is responsible for growth, profitability, and customer service. One product manager stated that the primary advantages of using this system include open communication, quick market response, and agent satisfaction.

Despite these advantages, this insurance company's structure does not maximize the performance of its insurance products. Optimally, there should be a sense of the entrepreneurial, innovation, skimming the cream, delivering value to insureds. However, without the in-depth analysis associated with Dynamic Product Analysis, insurance product managers (whether from marketing, underwriting, or operations) will not be able to capitalize on these possibilities. Appendix B outlines a few reasons why the marketing emphasis usually associated with product management is not appropriate for the management of P&C insurance products.

The Actuary as Product Manager

As discussed above, the role of the Product Manager is essential to the product management system. If both the DPA and product management systems may be instrumental in strengthening the financial, market, and operational performance of the insurance product, it makes sense that the actuary be selected to play the role of Product Manager.

There are several reasons why the pricing actuary is an appropriate choice to assume this position.

1. The nature of the product. The insurance product is intangible, financial, and contingent. As a result, the product manager must constantly focus on issues such as risk, probability, finance, data, and performance measures. These are all subjects with which the actuary is most fluent. In fact, no insurance professional is as familiar with the subtleties and big-picture perspective of the insurance product as the actuary.
2. Know-how. The actuary alone has the technical knowledge to perform the Product Manager role. Actuaries are the insurance company's experts regarding data issues. They have an understanding of credibility and predictability, a sensitivity to data quality and integrity, and can define meaningful operational and financial measures (and explain them in real-world terms). In addition they can work with probability distributions, correctly utilize averages and measures of central tendency, appreciate the difference between causality and correlation, and manipulate measures of variance and deviation. The product manager will have to be fluent with respect to these quantitative issues in order to drive the DPA process.
3. Mindset. The actuary has the appropriate mindset for leading a technical, evolving

process. He is well-suited to think abstractly, build models, and integrate a variety of information, which will enable him to coordinate the complexity of the DPA model. Among the most important of these traits are:

- High intelligence, in addition to mathematical skills. This includes the ability to use logic, think rigorously, and precisely define one's terms.
- Conservatism. While comfortable with the contingent nature of the insurance product, the actuary is unlikely to take unnecessary product chances or to be inappropriately optimistic and thereby risk profitability for market share. The actuary will remain focused on long-term product success, particularly as defined by upper management.
- Perfectionism and accuracy. The actuary is motivated to develop methodologies which recognize fundamental exposure and financial issues. [Patrick]

In addition, the role of Product Manager can be expected to become more important with the globalization of the business, changes in the market, the ubiquity of technology, and the explosion of information.

4. Product Experience. The traditional scope of responsibilities associated with the pricing actuary is similar to the range of issues facing the product manager. The rate structure and rate level (both of which are maintained by actuaries) are quantifications which explicitly recognize all fundamental insurance issues: risk and uncertainty, product distribution system, loss development, risk selection, expense structure, cash flow, solvency, state regulation, spread of risk, and coverage.

There are obvious parallels between the product manager's responsibility for product pricing and the actuary's. Not only must both these professionals be familiar with product costs arising from company operations, they must be well aware of the competitive environment in which these products are sold. For the actuary, this includes research into the market, the exposure environment, regulations and statutes, and the competition. As a result, actuaries typically collect information on the rate level, rate change history, growth, size, loss ratios, and ratings of each competitor.

In the rate change process, the actuary generally plays a role similar to that of a product manager who is coordinating the upgrade of a product. In addition to performing the ratemaking function, the actuary either leads or is heavily involved in activities such as training the sales force and the regional staff, filing the new rates, changing the rate manual, communication with regulators.

On the other hand, not all pricing actuaries will be interested in the Product Manager position, nor will all be qualified. For those interested in playing this role, there may be some additional skills or sensitivities to develop.

1. Operations. Product Management requires a very intimate connection with the details of the company's operational processes, a topic which the actuary may either not be knowledgeable about or interested in. It is important for the actuary to anticipate the increased ambiguity and compromise involved in working with operational and market issues, rather than just with numbers. In addition, the product manager must push each department to become more self-aware and quantitative regarding the costs, efficiencies, and contributions of each of its processes.
2. Administrative. The Product Manager will have to contend with a variety of administrative

duties which are complicated by leading one's peers and operating in a political environment.

3. Marketing Orientation. The product manager's role requires an understanding of marketing and sensitivity to market conditions. In response, the actuary would be required to shift from a focus on long-term, macro issues to short-term calendar quarter developments and day-to-day results. In addition, there are local marketing and exposure aspects to the management of P&C insurance products which suggest that the Product Management position be filled by a professional in the field -- perhaps by an underwriting manager -- rather than by an actuary.
4. Attitude. The product manager exhibits an aggressive style and entrepreneurial attitude. This may be difficult to balance with the generally conservative nature of the actuary and his activism on behalf of company solvency. In some ways, the actuary may already exhibit these traits by discrediting unworthy data and asking tough questions of company strategies and operations. While he may have played a role in the identification of new business opportunities and additional sources of data, the actuary's role has traditionally been that of the realist and as singly responsible for accounting for changing business circumstances and badly-aged data.
5. Communications. Some actuaries may need to refine their interpersonal communication skills. The product manager needs to develop and maintain a wide range of relationships, with other managers, with field professionals, and upper management. As an actuary, he may have developed the habit of speaking solely in terms of numbers and models and thereby fail to speak to other employees on their own level, according to their own needs.

These issues are more a matter of perception, self-identification, and motivation, than of talent or skill. In terms of background, knowledge, and scope, the actuary is the most appropriate professional to play the product manager position. Whether they, their peers, or upper management realize this is another issue.

If another professional is chosen to play the role of product manager, it is still essential that the actuary be designated to build and control the DPA model. No one else can fulfill this particular role as well. This position requires the technical ability, analytical skills, independence, curiosity, conservatism, and work habits exhibited by most actuaries. [Patrick]

Applying Product Management

Many of the issues associated with applying dynamic ratemaking and DPA also relate to implementing a product management system. Recognize that this process can start with one product (or region or market) and that reporting structures do not necessarily need to change. It is important to remember that the general purpose of product management -- focus on products, greater communication and coordination, market sensitivity -- are issues which are already idealized and pursued by most, if not all, insurers.

In adopting the product management approach, some organizational and methodological changes are required, particularly with respect to developing a role and career path for the product manager. The rest of this paper discusses these issues and how an actuary might go about applying the ideas associated with product management and dynamic product analysis.

ASSEMBLING THE DPA MODEL: PRODUCT MANAGEMENT IN ACTION

With the development of the DPA/product management system which integrates dynamic

ratemaking and product-based coordination, the discussion now turns to some of the issues of implementing this paradigm.

Rather than listing the components of a Dynamic Product Analysis model or detailing its structure, this paper recognizes that it cannot do justice to the vastness and intricacies of these topics. The development of the DFA model has addressed many of these issues -- as will other submissions to this Discussion Paper Program. Other issues are effectively covered by the fields of accounting, finance, management science, economics, and statistics. As a result, several topics which are fundamental to the development of the DPA model are not addressed here. Among these are financial (cost accounting, investments, taxation, financial statement, finance activities), modeling (stochastic modeling, systems dynamics, forecasting methods, macroeconomic models, programming issues, credibility, data quality, heuristics, econometrics, causality-correlation-coincidence), and business issues (strategic development, business planning, regulatory issues, project management, defining the product, quality management, competitive analysis, market research, specific critical performance measures).

The exclusion of these topics from the discussion are meant in no way to deny their importance to the creation of the DPA model. Instead, the following comments were selected for inclusion here because the author has either formulated ideas regarding them or has found some material which sheds light on them. The following discussion focuses on systematic and implementation issues, and perspectives to consider in building the model. Specific approaches are recommended with regard to selecting variables, utilizing data sources and elements, organizing the product management team, employing technological resources, and recognizing operational issues.

The discussions below covers the following general topics concerning the building and implementation of the DPA model:

1. The Product Management Team / Assembling The Model
2. Data and Information
3. Operations Analysis
4. The Hypothesis Paradigm
5. Accounting & Expense Issues
6. Analytical Tools
7. Maintaining the DPA Model

The Product Management Team / Assembling The Model

The Product Management Team

The most essential element of the product management system is the functioning of a capable product management team whose members contribute to the process of a variety of product issues and processes. As product manager, the actuary must harness the abilities and resources of these contributors. The composition of this team will vary from company to company. However, it is essential that these managers have the experience, know-how, and stamina to contribute to a long-term process in building a very complicated model. Because much of the success in developing a sophisticated DPA model rests on organizational resources which foster communication, coordination, commitment, and problem-solving, the capabilities of this management team -- as individuals and as a unit -- is essential to the success of the product.

In determining the membership and dynamics of the product management team, consideration

should first be given to the output of the DPA model. There are two primary products to be generated by the management team. The product plan is created for a comprehensive set of product management activities. As noted before, these include forecasting, budgeting, and variance analysis. Strategy is another result of the product management team's work. Strategic considerations drive issues such as the definition of the product, its goals, and its competitive advantages. Conclusions from the DPA process lead to the identification of insights into the insurance system's functioning, which in turn feed the product's strategy and tactics. Combined with the corporate objectives as understood by the product management team, the result is a product plan which integrates a variety of expectations and measurements.

The model will be used for a variety of management and financial activities, including planning, strategy, budgeting, operations analysis, net present value analysis and investment decisions, marketing, and ratemaking. In order to be accurate and flexible enough to accommodate these disparate uses, the DPA model must be built after reviewing issues arising from a variety of considerations, such as pricing, profitability, product performance, expenses, strategy, operations, marketing, underwriting, claims, staffing, external forces, reinsurance, and the economy. These all need to be successfully modeled to ensure that the business plan is workable, avoids faulty assumptions, and anticipates all issues dynamically.

With these aggressive goals for the model, each of the members of the product management team must have a variety of skills and talents. These include solid business and financial skills, an extensive background in insurance, creativity, purposefulness, familiarity with the vocabulary of technology and information systems, and a sensitivity to data quality and credibility.

The product management team should include a directorate composed of managers from different departments and functions who may provide a wide variety of perspectives. Full time participants will come from operational departments such as Underwriting, Pricing, Claims, and Marketing. Field professional will also participate on a regular basis, providing insight on local company-specific issues, such as operations, processing, and staffing topics, and on external issues, such as changes in exposure, laws, regulations, and competitors. These regional representatives (who live in the markets they serve and may participate in local professional and social organizations) are likely to provide a raft of qualitative data regarding population shifts, competitor rate filings, or what the word on the street is.

In addition to these regular product management team members, there are other professional who may be able to provide information to the group on a part-time basis. These include support personnel from Human Resources, Accounting, Systems, and Legal. For instance, human resource personnel can present issues to the team regarding employee costs, training opportunities, or the state of the job market, all of which are important in planning for operational departments. Similarly, a representative from the Legal department can serve an important role by identifying emerging issues of liability, reviewing insurance contracts, and discussing the speed of courts in disposing of cases.

Other producers of information are likely to be scattered throughout the company: people in line positions, those who are in direct contact with customers, and business partners. This category includes agents, adjusters, underwriters, programmers, and customer service professionals. These people are in the best position to identify new strategic opportunities and tactics; as a result, they are an important supplement to a process which otherwise may reflect

only centralized and technological tendencies. Being open to the information these professionals can provide requires that the lines of communication be kept open throughout the organization. This is one aspect of the cultural changes which accompany the implementation of a product management system at an insurance company.

The product management team may often have a need to cast their net wide for information and input. As a result, the company may wish to have a variety of outside experts -- consultants, accountants, academics -- whose brains it wants to pick regarding economics, involuntary markets, population trends, advanced technical matters, etc. In addition to their expert status, these outsiders play an important role because they do not share the in-bred mindset which may pervade a company whose managers have worked together for a long time, have not been employed elsewhere, and who do not avail themselves of outside information through seminars, periodicals, and industry groups.

Designing the DPA Model

The DPA model must be designed before it can be built. The design team is to identify the needs of those who will maintain, expand, and utilize the system for product management activities. As a result, it is likely to be composed of members of the product management team, in addition to various managers and professionals who will either provide feedback to the model or utilize it for developing projections. The design team should be lead by a pricing actuary, whether he is the Product Manager or not, and include all operational managers and regional representatives.

