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Data Mining for Insurance

Objectives:

- Data mining is a "horizontal" technology, it can be applied in a wide range of enterprises to continuously improve business decision making. Innovation is the order of the day in the insurance industry as providers grapple with a range of business challenges.
- Data mining can be applied to evaluate and refine the business rules and processes that form the basis of their underwriting polices.
- The high-level "pitch" for data mining in insurance underwriting is that consistently having a sound understanding of underlying patterns, trends, and relationships that impact on strategic and operational success ahead of industry peers, and acting on these findings, can enable a sustainable advantage in competitive markets.
- The distinct benefit of data mining is its ability to reveal patterns and relationships in large volumes of data and generate a range of predictors with specified confidence levels – that is of special relevance to those tasked with the underwriting function in insurance businesses.
- The internal data resources used by the leading insurers can be used to streamline, improve, and target their business processes where premium/ pricing constraints are real and enduring, lowering their effective delivery cost of their insurance products and their total cost of risk, and enabling the pursuit of specific profitable subcategories of risk in areas of business that were formerly "out of bounds."
- Business intelligence (BI) forms the most critical component of claims management, helping in fraud detection and claims estimation. On the asset management side, it can lower the insurer's risk through sophisticated risk models developed using data mining tolls.
- The insurance industry is totally dependent on the ability to convert raw data into intelligence – intelligence about customers, markets, competitors, and business environment. Over the years data processing technology has progressed phenomenally and tools like data warehousing, OLAP, and

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data mining, which constitute the cornerstone of an effective business intelligence (BI) environment, have been widely accepted across industries.
- The insurance industry is extremely divided in its adoption of business intelligence environment based on technologies like data warehousing, OLAP, and data mining. Efficiently gathering the information requirements of all the user groups is thus extremely critical for the success of any data warehouse.

Abstract. In this section, the application of business intelligence tools like data warehousing, OLAP, and data mining in insurance and insurance underwriting decision support systems are presented.

In this section we explore background trends and concepts relevant to the insurance underwriting process and overview specific areas where we believe data mining technology can be deployed to improve certainly and efficiency – two important business objectives to insurers at this stage in the industry's evolution.

As customers know, data mining involves the application of technology, relevant business knowledge, and a creative approach to problem solving, to the achievement of defined business objectives. Since data mining has inherently "horizontal" technology, it can be applied in a wide range of enterprises to continuously improve business decision making. Innovation is the order of the day in the insurance industry as providers grapple with a range of business challenges. We suggest that the innovation use of data mining technology in the underwriting process is an area worth exploring.

The insurance industry is totally dependent on the ability to convert raw data into intelligence – intelligence about customers, markets, competitors, and business environment. Over the years data processing technology has progressed phenomenally and tools like data warehousing, OLAP, and data mining, which constitute the cornerstone of an effective business intelligence (BI) environment, have been widely accepted across industries. However, insurance companies have been relatively slow in adopting these tools, primarily because of lack of competition due to protective regulations. But now, they can no longer afford to be complacent as the Internet, deregulation, consolidation, and convergence of insurance with other financial services are fast changing the basic structure of the industry.

20.1 Insurance Underwriting: Data Mining as an Underwriting Decision Support Systems

Persistent overcapacity in the insurance industry has reached the point where more competition on price would be suicidal for carries. This inability to make further concessions on price has shifted the locus of competition to the quality of products and services being offered. Lowering the total cost of risk will require more than simple price cutting. To increase revenues, insurers, reinsurers, and brokers will need to add value to their clients by:

- Enhancing ancillary services such as risks control and claims handling.
- Customizing products for individual industries and individuals clients.

- Finetuning of existing products or developing new ones to address emerging and nontraditional risks.

20.1.1 Data Mining and Insurance: Improving the Underwriting Decision-Making Process

The discussion on business applications of data mining technology in this section is industry specific (insurance). We focus on a core competency and critical business process for insures (underwriting) – a domain with clearly defined "business rules." These business rules are typically developed using traditional statistical tools and methodologies (actuarial analysis), codified for further reference and guidance (an underwriting manual or polices), and administered by highly skilled professionals (underwriters). These professionals apply judgment and discretion, based on their training and experiences, to obtain defined business objectives (an underwriting break-even or profit position at the lowest possible cost to insured and at the lowest possible risk to the insurer).

At ANGOSS Software Corporation they market the data mining solutions as enabling technology that "help businesses make better business decisions every day." This discussion is meant to be informative and illustrative of the broader ways data mining technology can be used to optimize (validate, debunk, and refine) the core business rules that guide decision making in many industries. Many of the underlying concepts and approaches outlined in this section apply equally to the core processes of banking, telecom, retail, and other enterprises. This discussion assists the insurance users in generating dialog, within their companies, about areas where data mining can be applied to evaluate and refine the business rules and processes that form the basis of their underwriting polices.

The approach is not rocket science, but we think it involves more than simply actuarial science; at least as traditionally understood and practiced by actuaries in large insurance organizations. Hopefully, the readers will find some of the themes and ideas presented here useful, regardless of their industry background. We were warned never to watch how sausages and laws are made. Some would say the same thing about decision making in large organizations.

"Gut instinct" and "tribal knowledge" have always played an important role in business decision making for companies large and small. With government oversight and "following the market leader" becoming less important in insurance and elsewhere, most businesses are finding far broader flexibility to chart their own course.

Increasingly, business decision makers face the task of absorbing, analyzing, and acting on the knowledge contained in their own data, as well as in external data sources relevant to their particular business. This intuitively obvious cliche has been overworked by "big ticket" sellers of technology in such areas as "data warehousing," "enterprise relationship management," and

"knowledge management," but it is understood by most businesses to be of central and growing importance to their business success.

Properly managing and executing projects revolving around data analysis often seems like a Herculean task – fraught with bureaucracy, political risk, and uncertain business outcomes. This is why advocates of data mining in operational systems – especially "core competency" zones like insurance underwriting – must make sure their course is well charted early on, by engaging senior executives, and proceeding incrementally to define and consistently achieve or exceed stated business objectives.

The high-level "pitch" for data mining in insurance underwriting is that consistently having a sound understanding of underlying patterns, trends, and relationships that impact on strategic and operational success ahead of industry peers, and acting on these findings, can enable a sustainable advantage in competitive markets. In this respect, equipping underwriters with the more flexible, automated decision support systems data mining enables is good business – it is driven by the recognition that the underwriting process itself is undergoing fundamental stress and change as insurers seek to evolve their businesses.

The "fear" is that others may already be doing what the organization's structure prevents from achieving. Despite the industry noise, moving incrementally is a very sound approach – but movement is strongly advised! And do not accept arguments that "data quality" problems exist, that "data" is not available, that "we don't need to do this," or "we are already doing this." The "data" is not the obstacle; organizational complacency is.

Even for many large organizations, underwriting decisions are still driven largely by imperfect knowledge, fixed underwriting policies and procedures that resemble sledgehammers more than scalpels, and ultimately the "gut instinct" of underwriters seeking to maintain existing business and win share in a soft and highly competitive market.

ANGOSS Corporation Customers knows that data mining technology – at its most simplistic level of use – is a flexible and affordable business decision support tool. Data mining technology enables users to explore internal and external data sources, in the context of defined business objectives, to achieve deeper understanding of the underlying drivers of their business success.

When properly understood and used, data mining technology can help enterprises chart their business course aggressively, with higher confidence in more certain outcomes. It is this distinct benefit of data mining – its ability to reveal patterns and relationships in large volumes of data and generate a range of predictors with specified confidence levels – that is of special relevance to those tasked with the underwriting function in insurance businesses.

Insurance companies, like others, face major challenges in their core business as we move through the next decade. The following are some of the relevant trends and developments:

- Increased competition among insurers in both traditional "commodity" lines (automobiles, life and home owners' policies) and more complex insurance products (commercial P&C, workers' compensation, and benefits) for market share.
- Mergers, divestments of entire lines of business, and "demutualization" are preludes to further industry consolidation, rationalization, and specialization.
- Increasing dependence among insures on investment gains (rather than returns from the underwriting process) for bottomline earnings growth.
- Increased capital flows from external sources to reinsurance markets, lowering margins (and profitability) of this business to existing insurers.
- Emergence of technologically savvy "dot com" competitors for certain insurance business lines and insurance functions.
- Repositioning of major insurers around "core competencies" (lines/functions/outsourcing/"back office" services provision)
- Distribution/channel challenges (managing captive versus independent brokers and agents in an "on-line" business environment)
- The shifting of "insurance intermediaries" (third-party claims administrators, consultants, brokers, adjusters, and data source providers) to technologically more advanced on-line delivery and fulfillment systems more closely integrated with insurers own front- and back-office systems.