Building the DPA model is a technically demanding pursuit which requires converting the needs and wants identified by the design team into system blueprints and hardware and software requirements. Actuaries, strategic planners, and information technology professionals are responsible for designing the system's infrastructure. This includes providing for the information requirements, communication needs, and participation levels of the end-users. They must weigh a variety of considerations in drawing up the final requirements: cost, flexibility, ease of use, speed, security, remote access. Of course, programmers are needed to actually implement the system. As the Product Manager, the actuary has a enhanced set of responsibilities for managing the progress of the endeavor.

Because the goal of this process is a set of projections of the future, it must be recognized that there is much that is unknown and that this is not a quick or simple process. However, if departmental managers know the business, they should have a set of working hypotheses about the realities of the market and their own company's operations. A manager who does not have a basic knowledge of the business or an awareness of business conditions is ill-equipped to serve in a planning role. This also recognizes that an actuary can only perform as a Product Manager if he has a high level of awareness of his company's business environment.

In his article, Ian McKechnie outlines some steps to take in preparing for building a model:

- Provide historical data to limit the amount of work required to attain a context for the data
- Data should be adjusted to reflect current conditions, not historical circumstances
- Provide supplemental data for context
- Attend to the infrastructure: provide training and instructions, test software used for the model, anticipate variations in hardware, institutionalize a help function
- Know how the model results will be used
- Focus on developing a business plan, not a numerical projection

- Beware of institutional bias. [McKechnie, p.49]

The Building Process

The business plan will no doubt start off by projecting a continuation of historical results. Start with some basic variables through which the product plan may be modeled. These should include modules reflecting the amounts and timing of basic insurance processes: premium production, investments, loss payments, expenses, reinsurance, and financial ratios.

It is unrealistic to expect that a comprehensive DPA model be developed on the first effort. Instead, the actuary is encouraged to start simply and the build model up with successful layers of sophistication. One way is to identify management's product goals and strategies before determining the focus of the modeling process.

Despite earlier comments against the use of historical averages, these are the best place to start for parameter estimates. In addition, although insurance costs should be explored multidimensionally by the pricing actuary in order to build an optimal model, this is admittedly a very difficult way to initiate the analysis. A one- or two-dimensional analysis may be an appropriate start as long as the variance and skewness statistics are evaluated in order to determine if a more sophisticated analysis is warranted.

The basic model should reflect universal insurance formulas, such as: loss ratio, the calculation of frequency and severity statistics, the recognition of commission expenses, the use of IRIS ratios, etc. It is easiest to start the business plan with estimates for revenue. Thereafter, select ratios or factors to use whenever possible since they represent links between concepts and statistics and ensure the model's internal consistency.

After the current model is judged to make sense, add to it until it covers all fundamental areas. Then build in more detail and undertake to recognize dynamic relationships. As these dynamic relationships are discovered, the fundamentals of the model which were established in earlier versions may change. As the model matures, selected parameters and formulas will become integral parts of the model. In addition, different parts of the model will develop at different rates based on the product strategies and objectives. Because of these model-specific issues (product objectives, hard-coded parameters, dynamic relationships), it is unlikely that an universal DPA model could be developed for all insurers.

Selecting the model's parameters will enable the actuary to convert future expectations into the product's business plan. This involves the coordination of assumptions and hypotheses about the past, present, and future. Then historical results can be recast and future expectations proposed.

The Product Manager's Responsibilities

Among the most important of the Product Manager's responsibilities is leading various groups of employees, including the product management team and the DPA Design team. In directing these teams, the product manager must facilitate and elicit perspectives regarding internal processes, environmental conditions, product strategies, and the structure of the model. These meetings will focus on a range of historical and prospective time periods; require the use of ratios, financial measures, and other statistics; and are very data- and information-intensive. It goes without saying that these meetings involve an incredible level of detail and consume an considerable amount of time.

In his work with these teams, there are many obstacles with which the actuary must contend:

- The teams should be composed of a variety of professionals who work with the product. Some of these will work in the home office, but many will not. It is likely that many of these members will be spread out countrywide. Because local conditions are essential elements to capture in these models, all efforts must be made to eliminate geographical barriers to anyone's participation.
- The product manager is likely to be leading teams composed of his former peers. This situation, if not handled well, may lead to awkward moments, passive aggressive behavior, or outright insubordination.
- Managers serving on the product management team will often have responsibility for operational areas, such as claims, underwriting, marketing, or pricing. If poor results develop, these managers may not be able to objectively assess the situation and make appropriate product changes. Instead, they may try to evade blame, protect their people, and point fingers at other managers.
- With managers coming from different functions and with different backgrounds, it may be difficult to reconcile different visions. Even the most experienced, objective, and intelligent professionals can disagree on historical facts, evaluations of subtle performance issues, market and economic trends, investment decisions, and the details of multiyear projections. As the leader, the product manager will have to be able to deal with these group dynamics and build consensus.
- There may be problems concerning the ability or dedication of the people on these teams to rise to the expected performance level. Some of the biggest issues may be connected with complacency, lack of creativity, impatience, low commitment, inadequate talent and experience, lack of time, desire for quick solutions, and miscommunication.

While these issues are not otherwise unknown in the business world, they are mentioned here because they present the product manager with added pressures and concerns.

In addition to heading these teams, the product manager's duties include administration, management, and planning. Given that product management emphasizes coordination of effort companywide, the product manager is responsible for communicating product issues and results to operational managers, regional managers, individual employees, and to the executive level.

Of course, the product manager provides hands-on management for the insurance product, and ensures that the process for maintaining and expanding the DPA model continues. He also directs strategic development and decision-making, oversees the operational tasks which enable the product's performance goals to be met, and revises and implements the business plan. Another on-going role is guiding each department towards becoming more self-aware and quantitative regarding the costs, efficiencies, and contributions of each of its processes.

Changing to a Product Management Culture

The company which adopts the DPA/product management system in order to improve the performance of its insurance products is likely to undergo some transition itself. Many of these changes will effect the activities of all functions and lead to changes in the corporate culture as the company's vocabulary, pace of activity, strategies, planning schedule, and organizational structure all experience significant modifications.

DPA necessitates widescale review of operational processes, the company's investments and

expenses, and market assumptions. In order to effect internal improvements, global measurement and constant assessment become significant components in the management of company functions. This will require the development of corporate self-awareness and self-actualization in which current activities are evaluated on the basis of their performance and are modified or replaced if they are unable to measure up.

The wide use of dynamic planning constitutes another aspect of the product management regime. This requires a large focus on gathering, modeling, and evaluating information. Constant hypotheses about external economic and demographic forces and a greater focus on local market conditions together will necessitate greater companywide communication.

This constant analysis requires the use of new technological tools and statistical methods on a widespread basis. This means that what had been backroom technical work will be recognized as intellectual capital, and will assume a role as a strategic advantage and corporate asset.

Data and Information

One of the biggest differences between traditional ratemaking methods and dynamic ratemaking is the amount of information required. In positing a static model, traditional pricing employs a limited number of data elements in a simple linear approach. On the other hand, a DPA model strives to comprehensively reflect all exposure and financial issues which affect the insurance product. As a result, more information is required. These include not only additional data elements, but also non-traditional data. As a complement to internal data sources, an extensive volume of external information may be cultivated from economic, demographic, regulatory, competitive, and industry sources.

In general, the amount and type of information available must be expanded to sufficiently allow for in-depth analyses of premium and loss data, internal processes and business practices, financial ratios and results, and external economic and market forces. This information will be both quantitative and qualitative. With a wide range in the types of data and sources to be utilized in the DPA system, it may be necessary to reevaluate the method for attributing credibility to data in order to reflect the differences in the predictive nature of each source.

Company Data

Elements

In an ideal situation, a DPA model should incorporate quantitative and qualitative information which appears on an insurance application or endorsement, is collected as part of the claims adjustment process, is associated with premium financing transactions, or may be culled from customer service interactions. These sources should include all data which would allow any policy to be re-rated (and the factor to current rate level to be correctly derived).

The company information which would be included in the DPA model starts off with the standard statistics tracked for a range of insurance company functions. These include premiums, other revenues, exposures, losses, claims, and expenses. DPA modeling favors the review of all details and categories associated with these data elements. From these, of course, a variety of ratios may be developed for evaluating premiums and exposures (renewal ratio, average premium, average factor by rating plan), claims and losses (frequency, severity, reopened claim ratio), and summary statistics (loss ratio, expense ratio, operating ratio). Many important data elements are listed in the CAS's "Guidance Regarding Management Data and Information."

Claims information may be categorical, in addition to statistical. Information on injury type, attorney involvement, type of medical practitioner, compensation system, and legal specifics are useful for understanding the drivers of the loss costs. Then there are the company's market statistics, such as market share, growth rate, and number of appointed agents. Financial data (taxes, capital investments, ROI/ROE, profits, earnings, dividends, net present value) are also essential ingredients of the model since they provide the basis for assessing product performance. Operational information (as discussed below) must also be included.

Given the dynamic nature of DPA modeling, timing considerations are significant details. This includes information regarding units of time (month, days, quarters) and timing issues for each statistic. This information may be used analyzing revenue streams, seasonal issues, the timing of economic and operational changes, loss development, and other rates of change.

Detail

In the discussion below, many data elements are listed as important for building the DPA model. It is essential not only to collect data in sufficient detail but also to capture information which allows for accurate and meaningful interpretation of insurance statistics.

Another source of information is time-stamping, which, if done frequently, allows for a better understanding of the company's operations. All dates should be recorded and coded to account for every instance in which the company touched the policy or claim, such as policy issuance, customer service opportunities, loss reporting, reserve established, claim reviewed, payment made, endorsements processed, vehicle/property examined, etc. It is also important to collect the name of the employee who processed the transaction. This information is important if the company is to review the impact of its activities and operations, in addition to its efficiencies. It is also essential for measuring the effect of all significant changes in the company's processes which impact the outcome of the work process, such as quality, timeliness, and dollar amounts. This information may be used to reconstruct historical results or to restate history.

Convincing functions like Claims and Underwriting to collect more data may be difficult. This is particular the case if they are required to input significant amounts of information, at varying levels of detail, including narratives. Such a request complicates their jobs and cuts their productivity. In addition, these employees may worry that the information they collect will be used to evaluate them. Of course, the Systems department must coordinate this information, which may require resources which would otherwise be committed elsewhere at the company. The request for all this information may lose management support if the actuary cannot promise that this data may not be fully credible for forecasting.

Expenses

The importance of expense statistics in the DPA model cannot be overestimated. This information is used for evaluating company operations and processes, developing target loss ratios, and budgeting. Because of the special role of expenses, every effort should be made to accurately allocate all expenses by product and insured.

Because loss costs are such a large component of the premium charged, loss adjustment expenses -- both allocated and unallocated -- are important to analyze. For instance, these may be used to evaluate the utilization of legal firms and outside adjusters, identify opportunities for the use of enhanced claims technologies, and indicate other cost saving

practices for adjusters.

Expense allocations are another important component of DPA. Allocating them appropriately by rating plan may lead to improvements in product underwriting and pricing.

Pricing Research & Development

Other information which would help the product management process regarding the pricing function's historical performance. For instance, how effective were recent rate changes? What amounts did they project in terms of premium volume, average premium, frequency, and severity? Where was the rate change focused and what was the market reaction? What was the effect on the company's rates compared to the competition? What was the competition's response to the rate change? What assumptions were made that did not pan out?

In addition, there are operational issues which are also of interest. What was the quality of the work performed in the review? Did the review meet its internal deadlines and its targeted effective dates? Was the filing approved as expected? Was training completed on time? Was the coding and programming? the rating disks?

External Data

The external data and information which may be included in the DPA model is extensive. The guiding principle is that this data allows the practitioner to better interpret historical statistics and anticipate prospective conditions. Among the information to collect and analyze are:

- macroeconomic statistics, trends, and projections -- on both a local and national basis -- which include consumer confidence, unemployment, and inflation
- state regulations and the legal environment, which includes mandatory insurance, changes in tort law, changes in claims or underwriting practices
- exposure issues, which may include catastrophes, demographics, and trends
- insurance market forces, such as individual competitors, the concentration of market share, the role of intermediaries, and the size of the residual market.

Of these, the most important external issues regard the specific markets that the product serves and activities of individual competitors.

- Has the market been growing? What are the market's demographics? Where are opportunities for growth? Which segments are underserved? What can be expected of the size and costs of the residual market?
- What are the markets of these competitors? How about their growth rates, premium volume, loss ratios, financial strength, and retention statistics? What are their strengths, weaknesses, strategies, and goals? Who are their business partners? What is their reputation?

There are a variety of sources to call upon in searching for information regarding these issues. For instance, both the Journal of the Society of Insurance Research and the CAS's website provide lists of resources. In addition, other organizations -- such as, rating agencies (A.M. Best, Standard & Poor's), statistical reporting agencies (Insurance Services Organization, the National Association of Independent Insurers, National Council on Compensation Insurance), regulatory associations (the National Association of Insurance Commissioners), government entities (Federal Reserve, Bureau of the Census, Department of Labor), and industry committees (Highway Loss Data Institute, the Reinsurance Association of America) -- possess a wealth of information. There are databases containing important exposure information, such as zip codes data, driving records, weather statistics, construction data, and crime statistics. In

his article, Garven lists a variety of resources appropriate for DFA modeling which are also applicable to DPA work.

Most important is the sophistication with which these external considerations are reviewed and integrated into strategies and plans for the insurance products of an individual insurance company. In particular, the dynamic nature of these issues must be considered. For instance, the actuary must address how the product has historically responded to market dynamics and macroeconomic forces, as well as how the market will react to the company's actions.

Paradigms for Interpreting Information

Along with more data, DPA recommends new paradigms for exploring data and identifying important product relationships. This requires the creation of organizational structures and management expectations which foster creativity and promote more sophisticated analyses. In addition, the actuary's mindset should also become more exploratory and creative in the identification of rating issues and the development of pricing approaches.

- The product management team should try different approaches to understanding the insurance product/exposure. For instance, look at information by transaction, claim, exposure, policy, and account, and examine the lifecycle of each. Identify: issues facing the purchaser of insurance, the perspective of the agent, and the image projected by the insurance company (how easy it is to submit business, integrity, etc.) and how these elements may affect the quality and volume of the risks insured. What insight may be contributed by looking at the insurance system from the vantage point of various company functions and of other business partners, such as legal firms, agents, and independent claims adjusters?
- Consider what each rating variable is supposed to measure. How well does it explain variation in loss costs and/or expenses? Are there worthwhile surrogates? Could changes to existing policy rating rules capture exposure issues better?
- Additional insight may be gained by evaluating subsets of a variety of insurance categories. For instance, claims may be examined by amount, demographic, average premium, accident type, adjuster code, injury type, or territory, to name a few categories. Classifications of insureds may be analyzed by average premium, expenses, frequencies or further broken down by rating plans, renewal ratios, etc. Agents may be evaluated by volume, age of agency, other carriers represented, location, or market niche. Employees may be classified as new, lifers, exempt vs. non-exempt, recently promoted, or by experience, rank, age, sex, marital status, and ethnicity.
- Actuaries may anticipate the quantitative changes which may be expected with higher premium volume, in terms of expense issues, number of employees, marketing niches and specialization, average premium, use of payment plans, etc. Also, consider what qualitative changes may be associated with higher premium volume, for instance, selection issues, relationships with agents, and scrutiny of regulators.
- Another perspective may be that afforded by hypothesizing about the company's financial requirements. For instance, are the cash flow, sales pattern, and claims payment streams as regular and constant as expected? Are (the utility of) all currency units equal in all circumstances, whether the company experiences high profits, catastrophes, uncollectable or non-admitted reinsurance, higher interest rates, financial demands of parent/subsidiary, significant currency exchange rate changes, or changes in its aversion to financial risk? How reasonable are the assumptions on which the operations and practices of the

investment department are based?

- Pricing actuaries need a reserving perspective also, acknowledging the timing and process issues of loss development. Complete the bottom half of the product's loss development triangles. Differentiate between different types of development (report lag, recording lag, payment, reserve changes, reopening) and by the organization of the claims department. Evaluate development based on accident year, policy year, report year, payment year, and calendar year statistics; subdivide the year by quarter, month, and day. Look for seasonal issues in loss development. Investigate how development may differ by exposure type.

Also to consider: What does the loss distribution curve look like? What does the loss development curve look like? Can the shape or variance of either be reduced if certain types of risks are isolated or eliminated?

- Extreme loss or distributional statistics associated with a particular variable which has very limited data should not be ignored for credibility considerations. In the spirit of trying to master the exposure environment and looking for competitive advantages, these statistics should be monitored proactively to determine if they are a statistical anomaly or a meaningful rating issue.

Other paradigms may be discovered in actuarial literature, industry periodicals, and business publications. These resources are underutilized in insurance product analysis. The references cited at the end of this paper are only the tip of the iceberg. For instance, the Connors and Feldblum article does a wonderful job of identifying dynamic issues in personal auto loss costs through a willingness to look past common actuarial conventions.

As an example of the ideal use of data and type of analysis which the DPA process should result in, the following example comes from *Discover* magazine. Qi Yang of MIT has developed a traffic simulator which replicates the driving activities of millions of individual digital drivers who reflect every combination of driving habits and who drive a variety of vehicles. [Discover] While his tool does not necessarily reflect the distribution of drivers and vehicles insured by a particular insurance company, dynamic models such as his may be able to provide insight into risk factors like the effects of highway repairs, weather conditions, and traffic volume on accident frequency. With extensive data regarding vehicle types, road conditions, and weather, combined with satellite traffic tracking for each vehicle, the technologically savvy insurer may be able to improve loss projections, pricing accuracy, risk selection, and rating plan sophistication. This can only be accomplished if the actuary is ambitious, thinks dynamically, invests in technology, can convert huge volumes of data into workable rating plans, and has the autonomy and resources to undertake such an enterprise.

Some of the data elements mentioned in the discussion above may help the reader identify additional information to be collected. More importantly, these considerations should indicate the level of creativity and open-mindedness required for working with the DPA model. In fact, until the dynamic paradigm has been used to develop reliable and valid methods, solve problems, and model phenomena, actuaries are likely to find that its real power is in the metaphors and speculation that it inspires. "Modern theories of creativity have begun to incorporate many of the characteristics of chaotic thinking, such as considering multiple realities, exploring playful combinations, seeking out interesting contrasts and contradictions, developing useful metaphors, and discovering emergent properties." [Finke and Bettle]

Operations Analysis

In addition to the quantitative models with which actuaries are so comfortable, there are qualitative issues which the product manager must incorporate into the planning function. The analysis must also extend to the human resource, technology, and operational systems which contribute to the delivery of the product to the consumer and the maintenance of its functionality. Included in these operations are the resources utilized by a variety of departments in the course of their work, such as underwriting, claims, marketing, and customer service. While issues regarding these systems are not readily convertible to numerical goals such as premium volume, an expense ratio, or profitability, they play a significant role in determining what these statistics settle at.

By initiating research into the costs and performance associated with the company's production and support systems, more precise expense measurements and allocation methods may be developed. The results of this analysis will enable the product manager to better assess operational issues and better estimate the product's true costs.

The qualitative operational issues which are the most important to analyze in the DPA model are those which

- reflect changes in the company's internal business processes or managerial policies
- represent challenges to the business model by indicating shifts in the most basic assumptions regarding the nature of the exposure, the competition, or macroeconomic forces, based on which the operating system and organization have been developed
- dramatically affect the quality of business written, based on market changes and the company's response in the form of underwriting, marketing, pricing, and selection policy
- are explanatory in nature and may be expressed as hypotheses (discussed below).

General Operational Issues

Operational issues are important to analyze because they arise from the company's support of the product. Without addressing these considerations, the product management team is restricted to a limited view of reality. Operations analysis provides a context for understanding product experience and analyzing expenses. Ignoring these issues in the global business model may mean overlooking a niche, product improvement, or some other opportunity.

The information required for this type of operations analysis must contain a level of detail and precision sufficient for each department to perform its own planning and budgeting, and to practice its own R&D. Each function or department in the insurance company must take steps to enhance self-awareness. This means that procedures and standards should be regularly measured and monitored, not only to promote quality management, but primarily to ensure optimal contributions to strategic development, business planning, and pricing precision. This practice includes tracking production and efficiency, expenses and their allocation, practices employed, and important staffing considerations. In order to promote optimal performance and strategic alignment, it is important that each of these functional areas perform R&D with respect to its operations.

Some of the considerations to be measured, evaluated, and/or acted upon regard:

- Organizational hierarchy
- Strategy, mission, responsibilities, role in company
- Performance, quality, service, timeliness

- Goals, targets, benchmarks
- Departmental practices
- Reengineering, outsourcing, process redesign
- Human Resource issues: staffing, skill sets, morale, attendance, turnover, pay level and benefits, hiring selectivity, productivity, downtime
- Management style, communication, empowerment, incentives
- How the work involving tasks and projects are organized
- The use of information technology
- Costs, expenses, (physical and intangible) assets, and investments.

Support and Systems functions should also be evaluated, particularly with respect to production issues, such as efficiency, quality, customer service. The professionals should also understand that they are part of the insurance product in the form of expenses and support, if not direct service.

Management controls are an essential aspect of operations. The productive use of company resources depends on management oversight of all activities, the attention of the audit function, and the adequacy of management information systems.

Human Resource Issues

All systems issues ultimately affect human performance. Because insurance is so labor-intensive with respect to marketing, production, underwriting, claims adjusting, and pricing, it is necessary to explore the organizational, technological, human resource, and operational environments in which insurance company employees conduct business. Among the issues to assess are efficiency and productivity, expenses, morale, staffing, skills, competence, attendance, and downtime, all of which impact the quality or profitability of the product.

In the DPA model, actuaries must assess a variety of insurance operations, most of which involve processes involving the company's knowledge workers. Since production, efficiency, and standardization are all connected to the motivation, knowledge, and organization of human resources, it makes sense that projections of employee behavior are as important to hypothesize about as are economic trends, loss statistics, data issues, and market shifts. Human resource issues have their own set of dynamics in which management actions or work environment issues often effect strong, and not necessarily predictable, reactions. These human issues are both too mundane and too profound to discuss here. However, organizational psychology and management theory provide worthwhile constructs. Whether the human resource reactions to institutional or business changes is analyzed by the actuary or is merely assembled and reviewed by him, this is a function which must be evaluated in assembling a complete DPA business plan. Even if these systemic human resources are considered a black box, this box still produces output; it is the actuary's role to understand, and try to model, employee processes.

There are a wide variety of issues for the actuary to consider in modeling human resource operational issues as part of the DPA model.

- There are a variety of economic forces which impact the supply, morale, motivation, and capabilities of insurance company employees. Among these are reengineering, company reorganizations, mergers and acquisition, globalization, temporary labor market, and demographic changes in society and in the labor market. These demographic trends may reflect the aging of the population, a more educated workforce,

generational issues associated with baby boomers and Generation Xers, and the effects of immigration.

- What contingencies should be established for turnover? How are efficiency, accuracy, production affected by turnover, training time, redirection of personnel towards administrative tasks? What are the costs associated with these issues?
- The use of employee-hour units may lead to significant distortions in evaluating employee productivity and costs. Not all hours worked are the same in terms of production, quality, and employee costs. In addition, not all workers are the same in terms of training, talent, quality, and morale. It is probably more accurate to develop employee classifications for analyzing populations of employees.
- The product manager should also assess managerial talent in developing new initiatives. Does management have what it takes to follow through on a business plan? Has their attention been redirected towards non-operational issues (regulatory changes, mergers) and away from operations (efficiency, quality)? Which managerial strengths may be exploited? Against which weaknesses should other managers be on guard?
- What is the human impact on work that employees perform? How well do human perform when they make projections and estimates? How effective are they at prioritizing and planning? How does “group think” and the corporate culture affect the accuracy (and biases) of the decision-making process and the identification of potential problems? How do employee passion and empowerment affect the quality and quantity of the work produced?
- In assessing its investment in its personnel, a company uses human resource accounting asset models which treat employees as capitalized resources. On the other hand, human resource expense models measure the economic effects of employee behavior, with respect to the quantity, quality, and cost of their work product. Standard cost accounting procedures are used to assess these costs. The categorization of human resource costs are generally conceptualized in one of three ways:
 1. outlay costs (materials or resources used) vs. time costs
 2. personal expenses (salary, benefits) vs. system expenses (personnel taxes, recruiting, training, turnover, outplacement)
 3. fixed, variable, and opportunity costs. [Cascio]

While any one of these approaches, vigorously employed, can be used to conceptualize all human resource costs, it may be useful for the actuary to consider all three sets of categories in order to be vigilant about accurately modeling all of these expenses.

Technology

There are other human performance issues which pertain specifically to the use of information technology in the workforce. Some of the important issues involve how humans use technology in the course of their work and how they adapt to changes in technology. Of primary concern to management is the extent to which operations, efficiency, and coordination may be affected by the use of these systems.

Technology issues which affect these concerns of management include:

- the availability of information to different levels of employees
- the ability to use technology to communicate internally to coworkers and externally to business partners
- the functionality of PC-based vs. mainframe systems

- integration of systems
- security from hackers and viruses
- quality control and training to ensure optimal use of applications
- purchase and maintenance of technology resources
- support and support team expenses
- telecommuting and coordination of remote workers
- conversion from legacy systems.

Implementing New Information Systems

The implementation of new or upgraded information technology is now a way of life for businesses in the insurance industry. While these purchases may be motivated by the desire to increase productivity, there are those who point out that expenditures on information technology have not led to the expected improvements in business performance or profits. Expenditures on computer systems are rarely based on careful calculations of returns or added value, nor can they be tied to strategic product plans. According to the critics, computer technology is often misused or misapplied, leading more often to nicer memos and more polished presentations than higher quality work and meaningful output. [Schrage]

Others have recognized that the introduction of new technology in the workplace changes not only the operational flow, but it also challenges the relationships which have developed in support of the work process. Information technology is not the exclusive source of information, knowledge, and know-how. Instead, work environments support “ecologies of information” which “have a much broader array of interaction and interdependence” [Schrage, p. 185] than do systems of information. Technology should not be foisted on the unsuspecting or unprepared. Integrating new information systems into the work process are most successful when effort is made to complement, not disturb, the organic information relationships which already exist. In other words, “human relationships create a context for information more than information provides a context for human relationships.” [Schrage, p. 186] Here the context is an organization centered around the product, dedicated to cooperative effort and global measurement and analysis.

Of course, it cannot be assumed that the benefits and drawbacks of information technology cancel each other out. Therefore, it is important that the impact of technology on operations is sufficiently measured. It is up to the product management team to ensure that all technical resources live up to their anticipated production and quality benefits. If not, the expense analysis will need to be revisited and the product plan and pricing model will need to be adjusted.

The Hypothesis Paradigm

Providing a Context for Information in the DPA model

As much as information and data are valued in the DPA model, they can only be employed within a particular context. Traditional approaches define the context as the form of the existing rating structure. However, this mindset leads to the development of insurance rates based solely on historical data, without an appropriate emphasis on the predictive value of this information. In addition, by reflecting only historic quantitative data, even the most sophisticated technical system cannot be used to explain the system’s past performance. As noted above, however, understanding product results are an important part of DPA. In addition, the rates and business decisions thereby resulting from the DPA model would be inconsistent with the forward-facing orientation of product planning.

The hypothesis paradigm recognizes the importance of starting model construction from a hypothesis which is explanatory in nature, and from this to logically deduce other components of the model. The temptation to follow basic data analysis techniques or to use software for discovering correlations must be resisted. It is probably easier to rapidly analyze a collection of historical data to derive significant relationships than to go through the process of investigating the situation and formulating prior hypotheses. However, because the analysis must be understood, explained, modeled, and utilized widely, taking shortcuts early on will result in a conclusion which is only marginally useful.

The issue of providing context in a dynamic system is complicated. It is this context which enables the actuary to consider many qualitative and categorical factors when developing rates: the insurance product's pricing, marketing, underwriting, and operational structure; its direction and strategy; beliefs about the insurance market and insured behavior; and interpretations of historical and future company processes and performance. It also allows him to recognize the impacts of the company's change agents whose activities target greater efficiency, new technology, superior strategies, and which recognize economic, expense, and demographic trends. The hypothesis approach is one part of the DPA system in which actuarial judgment is designed to be exercised.

It is for this reason that the hypothesis paradigm is an important tool in the DPA/Product Management system. Management cannot recreate the past, identify all historical operational issues, nor deconstruct the exposure environment to its most primary elements. As a result, projections of the future are a leap into the unknown, even when historical data is relied upon. However, experienced, informed, and interested managers are likely to have some ideas regarding what has transpired and what trends may continue in the future. These ideas may be developed with help from a wide range of measurements, management initiatives, and outside research. They enable product managers and their staff to hypothesize about the extent to which the future will differ from the past. These hypotheses are ideas through which the relationship between past, present, and future is considered. Finally, through hypotheses, product managers decide which information will be accepted as fact and utilized as a basic assumption in the DPA model and which items will be ignored.

Of course, these ideas don't need to be called "hypotheses;" they may also be called "beliefs," "assumptions," "theories," "explanations," "themes," etc. The important thing is that no longer should it be assumed that historical patterns will be played out in the future.

Examples of hypotheses:

1. The new claims system was implemented in February 1997. All adjusters were trained on it by April 12; 90% reported proficiency by April 30. We anticipate that this new technology will result in:
 - faster disposition of claims (from x to y)
 - greater productivity from adjusters (z%)
 - quicker salvage and subrogation processing (an average of 6 days faster)
 - fewer indemnity checks sent to incorrect addresses, saving \$1000 per month
 - better claims data for use by claims management, finance, and pricing, as measured by fewer adjustments on status reports and data with higher credibility
 - complete integration with underwriting systems by September
2. The inflation rate will remain steady at 3% throughout the 1998 calendar year, rising to

4.5% in the 1999-2001 period. We anticipate no irregular effects on our financial or operational results, nor on the predictive nature of our models, arising from these inflation assumptions.

3. Company XYZ is likely to strengthen reserves in CY1998. As a result, they will raise their rates in the markets where we know they are losing money. Independent agent reaction will be negative, providing a marketing opportunity for us. While other competitors may pursue this opportunity, specifically Company ABC, we are poised to take advantage of specific markets due to our AgentFirst program, and will take the following steps to ensure that we will be successful....

It is apparent from these examples that the first step in the hypothesis process is the identification of forces which dynamically impact the success of the insurance product. Once identified, the status of these variables are considered. The likelihood of changes in these variables, the magnitude of these changes, when they would take place, and how they would affect other elements of the dynamic system (markets, competition, demand on company resources, the status and effects of other initiatives) are all necessary parts of the hypothesis process.

Why does the DPA model call for the use of hypotheses rather than relying on averages and factors developed from historical data? Because these random variables, and their relationships to each other, are unable to explain insurance phenomena, both historical and prospective. First of all, the hypothesis approach gives product managers the flexibility to recognize a change in trends before it occurs, rather than reacting to it only after it has impacted historical data, at a sufficient level of credibility. In addition, hypotheses may be developed regarding the quality of the underlying historical data. Hypotheses also serve the purpose of accounting for all the model's inputs and assumptions, thereby indicating that management attention has been directed towards each issue. Finally, professional judgment is generally employed at the final step of any actuarial analysis. This judgment is usually based on the experience the actuary has acquired with respect to the product, the market, and company processes. When this is the case, the actuary is projecting his own understanding of business issues onto the data, perspectives which embody his own hypotheses regarding meaningful trends.

Developing Hypotheses

Product managers should develop a limited number of solid hypotheses regarding a variety of issues which strongly impact insurance results. A collection of variables such as economic trends, employee resources, insurance market issues, selection, claims philosophy, catastrophes, and financial topics may be a good start. These hypotheses should focus on whether the values of parameters of the DPA model will change. Also consideration should be given regarding how historical conditions have changed over time and what these changes suggest in terms of the DPA model's parameters.

Hypotheses may be either qualitative or quantitative. It is important to recognize the importance of qualitative information in understanding the book of business and its financial results. Qualitative issues determine to what extent historical patterns (loss development, frequency, etc.) may be actualized in the future. Depending on what they are, it may be possible to quantify otherwise qualitative issues. Of course, qualitative issues ("Joe Smith is not a good agent") may be corroborated with quantitative data (high loss ratios, customer complaints, episodes of lost paperwork).

Insurance professionals should be expected to have working hypotheses about recent qualitative (regulation, competition, weather) and quantitative (turnover, rate change, CPI) business issues before they look at the data. In other words, their opinions and knowledge should not be limited to data when it becomes available; managers should always have their feelers out. In this way, the “let me see the numbers first” mentality may be avoided whereby operational or marketing people are unwilling to make characterizations about the business without first checking out ratemaking or financial statistics.

An important aspect of the hypothesis system is that it asks for insight which arises either from an independent set of observations which are either qualitative or which are measured separately from the aggregation of actuarial or financial data, such as operational statistics.

Hypotheses are also useful when no data or indications are available or when data quality is a concern. Limitations on the amount and detail of data should not constrain the questions asked, paradigms considered, or analysis performed, at least theoretically. The challenge is to either find other data, identify correlative data, or carefully develop hypotheses. The product team may use hypotheses to establish a range of expectations. They may investigate how the information required to track the hypothesis may be acquired in the future (through surveys, special studies, new data fields) or otherwise focus on how to interpret data as it hits the books in order to determine which assumptions were appropriate and which future steps to take.

On the other hand, it may be that a significant amount of data becomes available. In this case the different ways of splicing the data may present too many options, being limited only by the imagination of the practitioner. Hypotheses may be used in this case to prioritize which approaches to take, which general issues to explore, and which variables and processes to be examined.

Finally, hypotheses may be used to judge results. Because insurance statistics are random variables, there is always the possibility that historical results or trends may be statistical anomalies and that to use these statistics for interpreting the past constitutes a Type I (false positive) error. The hypothesis that this particular result is not reasonable to use in business planning relies on the judgment of the product management team. However, such a decision is an appropriate use of managerial discretion.

Private Passenger Auto Example

The actuary reviewing the auto program in a given state realizes that not only does accident frequency differ by age of driver, but so does the paid claim severity. Of interest are a group of married males in their thirties whose severity is higher than the norm, at a statistical significance level of 75%. An investigation may look into correlating these results with a variety of other rating variables to better identify this group, in accordance with credibility standards. Underwriters, adjusters, and agents would be consulted. External material, perhaps from the insurance industry and auto manufacturers, would be reviewed. Sophisticated technical tools may be used to canvas the data. Eventually a hypothesis would be made, such as: an individual adjuster settled these claims improperly, the current driver classification structure is not precise enough, these drivers commit more fraud, or that this is a non-issue with short-term ramifications and minor financial impact. These hypotheses would be examined with respect to reasonability, management confidence, and strategic issues such as risk aversion, marketing efforts, or growth goals. Depending on the hypothesis, the rates may be changed, underwriting standards revised, adjusters warned, agents contacted, or loss

prevention efforts established. The product manager would decide what type of monitoring, documentation, and coding should take place.

This example shows that DPA is not limited to ratemaking; it feeds a knowledge of the product which enables management to make appropriate decisions and policies in response to product issues. It is the hypothesis paradigm which enables management to leap from individual data elements to an analytical model to a comprehensive strategic product plan. In fact, developing hypotheses within this paradigm is the product management team's greatest responsibility.

Hypotheses and Projections of the Future

The actuary who is projecting rates for the next year and using historical results as a base, should not blindly rely on the actual data. Instead, adjust or recreate the results by referring to those hypotheses and models which best explain recent activities and developments. The point is to avoid using historical averages, which are calculated from a variety of statistics and which in turn reflect a variety of evolving conditions. If it is believed that operating or exposure conditions have changed, a variety of details should be explored: causes, timing, and measurements. If the model results in the identification of interactions between variables, it must be decided how to add this information to the model.

There are several issues to investigate when anticipating future conditions. First of all, demographic changes portend changes in the policyholder profile. Population shifts, cycles in birthrates, and immigration trends will all affect the distributions of insureds and the average premium charged. More dynamic (and further into the future) issues may involve new sets of financial needs, motivations, and desires of these consumers. Some of these changes will reflect economic issues such as the standard of living and consumer confidence.

Of course, the passage of time and new technology will bring new items to insure (new industries), new perils (Year 2000), changes in the costs of risk retention (safety equipment), and economic innovation (electronic commerce). Technology will lead to operational and productivity improvements, better information analysis tools for refining the DPA model, and

New competitors, both known and beyond the horizon, may pose new challenges in the future. New insurers will pop up, established competitors will use technology or product ideas aggressively, foreign insurers will penetrate local markets, mergers and acquisition activity will change the financial strength of weak competitors, financial institutions will sell more insurance, and self-insurance opportunities may rob insurers of sizable and profitable pieces of their markets. In response, insurance regulation may change locally or nationally, posing threats or opportunities for insurers.

Despite the futuristic tone of this discussion, insurance industry experts have spoken of these issues constantly in recent years. The proactive product manager makes it his business to anticipate these trends and the responsible pricing actuary recognizes the importance of modeling them in his rate structure.

As significant as these issues may be, it is important to assess their ramifications on the local insurance market. Again, it is important to ignore the tendency to use national statistics developed at Home Office. Instead, incorporating details regarding field operations and local markets, when possible, leads to more accurate projections of the future.

Of course, these issues also apply to interpreting the results of the past. Once the changes in

conditions have been identified, any historical data being used can be restated based on prospective conditions. This step may be implemented by applying a single factor to the experience, adjusting the results associated with specific classifications, or utilizing a simulation method.

Global Hypotheses

A basic DPA model may be created out of a collection of miscellaneous modules. This is a practical necessity since no DPA model can ever be comprehensive enough, in all conceivable ways to truly reflect the dynamics and detail of the insurance system. These modules may each forecast projections associated with various insurance operations and statistics, such as the economy, claim frequency, human resource issues, competitors, claims philosophy. Hypotheses can be used to string these modules together. Product management would be prompted to fill in gaps where no modules exist with global, or macro, hypotheses. These global hypotheses enable product managers to consolidate a variety of different ideas, statistics, trends, changes, and sources into a single belief (or set of probabilities) regarding the future. This is important because the level of confidence and magnitude associated with each of these may vary.

Global hypotheses may also include consideration of mathematical issues, such as correlations between both variables and modules, nonlinear relationships, simulated results. If these cannot be added to the DPA model, the global hypothesis provides an avenue for these issues to be articulated and added to the product plan.

Being able to formulate a useful global hypothesis is a reflection of the focus and ability of the product management team. After all the DPA analyses have been completed, it is this global hypothesis which is used to develop strategies and a business plan. This hypothesis is used because it comprehensively accounts for all issues, either explicitly or implicitly. Once it is agreed on, product decisions can be made in anticipation of future exposures. Product managers can decide what combination of actions to use: change rate levels, classification, operations, marketing, claims, underwriting, or a combination.

Evaluating Hypotheses

Hypotheses are given a prominent role in the DPA model, perhaps because this step in the model is the “miscellaneous” or “all other” section wherein all issues which are unknown or unquantifiable are thrown. Other models also have these same issues; however, they usually do not set aside a process for capturing these elements of the model.

As they were created, these hypotheses were analyzed, peer-reviewed, and second-guessed. But just because these guesses are called “hypotheses” and are promoted with rationales from management does not mean that they will come to be. How may the quality of these hypotheses be evaluated?

Hypotheses may be tested by combining financial statistics with operational information and data. Without this variety of data, it would be difficult to determine which hypotheses were most off-base. So in order to test hypotheses, a wide variety of statistics must be tracked: distributions of insureds, coverages purchased, number of agents appointed, catastrophes and weather issues, types of claims, paid severity, % of claims with attorney involvement, etc. The insight gained from reviewing this qualitative data will help evaluate how accurate the hypotheses were.

Perhaps actuarial methods will be developed to evaluate these hypotheses based on maximum likelihood estimation principles or by Bayesian probability models.

The goal is to develop meaningful product models, which make sense on an a priori basis. It is however hoped that the historical statistics will corroborate reasonability of the model. The hypothesis model is ultimately about summarizing volumes of data and complex forces by telling a story.

Accounting & Expense Issues

Actuaries can contribute to the process by which expenses are evaluated. Although this role is usually played by the company's cost accountants, actuaries have a great arsenal of tools and knowledge to use in analyzing expenses.

Actuaries are expert in the use of ratios, understand variation and measurement error, are more comfortable modeling expenses in a changing operational environment, can use statistical models, know the business (loss environment, exposure distributions as affecting premiums collected, competitive issues, contractual and exposure changes), can use economic models, and understand the importance of precision (by line, territory, class) in allocating expenses. All these issues are required in order to best model the true costs of writing and processing business. Actuaries also recognize how essential it is to get correct expense figures for ratemaking. In addition, we can model non-ledger costs, such as exposure to catastrophic risk, impact on risk-based capital standards, and cost of capital (surplus) requirements. Finally, actuaries understand that nothing is free, that there are trade-offs to changes in any process, a perspective which is essential in expense analysis.

There may be other accounting issues which pricing actuaries should influence or review on behalf of the insurance product, such as budgeting, investments, and internal audit. While internal auditors traditionally check for operational consistency and data integrity, they are less likely to review data usage issues since they are not generally familiar with the level of data analysis -- particularly with the restatement of historical data -- which is practiced in DPA-type work. In general, accounting professionals are unable to apply the same sensitivities, skills, or sense of purpose to these tasks as can the DPA actuary. As a result, it is the actuary's role both to ensure that these financial activities support sophisticated product analysis and to otherwise maintain the lines of communication.

Analytical Tools

In addition to utilizing a vast array of information and data, the approach to building a Dynamic Product Analysis model differs from the traditional approach to ratemaking. The volume of information and the goal of modeling the exposure environment comprehensively necessitates the use of sophisticated computer tools. While this discussion does not provide an exhaustive guide to the technological tools available to the DPA actuary, it provides an outline of them while supplying a context for them in the product management and ratemaking process.

Analytical tools are used for many purposes in the DPA/Product Management model, to explore data, build the model, and assess strategy. Because of the complex and global nature of these tasks, the collection of tools employed must together accommodate data mining, statistical analysis, forecasting, and simulation.

Due to the comprehensive nature of the DPA model, the presence of operational and external data, and the roles of qualitative issues and hypotheses, it is likely that the use of more than one of these will be required. The items in the modeler's repertoire may include:

- Artificial Intelligence models such as neural networks, pattern recognition systems, and expert systems
- data warehouses and data mining tools
- software for fitting and manipulating probability distributions
- Monte Carlo simulation software or add-ins, process simulators
- flow diagrams, decision trees, scenario testing, game theory, option valuation models
- comprehensive statistical analysis and forecasting tools
- visualization tools for depicting data or model results (particularly useful for multi-dimensional illustrations)
- management science/operations research algorithms, fuzzy set theory, optimization models, and mathematical modeling techniques
- DFA models
- finance models and software.

In determining which tools to use for individual modules of the global model, there are several issues to consider. Aside from statistical concerns, such as goodness of fit, the power of tests of significance, or overfitting, these include:

- What is the optimal way to use the tool? For instance, use of categorical inputs in neural network analysis is preferred.
- Identify common pitfalls (extrapolation is not appropriate for linear regression)
- Are the set of possible solutions predetermined based on nature of model? Using linear approximation tools will result in linear models
- Does the process allow the practitioner to gain insight from the process? Working with a black box is rarely appropriate.
- How sensitive is the model to more data quality?
- Can qualitative scenarios be simulated (adverse selection, law changes, high inflation, frequency trends down) in addition to specific quantitative parameters?
- Are analytical tools being used where human judgment is more appropriate? Actuaries need a theory on where this boundary lies.

Many of these issues also apply to in-house modules which are used for ratemaking. Despite the high-tech nature of the tools listed above, there continues to be a significant role for actuarial judgment. It is important for the actuary to have flexibility, to be able to override formula results, change basic assumptions, and model special issues specific to individual class, territory, coverage, or other subset of insureds.

Other business needs are that these tools be versatile, assessable to non-technical professionals, and secure, while allowing for company-wide and remote access. The technology issues raised above in the Operations Analysis sector also apply here. The most important issue is whether the results make sense.

Maintaining the DPA Model

Updating and Improving the Model

Once the DPA model has been developed as a tool for product management, updating the model is straight-forward, but time-consuming. New statistics and operational information must

be collected, allowing the model's inputs to be changed as new data comes in. After assessing the results and reviewing the set of hypotheses, the model is then able to generate a new set of projections, and thereby extend the product business plan to another year or set of years.

If the product management team seeks to improve the accuracy, comprehensiveness, and sophistication of the model, there are additional tasks to tackle. The inputs used by the model can be upgraded by improving data quality. Global measurement efforts may lead to the collection of additional types of data. Perhaps on-going research efforts will result in identifying additional correlations or new patterns in the data. Any improvements to the structure to the DPA model are likely to require a new set of hypotheses.

Assessing the Model's Results

If the results do not match the plan -- whether the performance was better or worse than predicted -- the product management team must investigate. There is significant analysis to perform in order to identify why and develop an appropriate response in order to understand the product better

First of all, it must be determined how credible the variance is in order to determine whether a parameter or system error is indicated or if it is due to a statistical anomaly. More data should be collected to help determine whether changes to the model are warranted and to choose what course to take. For liability coverages, the results of DPA planning are difficult to analyze due to the long tail. In this case, there may be operational measures or benchmarks to look at for insight.

The hypotheses must also be evaluated. Were the hypotheses wrong? If so, which ones? by how much? Should the hypotheses be changed for future? If so, by how much? what will be the effect on the model? to the projections? on product strategies?

It is essential that the product management team learn enough about the causes and impacts of the variances to make intelligent changes, not only to the structure of the model, but also to the decision-making and planning processes. A comprehensive review of the model's hypotheses, correlations, and variables is essential. This analysis will also provide a basis for evaluating the product's operating processes, marketing strategies, and organization.

FINAL CONSIDERATIONS

Under the Dynamic Product Analysis system, significant effort is to be expended on a set of very time-intensive, sophisticated, heavily-detailed insurance product issues. As discussed above, these tasks include understanding the product, composing hypotheses about historical and prospective processes, examining operations and expenses, building a comprehensive product model, and developing strategic budgets and product plans. Unfortunately, all of this effort and activity are no guarantee that a financially-successful product will result. It is essential that actuaries recognize the limits of the DPA paradigm, as well as any other, when they attempt to model dynamic, complex, and extensive systems. These limitations must be acknowledged whether historical results are being dissected or forecasts are being made.

There are several sources of uncertainty. Many of these relate to general obstacles to making any projections. Most fundamental of all, projections of the future are often developed from historical data, without first establishing why the past occurred the way it did. In addition, it is

important to recognize that the discovery of historical correlations does not mean that causality has been established. Of course, any model trying to capture the realities of a complicated system must also contend with an incredible degree of complexity. In response to these obstacles, the modeler develops an approach which, no matter how sophisticated, pales in comparison to the extensive detail of real life.

In addition, there are complexities associated with modeling the performance of an insurance product. Not only is this system fraught with contingency, it must be recognized that so much of insurance results is dictated from processes occurring in society, the economy, weather, non-insureds, etc. In other words, the insurance company's operations and management exist and are organized in response to those dynamic realities.

There are also a wide range of measurement issues with which the modeler must contend. Of course, there are problems regarding basics such as data quality, measurement error, and significant digits. The level of detail in the data can never be complete enough. With many more variables to evaluate than the number of data points, the data is insufficient to "solve" for the appropriate relationships which the model attempts to capture. In addition, in developing a comprehensive model, there is the potential for a variety of process, parameter, and system errors.

Finally, there are a variety of human issues which subvert the development of any model. Among these are estimation issues which are inescapable: at some point in the modeling process, it falls upon human practitioners to select a range of assumptions and apply guesswork, judgment, and gut-level decision-making. It goes without saying that these ingredients are fallible. There are also environmental business issues which impose limitations on human processes and thereby contribute additional sources of error. Examples of these are time constraints, miscommunication, biases, and lack of consistency; the existence of these elements jeopardize the quality of the model, its parameters, or its application.

Because of these problems, the DPA model -- like the DFA -- is doomed to failure, unless such a significant amount of variance from plan is allowed to compromise the value of the entire process. Despite these very real and very significant problems, the management activities embodied by systems such as Dynamic Product Analysis and product management are nevertheless worthwhile. These are still essential exercises for management to complete in order to stay on top of the business, create strategies, capture intricacies of external forces, recognize consumer issues, and execute business plans. It thus falls upon actuaries and product managers to execute these paradigms to the fullest extent.

As Richard Farson says:

"If planning is so ineffective, why do we do it? And why is it so important that we continue to do it? Planning may not be effective at assessing the future, but it can be a good way of assessing the present. It also indicates trade-offs which may be necessary, sets boundaries so that possibilities can be carefully assessed, simulates plausible scenarios, integrates ideas, and forces people to think about consequences. Additionally, it can put management on ..."anticipatory alert," so that it is better prepared for the unexpected. The process, not the product, is what is important. At its best, planning becomes a form of anticipatory, strategic thinking -- the basis for organizational flexibility and readiness. That may be the most it can offer, but that's a lot." [Farson] p.125

CONCLUDING ISSUES FOR ACTUARIES AND ACTUARIAL SCIENCE

DPA and Product Management are both models with which a comprehensive dynamic ratemaking program may be supported. They both recognize the dynamic nature of the insurance system, the interaction of a variety of company functions, the centrality of the insurance product, and the important role the actuary has to play.

Implementing these systems -- and practicing within them -- will expand the actuary's repertoire in terms of statistics, complexity theory, forecasting, model-building, artificial intelligence, and market dynamics. Given the sophistication of these skills and the requirements of these product models, the actuary will be expected to play a prominent management role in the insurance industry. With these skills, the actuary may find a role in enterprises outside of insurance -- such as real estate, investing, business valuations, demographics, and banking -- which are dynamic, financial, and contingent. In addition, through his exploration and mastery of the dynamic nature of contingencies, the actuary may be able to contribute to general scientific and mathematical pursuits.

Because of the importance of these skills, or just in anticipation of the work environment of the early 21st century, the focus of the CAS exam syllabus should change. Computers are now used universally by all constituents of the insurance industry -- insurers, reinsurers, brokers, third-party administrators, statistical agencies, insurance regulators. Obviously, actuaries have come to rely on these tools also. As a result, actuaries should be required to familiarize themselves with overview material on computer science, artificial intelligence, information storage and retrieval, and information theory, in order to keep up with the vocabulary, if nothing else. In order to use these systems wisely, the statistics exams should require more fluency with respect to concepts and applications, in particular as related to manipulating correlated probability distributions and evaluating data quality using the tests discussed in the CAS's "White Paper on Data Quality" (p. 164). What should be graded is how intelligently candidates can employ multivariate statistical models -- on an open-book and non-timed basis. Also, mathematical modeling techniques and measurement theory will grow in importance for actuaries in order to ensure that they understand the workings of the sophisticated software applications which they may encounter in the work environment. As a result, operations research and numerical methods should be brought back as exam material, to be augmented by other mathematical models. In addition, actuaries should avail themselves of the knowledge and research associated with dynamics, systems analysis, and complexity.

The role of Product Manager is not necessarily for every actuary. It is a way to create another career path for actuaries, one that can introduce them to more operational issues and take them to the Executive level. However, if DPA becomes a fundamental model for the design and maintenance of products in the P&C insurance industry, casualty actuaries will become much less vulnerable to outsourcing, downsizing, replacement by computers, or encroachment by life actuaries. Instead, they will be the master modelers and strategic thinkers of the industry, much too valuable for an insurer to be without.

REFERENCES

1. Actuarial Standard of Practice #23 - DATA QUALITY.
2. Blatt, John M., Dynamic Economic Systems, (Armonk, NY: M. E. Sharpe, Inc., 1983).

3. Campbell, Andrew and Marcus Alexander, "What's Wrong With Strategy?," Harvard Business Review, Volume 75, No. 6, (November/December 1997), pp. 42ff.
4. Cascio, Wayne F., Costing Human Resources: The Financial Impact of Behavior in Organizations, (Boston: PWS-KENT Publishing Company, 1991).
5. Casualty Actuarial Society, Dynamic Financial Analysis Handbook. Release 1.0 Draft. (September 1995).
6. Casualty Actuarial Society, Statement of Principles Regarding Property And Casualty Insurance Ratemaking. (Adopted May 1988).
7. CAS Committee on Management Data and Information, "1996 CAS Geo-Coding Survey," Casualty Actuarial Society Forum (Winter 1997), pp. 169ff.
8. CAS Committee on Management Data and Information, "Guidance Regarding Management Data and Information," Casualty Actuarial Society Forum (Winter 1997), pp. 133ff.
9. CAS Committee on Management Data and Information, "White Paper on Data Quality," Casualty Actuarial Society Forum (Winter 1997), pp. 145ff.
10. Christenson, Clayton M., "Making Strategy: Learning by Doing," Harvard Business Review, Volume 75, No. 6, (November/December 1997), pp. 141ff.
11. Connors, John B., and Sholom Feldblum, "Personal Auto: Cost Drivers, Pricing, and Public Policy," Casualty Actuarial Society Forum (Winter 1997), pp. 317ff.
12. Coyle, R. G., Management System Dynamics, (New York: John Wiley & Sons, 1977).
13. Cummins, J. David, and Richard A. Derrig, "Fuzzy Trends in Property-Liability Insurance Claim Costs," Journal of Risk and Insurance, Volume 60, No. 3, (September 1993), pp. 429ff.
14. D'Arcy, Stephen P., "Special Issues -- Data Sources," Foundations of Casualty Actuarial Science, (Second Edition) Casualty Actuarial Society, 1992, Chapter 9, pp. 561-567.
15. D'Arcy, Stephen P., Richard W. Gorvett, Joseph A. Herbers, and Thomas E. Hettinger, "Building a Dynamic Financial Analysis Model that Flies," Contingencies, November/December 1997, pp. 40-45.
16. Discover, "1997 Discover Awards," Volume 18, No. 7, (July 1997), pp. 55ff.
17. Farson, Richard, Management of the Absurd, (New York: Touchstone / Simon & Shuster, 1996).
18. Feldblum, Sholom, "The Actuary as Strategist," *The Actuary as Business Manager*, (Casualty Actuarial Society 1993 Discussion Paper Program), pp. 145-157.
19. Finke, R. A., and J. Bettel, Chaotic Cognition, (Mahwah, NJ, Lawrence Erlbaum Associates, 1996).
20. Foley, Peter, "Regional or national: Program business is not for the faint of heart," National Underwriter - Property & Casualty/Risk & Benefits Management edition, (October 21, 1996), pp. 31ff.
21. Franzoni, Lauryn, "Product Managers: Finding the Right Fit," Bank Marketing, (May 1991), pp. 28ff.

22. Garven, James R., under the direction of the CAS Task Force on DFA variables, "Compilation of Variables Necessary for Performing Dynamic Financial Analysis of Insurance Companies," *Casualty Actuarial Society Forum* (Winter 1997), pp. 187ff.
23. Gertz, Dwight, "The Dynamics Of Corporate Growth," *Management Review*, Volume 84, No. 1, (January 1995), pp. 46ff.
24. Halpert, Aaron and Simon J. Noonan, "STRATEGIC ISSUES: Moving Beyond the Point Estimate," *The Actuary as Business Manager*, (Casualty Actuarial Society 1993 Discussion Paper Program), pp. 127-144.
25. Handscombe, Richard S., *The Product Management Handbook*, (London: McGraw-Hill Book Company, 1989).
26. Hickman, James C., "Introduction to Actuarial Modeling," *North American Actuarial Journal*, Volume 1, No. 3, (July 1997), pp. 1-5.
27. Kist, Frederick O., "Actuaries In Non-Traditional Roles," presented to the Midwestern Actuarial Forum, September 9, 1997.
28. Lissack, Michael R., "Complexity Metaphors and the Management of a Knowledge Based Enterprise: An Exploration of Discovery," submitted in partial fulfillment of the Stage 1 requirements for a Doctorate in Business Administration at Henley Management College, <http://www.lissack.com/writings/proposal.htm>, draft as of October 26, 1997.
29. Macdonald, Angus S., "Current Actuarial Modeling Practice And Related Issues And Questions," *North American Actuarial Journal*, Volume 1, No. 3, (July 1997), pp. 24-35.
30. MacMillan, Ian C. and Rita Gunther McGrath, "Discovering New Points of Differentiation," *Harvard Business Review*, Volume 75, No. 4, (July/August 1997), pp. 133ff.
31. McKechnie, Ian, "Developing Business Plans: Use of Computer Models in Premium Budgeting," *Journal of the Society of Insurance Research*, Spring 1996, pp. 47-53.
32. Miller, Michael J., "How to Successfully Manage the Pricing Decision," *The Actuary as Business Manager*, (Casualty Actuarial Society 1993 Discussion Paper Program), pp. 193-208.
33. Newing, Rod, "Data mining: data mining has become one of the latest trends in using data," *Management Accounting (British)*, Volume 74, No. 9, (October 1996), pp. 5ff.
34. Patrick, Mary C., "A Good Look In The Mirror," *Contingencies*, May/June 1994, pp. 46-51.
35. Rivett, Patrick, *Principles of Model Building: The Construction of Models for Decision Analysis*, (New York: John Wiley & Sons, 1972).
36. Saporito, Patricia L., "Research Sources Update," *Journal of the Society of Insurance Research*, Summer 1997, pp. 69-70.
37. Schrage, Michael, "The Real Problem with Computers," *Harvard Business Review*, Volume 75, No. 5, (September/October 1997), pp. 178ff.
38. Stein, Richard L. and Michael A. Stein, "Sources Of Bias And Inaccuracy In The Development Of A Best Estimate," *Casualty Actuarial Society Forum* (Summer 1998).
39. Strommen, Stephen J., "An Object-Oriented Design for Dynamic Simulation Models," *North American Actuarial Journal*, Volume 1, No. 3, (July 1997), pp. 38-49.

40. The Subcommittee on Dynamic Financial Models of the CAS Committee on Valuation and Financial Analysis, "Dynamic Financial Models of Property/Casualty Insurers," Casualty Actuarial Society Forum, (Fall 1995), pp. 93-127.
41. Urban, Glen L., John R. Hauser, and Nihilesh Dholakia, Essentials of New Product Management, (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1987).
42. Wasson, Chester R., Dynamic Competitive Strategy & Product Life Cycles, (Austin, Texas: Austin Press, 1978).
43. Wichman, William J., "Product Management Can Work," National Underwriter - Life & Health/Financial Services edition, Volume 88, No. 37, (September 15, 1984), pp. 13ff.
44. Winston, Paul D., "Industry must learn to ride new wave," Business Insurance, (October 13, 1997), pp. 22ff.

APPENDIX A

Applying Dynamic Sensitivities to the Development of a Rate Level Indication

The following exhibits depict the calculation of the rate level indication from actual ratemaking work done for the Bodily Injury Liability coverage of a personal lines auto insurance product. This example was chosen because it reflects standard actuarial pricing methods and provides an opportunity to demonstrate how dynamic ratemaking and product management sensitivities would impact a review of this auto program. The goal is to critique the methods shown on these exhibits and recommend more appropriate approaches to use or questions to ask.

This critique is based on the methodology shown and does not reflect any material from the filing package, any analysis performed separately, or any data not contained on these exhibits. As a result, consideration of issues such as market share information, competitive data, exposures, and paid loss development is impossible.

This analysis does not consider issues involving other insurance coverages offered, nor does it recommend additional steps, methodologies, or exhibits. Instead, the focus is on the selections which were made and issues which were investigated. It is possible that the concerns which are raised on the following exhibits were considered in the development of the original exhibits. However, the format of the exhibits and the selections indicate otherwise.

Because the underlying historical data (premium, exposures, distributional, losses, claims, expenses, operations, economic, and market) is unavailable, neither the Dynamic Product Analysis nor Product Management systems could be employed. Neither can sophisticated technical tools be utilized.

The exhibits which follow have been changed from the original set. For instance, the formats of the exhibits have been improved. In addition, the numbers on these exhibits have been modified, but just enough to hide the source of this material. Also, the effective date of this rate change has been changed to 12/18/93. Finally, this ratemaking review is now associated with the fictional state, East Virginia.

Exhibit 1	Determination of Statewide Rate Change
Exhibit 2	Premium Trend Factor
Exhibit 3	Calculation of Loss Development Factors
Exhibit 4	Development of ULAE Provision
Exhibit 5	Fitting Paid Frequency and Severity Trends
Exhibit 6	Paid Frequency and Severity Trend Factors
Exhibit 7	Development of Expected Loss & LAE Ratio
Exhibit 8	Commission and Brokerage Expenses
Exhibit 9	General and Other Acquisition Expenses
Exhibit 10	Reconciliation of After-Tax Operating Profit Provision
Exhibit 11	Present Value Analysis
Exhibit 12	Average After-Tax Net Rate Of Return To Assets

Determination of Statewide Rate Level Change

	AY1990	AY1991	AY1992	33%/33%/34% Combined
1) Earned Car Years	11,898	10,344	9,682	
2) Earned Premium at Current Rates	\$1,236,795	\$1,054,495	\$984,375	
3) Average Earned Premium at Current Rates	\$103.95	\$101.95	\$101.67	\$102.52
4) Premium Projection Factor (Exh 2)	0.958	0.968	0.978	
5) Projected Average Earned Premium at Current Rates	\$99.64	\$98.70	\$99.43	\$99.26
6) Incurred Loss and ALAE (Exh 3)	\$547,890	\$750,962	\$557,574	
7) Incurred Loss Development Factors (Exh 3)	1.058	1.114	1.393	
8) ULAE Provision (Exh 4)	1.107	1.107	1.107	
9) Ultimate Loss and LAE	\$641,475	\$925,684	\$859,693	
10) Average Ultimate Loss and LAE	\$53.92	\$89.49	\$88.79	
11) Paid Pure Premium Trend Factor (Exh 6)	1.043	1.033	1.022	
12) Projected Pure Premium	\$56.23	\$92.41	\$90.77	\$79.91
13) Current Provision for General & Other Acquisition Expenses (%) (Exh 7)				11.2%
14) Current Provision for General & Other Acquisition Expenses (\$)				\$11.48
15) Trend Factor for Provision for General Other Acquisition Expenses (\$)				1.050
16) Proposed Provision for General & Other Acquisition Expenses (\$)				\$12.06
17) Provision for Commissions, Taxes, & Profit (%) (Exh 7)				10.0%
18) Total Needed Average Premium				\$102.24
19) Indicated Rate Level Change				3.0%

General Questions:

- 1 What is the basis for weighing each year the same? How similar to the prospective period is AY1990?
 - 2 Why is the premium, exposures, and average premium dropping?
 - 3 How can the jump in pure premium be explained? Why average the results of all 3 of these years rather than the last 2?
 - 4 What is the likely response to the rate change? What rate change will be experienced by current insureds? What choices will consumers make? How will renewals be affected? How will the competition respond? How will distribution force respond? How similar to the consumers insured historically will the insureds in the prospective period be?
 - 5 With 59 paid BI claims in the 12 months ending 3/31/92 (Exhibit 6), how credible are these three years combined? What is an appropriate complement of credibility?
 - 6 How much credibility may be associated with all the factors and ratios used to project premium and loss statistics?
-

East Virginia
 Private Passenger Auto
 Bodily Injury Liability Coverage

Appendix A
 Exhibit 2

Premium Trend Factor

	2nd Prior <u>1990</u> 3/31/90	1st Prior <u>1991</u> 3/31/91	Current <u>1992</u> 3/31/92
1) Average Written Date of Experience Period (3 months after the beginning)			
2) Average Written Date of Proposed Policy Period (6 months after the beginning)	6/18/94	6/18/94	6/18/94
3) Number of Years from Experience Period to Proposed Policy Period	4.22	3.22	2.22
4) Annual Impact	-1.0%	-1.0%	-1.0%
5) Projected Trend Factor	0.958	0.968	0.978

General Questions:

- 1 Is the average written date of the experience period really 3 months after the beginning?
 Can this be correct given the operational challenges to implementing new rates, seasonality issues, and decreasing production?
 - 2 Can't these same issues be assessed to determine their affect on the average written date of the proposed policy period?
 - 3 Can't the correct average written date of the experience period be determined electronically?
 - 4 Why would the annual premium trend be constant over this period?
-

Calculation of Loss Development Factors

Accident						(Ultimate)
<u>Year</u>	<u>At 15 Mos</u>	<u>At 27 Mos</u>	<u>At 39 Mos</u>	<u>At 51 Mos</u>	<u>At 63 Mos</u>	<u>At 75 Mos</u>
1983					374,365	370,711
1984				587,712	597,977	598,256
1985			891,554	901,319	895,377	899,876
1986		540,895	542,704	590,952	628,833	631,462
1987	692,511	754,261	860,096	849,224	849,304	847,176
1988	568,474	837,744	860,637	886,661	900,468	
1989	851,047	959,082	1,002,683	1,082,187		
1990	484,693	522,944	547,890			
1991	505,554	750,962				
1992	557,574					
<u>Development</u>	<u>15 to 27</u>	<u>27 to 39</u>	<u>39 to 51</u>	<u>51 to 63</u>	<u>63 to 75</u>	
4th Prior	1.089	1.003	1.011	1.017	0.990	
3rd Prior	1.474	1.140	1.089	0.993	1.000	
2nd Prior	1.127	1.027	0.987	1.064	1.005	
1st Prior	1.079	1.045	1.030	1.000	1.004	
Latest	1.485	1.048	1.079	1.016	0.997	
Average	1.251	1.053	1.039	1.018	0.999	

Loss Development Factors

15-75 Mos	1.393
27-75 Mos	1.114
39-75 Mos	1.058

General Questions:

- 1 What explains the variation experienced between accident years in terms of the incurred losses?
 - 2 Although a ratemaking analysis is no time to do a full-blown loss reserving review, aren't there better approaches to selecting prospective link ratios than by simply averaging the last five link ratios?
 - 3 Based on the limited data, it appears that there is a three-year cycle in the 15-27 month link ratios. Given the range in the factors, what is the best approach to selecting this very important factor?
 - 4 What operational and claims processes have taken place over this period of time? How have they affected these loss values? Can these issues explain the 3 year cycle in the 15-27 month period?
 - 5 Reviewing the link ratios by accident year, it is clear that there are correlations between development periods. For instance, AY1989 has had only negative development since a disproportionate jump in the 27-39 period. Can correlations be calculated or estimated? How would the loss development factor selections change?
-

Development of Unallocated Loss Adjustment Expense

	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>Total</u>
1) Direct Losses & ALAE Expenses Incurred	\$2,565,798	\$2,737,982	\$2,453,477	
2) Direct ULAE Expense Incurred	\$246,545	\$285,425	\$301,513	
3) Expense Ratio	0.0961	0.1042	0.1229	
4) Three Year Total				0.1074
5) Selected Provision				0.107

General Questions:

- 1 What are the fixed and variable components of ULAE?
 - 2 There appears to be a significant upward trend. Is this what the company expected?
 - 3 Why not extrapolate the trend out?
 - 4 Why is the claims function becoming less efficient?
 - 5 Has there been a change in the way these expenses are recognized or recorded? Are some of these expenses coming from traditionally categories associated with ALAE?
 - 6 Are other insurers experiencing the same trends?
-

Fitting Paid Frequency & Severity Trends

12 Mos Ending	PD FREQUENCY				PD SEVERITY			
	East Virginia		Countrywide		East Virginia		Countrywide	
	Actual	Fitted	Actual	Fitted	Actual	Fitted	Actual	Fitted
6/30/87	0.76	0.781	1.30	1.317	7,761	6,909	7,399	7,495
9/30/87	0.76	0.779	1.29	1.319	7,962	7,076	7,438	7,577
12/31/87	0.68	0.777	1.28	1.322	6,898	7,247	7,575	7,660
3/31/88	0.70	0.775	1.30	1.325	6,129	7,422	7,612	7,744
6/30/88	0.69	0.773	1.31	1.328	5,602	7,602	7,626	7,828
9/30/88	0.70	0.771	1.32	1.331	6,817	7,785	7,837	7,914
12/31/88	0.74	0.769	1.34	1.334	8,394	7,973	7,957	8,001
3/31/89	0.80	0.767	1.36	1.336	8,435	8,166	8,081	8,088
6/30/89	0.88	0.765	1.36	1.339	9,361	8,363	8,272	8,176
9/30/89	0.94	0.763	1.37	1.342	8,890	8,565	8,310	8,266
12/31/89	0.92	0.761	1.37	1.345	8,419	8,772	8,484	8,357
3/31/90	0.92	0.759	1.36	1.348	8,784	8,984	8,679	8,448
6/30/90	0.84	0.757	1.36	1.351	10,665	9,202	8,795	8,540
9/30/90	0.72	0.755	1.37	1.354	11,359	9,424	8,962	8,634
12/31/90	0.74	0.753	1.38	1.357	10,582	9,652	8,958	8,729
3/31/91	0.70	0.752	1.39	1.360	10,315	9,885	8,983	8,825
6/30/91	0.74	0.750	1.41	1.363	8,997	10,124	9,087	8,921
9/30/91	0.77	0.748	1.41	1.365	9,984	10,368	9,146	9,019
12/31/91	0.78	0.746	1.40	1.368	12,493	10,619	9,273	9,117
3/31/92	0.79	0.744	1.39	1.371	12,292	10,876	9,294	9,217
6/30/92	0.68	0.742	1.37	1.374	12,230	11,138	9,237	9,318
9/30/92	0.73	0.740	1.35	1.377	11,675	11,408	9,247	9,420
12/31/92	0.68	0.738	1.32	1.380	9,081	11,683	9,143	9,523
3/31/93	0.64	0.736	1.29	1.383	9,909	11,965	9,098	9,627

General Questions:

- 1 The 1st 3 columns of actual data exhibit cyclical behavior. Are these exponential curves the most appropriate to use?
 - 2 Rather than using countrywide data as the complement of credibility, a regional source may be more appropriate. Can't states with similar demographics, rate levels, or population densities be identified?
 - 3 Instead of fitting a severity curve, can a correlation be established with macroeconomic inflation projections? Can other sources of external data, forecasts, or hypotheses be identified?
 - 4 Are there enough significant digits to the state's frequency data for it to be fit?
 - 5 What historical processing or adjuster issues have affected these state and countrywide statistics? Are there meaningful differences between these two sources of data or is it only a question of data volume?
 - 6 How does the fact that the same claims are being counted in 4 consecutive quarters affect the results?
 - 7 Should the paid severity fit be credibility weighted based on the number of underlying claims?
 - 8 Should the credibility be based on the variance exhibited in the columns of actual data?
-

Paid Frequency & Severity Trend Factors

# of Paid Claims in State for 12 Months Ending 3/31/93	59
Resulting Credibility to be Applied to State's Statistics	5.00%
Remaining Credibility to be Applied to Countrywide Statistics	95.00%

Average Annual Change based on Exponential Curve of Best Fit

	<u># of Data</u>	<u>Paid</u>	<u>Paid</u>	<u>Paid Pure</u>
	<u>Points Used</u>	<u>Frequency</u>	<u>Severity</u>	<u>Premium</u>
East Virginia	24	-1.0%	10.0%	8.9%
Countrywide	24	0.9%	4.5%	5.4%
Credibility Weighted	24	0.8%	4.8%	5.6%
	12	-1.9%	1.3%	-0.6%
	6	-6.8%	-2.6%	-9.2%
Selected				1.0%

Calendar-Accident Years Ending

	<u>3/31/90</u>	<u>3/31/91</u>	<u>3/31/92</u>
Midpoint of Experience Period	6/29/90	6/30/91	6/30/92
Date to which Trend is Projected	9/18/94	9/18/94	9/18/94
Number of Years from Experience Period to Date to which Trend is Projected	4.22	3.22	2.22
Annual Fitted Change in Paid Pure Premium	1.0%	1.0%	1.0%
Projected Trend Factor	1.043	1.033	1.022

General Questions:

- 1 Why is the same credibility standard applied to both paid frequency and paid severity?
 - 2 Given the sensitivity of the fitted results to the number of periods, aren't more sophisticated forecasting techniques warranted?
 - 3 Are trends generated from paid data always suitable for application to incurred data?
-

Development of Expected Loss & LAE Ratio

1) Commission and Brokerage	8.900%
2) Other Acquisition Expenses	7.400%
3) General Expenses	3.800%
4) Taxes, Licenses, and Fees	2.600%
5) Underwriting Profit Provision	<u>-1.456%</u>
Total	21.244%
Target Loss & LAE Ratio	78.756%

General Questions:

- 1 In the following exhibits, the expense provisions are developed. It is obvious that these expenses do not arise from static processes. How can the actuary establish the lines of communication to learn more about the underlying company processes so accurate projections may be made?
 - 2 How credible are these statistics?
 - 3 Should each of the past three years be weighted equally (based on dollar amounts) or should greater weight be given to recent statistics?
 - 4 Is there a mismatch or bias associated with applying calendar year expense provisions to accident year-based premiums?
 - 5 How appropriate is it to spread these costs based on premium or losses, rather than exposures or claim counts? Are there adverse selection issues which may be associated with expenses?
 - 6 For expense provisions developed from countrywide data, is there any reason to believe that East Virginia behaves differently, in magnitude or trend? Should this state receive a different expense allocation rather than one based on premium dollars?
-

Development of Commission & Brokerage Expense Provision

	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>Total</u>
1) Direct Premiums Written	\$3,094,852	\$2,917,936	\$2,767,087	
2) Direct Commission & Brokerage Incurred	\$276,974	\$259,808	\$244,292	
3) Expense Ratio	0.0895	0.0890	0.0883	
4) Three Year Total				0.0890
5) Selected Provision				0.089

General Questions:

- 1 What are the fixed and variable components of each of these expenses?
 - 2 There appears to be a significant downward trend. Is this consistent with the company's marketing and distribution activities? If so, how will these activities evolve over time?
 - 3 Could this decrease be associated with the decrease in production?
 - 4 Has there been a reallocation of these expenses over time? or a change in the way they are recognized or recorded?
 - 5 Why not extrapolate the trend out?
 - 6 Are other insurers experiencing the same trends?
-

Development of General & Other Acquisition Expense

	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>Total</u>
1) Direct Premiums Earned	\$6,377,851	\$6,537,189	\$6,378,994	
<u>Other Acquisition Expenses</u>				
2) Expenses Incurred	\$465,909	\$499,200	\$463,089	
3) Expense Ratio	0.0731	0.0764	0.0726	
4) Three Year Total				0.0740
5) Selected Provision				0.074
<u>General Expenses</u>				
6) Expenses Incurred	\$212,400	\$256,027	\$269,089	
7) Expense Ratio	0.0333	0.0392	0.0422	
8) Three Year Total				0.0382
9) Selected Provision				0.038
Total Provision for General & Other Acquisition				0.112

General Questions:

- 1 What are the fixed and variable components of each of these expenses?
 - 2 Is there an explanation for the swings in the Other Acquisition Expenses?
 - 3 Does this expense category exhibit cyclical behavior?
 - 4 There appears to be a significant upward trend for General Expenses. Is this what the company expected?
 - 5 Why not extrapolate the trend out?
 - 6 Why are the supporting operations becoming less efficient?
 - 7 Has there been a reallocation of these expenses over time? or a change in the way they are recognized or recorded?
 - 8 Are other insurers experiencing the same trends?
-

Reconciliation of After-Tax Operating Profit

1) Discounted Pretax Underwriting Profit	1.3935%
2) Applicable Tax Ratio	35.0000%
3) After-Tax Underwriting Profit	0.9058%
4) After-Tax Investment Income From Policy Cash	<u>6.9058%</u>
5) Total After-Tax Operating Profit	6.0000%

General Questions:

- 1 Are these values really as precise as indicated by their number of digits?
 - 2 How sensitive are the results to minor changes in these values?
 - 3 Are payment of any of these taxes ever deferred?
-

East Virginia
Private Passenger Auto
Bodily Injury Liability Coverage

Appendix A
Exhibit 11

Calculation of Present Values, as of the Beginning of a Policy
Of All Income and Outgo @6.00%

Policy <u>Year</u>	Cumulative % of Losses <u>Paid</u>	Incremental <u>Distribution</u>	Years of Interest <u>Discount</u>	Discount Factor <u>@ 6.00%</u>	Discounted % of Losses <u>Paid</u>
1	24.1%	24.1%	0.69	0.9606	23.1503%
2	60.4%	36.3%	1.42	0.9206	33.4174%
3	76.2%	15.8%	2.45	0.8670	13.6980%
4	85.0%	8.8%	3.46	0.8174	7.1932%
5	90.0%	5.0%	4.47	0.7707	3.8535%
6	92.5%	2.5%	5.45	0.7279	1.8198%
Subsequent	100.0%	<u>7.5%</u>	7.00	0.6651	<u>4.9879%</u>
Total		100.0%			88.1201%
Expected Loss & LAE Ratio					78.7558%
Present Value of Expected Loss & LAE Ratio					69.3997%
Commission and Brokerage		8.9%	0.71	0.9595	8.5393%
Other Acquisition Expenses		7.4%	0.58	0.9668	7.1541%
General Expenses		3.8%	0.56	0.9679	3.6780%
Taxes, Licenses, and Fees		2.6%	0.63	0.9640	2.5063%
Underwriting Profit Provision		-1.5%	0.75	0.9572	<u>-1.3935%</u>
Total					89.8838%
Premiums		100.0%	0.56	0.9679	96.7896%
After-Tax Investment Income From Policy Cash Flow					6.9058%

General Questions:

- 1 How much precision is associated with the percent of payments made after the first 3 years? Is it reasonable that the last 7.5% of the payments will be made at a rate twice as fast as the prior 2.5%?
 - 2 Are these policy year paid loss development factors consistent with the accident year factors?
 - 3 How accurate are the numbers in the Years of Interest Discount column? Should they be based off of past results or be modeled on current and future claims processes/systems?
 - 4 Are these values really as precise as indicated by their number of digits?
-

Countrywide
Private Passenger Auto
Company Portfolio

Appendix A
Exhibit 12

Average After-Tax Net Rate Of Return To
(Dollars in 000,000s)

<u>Year</u>	<u>Asset Base</u>	<u>Capital Gains After Tax</u>	<u>Average Net Rate of Return For NonFixed Income Securities After Tax</u>	<u>After Tax Investment Income</u>	<u>Average Net Rate of Return</u>	<u>Total</u>
1983	\$9,238.6	\$76.2	0.82%			
1984	\$11,054.5	\$78.6	0.71%			
1985	\$12,678.5	\$136.6	1.08%			
1986	\$14,141.8	\$97.1	0.69%			
1987	\$16,039.4	\$112.0	0.70%			
1988	\$17,722.7	\$93.3	0.53%			
1989	\$19,672.5	\$21.2	0.11%			
1990	\$20,944.6	\$141.7	0.68%	\$1,213.5	5.79%	
1991	\$22,881.7	\$126.7	0.55%	\$1,278.4	5.59%	
1992	<u>\$24,481.4</u>	<u>\$124.9</u>	0.51%	<u>\$1,290.7</u>	5.27%	
	\$168,855.6	\$1,008.3	0.60%	\$3,782.6	5.54%	
						Annual Effect of Interest on Corporate 0.13%
						Rate of Return Net of Interest on Debt 5.41%
						Total After-Tax Rate of Return 0.60% 5.41% 6.00%

General Questions:

- 1 Why are 10 and 3 years shown on this exhibit?
 - 2 Does an average make sense given economic trends and cycles?
 - 3 Shouldn't anomalies such as 1985 and 1989 be removed first before calculating the average?
 - 4 Shouldn't the downward trend for 1990-92 be taken into account when making the selection?
-

APPENDIX B

Why Marketing Professionals should not be Insurance Product Managers

The Institute of Marketing defines marketing as "the management process responsible for identifying, anticipating and satisfying customer requirements profitably".

In applying the Product Management concept to the property and casualty insurance industry, its heavy emphasis on Marketing should be reconsidered. As noted earlier in the paper, product managers have traditionally specialized in Marketing. This focus is consistent both with the issues and strategies which concern manufacturers of package goods and with the roles which product managers play with respect to their products. However, there are several reasons why the application of a product management system to P&C insurance products is less likely to require this emphasis on marketing, including the limited benefits of growth, consumer response to insurance products, and technical specialization.

Focus on Growth & Market Share

- A strong marketing focus is important for product managers of package goods, given that these brands are marketed countrywide. On the other hand, insurance is a local enterprise. Drivers of insurance product profitability are associated with underwriting selection, agent relations and support, and claims settlement, all of which must be practiced locally. Differences between states in terms of tort law, use and availability of underwriting information, demographics, and claims environment -- in addition to their regulation of rates, market conduct, and state filings -- reinforces this individual market perspective.
- In addition, the marginal costs associated with selling additional package goods are significantly less prohibitive than for insurance products. However, with respect to commissions and acquisition costs, insurers do not enjoy economies of scale as sales increase.
- The cost structure of insurance differs greatly from the packaged good model. In insurance, most of the expense of providing the product is associated with loss costs, over which the company has little control. Most other industries do not incur significant variance in the product expense loads associated with serving their customers.
- There are limits to growth to which insurance companies are sensitive which most industries can ignore. Insurance companies do not want to insure everybody, due to capacity limits and underwriting issues. While manufacturers can aim to saturate particular geographical markets with their products, insurers must take care to spread their risks.

Marketing Savvy

- Insurance products are commodities. There is a high level of standardization among insurance products and contracts throughout the industry. In fact, the identity of the company is not necessarily important to the consumer who may buy a product sold on an independent agent's paper. Product performance is not necessarily an area of differentiation since the primary purpose of insurance, indemnification of losses, is not experienced regularly by purchasers of most insurance products. In terms of product success, the selection, pricing, and operations functions are more important than the company's status within the insurance market. Although not insignificant, Marketing issues play a much smaller role in insurance.
- Insurance markets are defined by the coverages offered and risks insured. Consumer demand for insurance products is either mandated by statute or business necessity. As a

result, it lacks the range of responses elicited in consumers by package goods. Marketing and market research are essential for these consumer goods since there are a wide variety of submarkets to recognize and target. Within these submarkets, consumer purchasing decisions may be guided by a variety of considerations, such as price, style, brand names, customer service, convenience, coupons, contests, quality, and advertising. As of now, no similar impetus for insurance products have been identified by the marketing departments of insurance companies. In general, insurance products are not viewed as separate from the companies which control them. Insurers are distinguished by their financial strength and size, rate level, and customer service. These considerations appeal less to consumer emotions than do those which affect the package good market. Until this state of affairs changes, the high level of marketing savvy and refinement generally associated with product management is not required by insurers in managing their products.

- Consumers can purchase package goods in varying degrees of volume or frequency. On the other hand, it is doubtful that many insureds increase their coverage, or the number of exposures which they insure, based on their satisfaction with the insurance product. It is true, however, that relatively low rates may incent insureds to purchase higher liability limits of coverage.

Technical Specialization

A package good company is likely to have a wide variety of functions responsible for the creation, manufacture, sales, distribution, and customer service of a particular product, not to mention financial and administrative roles. While a product manager can coordinate several of these product processes for the brand, his expertise and authority are limited with respect to other functions. The product manager's primary allegiance is to Marketing, because this is the specialty he mastered in order to rise to his position. The product manager is chosen from the Marketing ranks since the position calls for focusing the wide range of product functions and processes to those issues which will result in sales growth and consumer acceptance.

In contrast to this situation, there is greater overlap among insurance specializations. In most insurance company environments, the claims, underwriting, marketing, and pricing functions all affect each other; none can operate independently. As a result, specialists and managers in each department are likely to know a great deal about each of the other functions. In addition, each is very aware of considerations such as the price sensitivity of the insurance market, competitive pressures, and customer service issues. This means that an insurance product manager may come from any of many functional areas, not just Marketing.

While marketing is important in P&C insurance, it is not the most fundamental aspect of managing the insurance product. In insurance, marketing issues such as product positioning, placement, and availability are also greatly affected by the pricing and underwriting functions, in addition to marketing. It must also be recognized that several other functions have greater responsibility for, and control over, profitability.