Despite relatively high levels of profitability, substantial reserves, and limited catastrophic losses in recent years, insurers are collectively fighting – and largely losing – decades old battle to regain lost profitability in their core underwriting business. So where does data mining fit in to all this?

An insurer chooses to accept a given risk because it can find a set of "terms" on which the particular risk can be assumed and the business can be profitably written. These terms comprise four general types: premium rates, policy provisions, the hazard presented in the risk, and the related reinsurance arrangement. As we move forward "risk" is coming to mean not only traditional hazards but broader organizational risks – political, trade, financial, and strategic risks formerly outside of the purview of insurance.

The underwriting process is central to the acceptance of any risk – and the defining and documenting of the terms of that acceptance. Underwriting is typically not a "no" decision but rather a "yes, but" decision. The "but" part of the equation – being the terms of acceptance – is a dynamic and continuously evolving process based – among other things – on consideration of all available relevant (past) data, which may impact on the advisability and cost of assuming a given risk.

In large measure, traditional actuarial analysis – based predominantly on benchmark indicators (such as mortality and morbidity analyses in life and benefits domains) and on the shared information or "collective" tribal knowledge flowing from industry wide statistics (advisory ratings, aggregate loss data and the like) has been used to define "underwriting procedures."

Everyone appreciates how far insurers have come since the early days at Lloyds where risks were formally presented for endorsement and acceptance, but few truly appreciate how far. As the concept of risk broadens to encompass new kinds of risk financing and risk control, an ever-broadening range of data from disparate sources can be found to impact on the entire insurance underwriting process – increasingly in real time! One ANGOSS customer explored a range of social, political, and economic indicators in the context of a dependent variable of "political insurrection" to seek predictors of instability. Lunacy? Or an enlightened attempt to define underwriting parameters for political risk insurance?

And though business in the "front office" at Lloyds may appear to be conducted in much the same fashion, as it was hundreds of years ago, times have definitely changed for tomorrow's leaders in the insurance industry. Leaving aside the technology hype, modern database technologies, as well as "e-business" and supporting infrastructure technologies represent en entirely new kind of "plumbing" – an on-line, real-time "digital nervous system" for the 21st century.

All of these technologies combine to offer exponentially greater interconnectedness and data sharing for insurers and the intermediaries they interface with at an operational level. This connectedness enables a breadth, depth, and speed of analysis – both of internally generated and externally sourced data – that is far more substantial than was considered possible even a decade ago. And good data mining software loves large volumes of data!

Leading insurers (and they are not always – or perhaps even often – the largest ones) know that by making investments in these infrastructure technologies they will be able to achieve substantially greater operational efficiency, while building up substantial internal data resources. These resources can be used to streamline, improve, and target their business processes where premium/pricing constraints are real and enduring, lowering their effective delivery cost of their insurance products and their total cost of risk, and enabling the pursuit of specific profitable sub-categories of risk in areas of business that were formerly "out of bounds."

Examples of enabling technologies that "set the stage" for data mining are rich and varied. They include:

Wireless connectivity to databases, enabling sales agents, claims adjusters, loss control experts and other intermediaries in the field to transmit data to and from their "host" insurer in close to real time. The Internet itself, which enables a range of interactions – "personalization" of information on the customer side, "self-service" investigation of pricing and product options, "self-reporting" by submitting applications and ongoing information, and ultimately, the "binding" of a broader range of insurance contracts to customers in near-real time.

The flexibility, scalability, performance, and declining cost of modem database systems from major vendors like Microsoft, IBM, and Oracle – and the solutions of thousands of application vendors supporting predominantly the

Microsoft database environment – provide unprecedented levels of flexibility in constructing, linking, and analyzing databases quickly and efficiently. Secure payment, funds transfer, outsourced third-party claims administration, and other technology improvements enable more efficient – but still integrated – administration, settlement, and analysis of payments and claims experience.

20.1.2 What does an Insurance Underwriter Do?

Underwriter as Gatekeeper

Few outside the insurance business have a full appreciation of the technical, legal, political, and practical skill set that defines the role of an underwriter in an insurance business. In general underwriters are tasked with the responsibility of assessing – accepting, rejecting, and revising – insurance contracts that the insurer's distribution channels and marketing systems bring forward for consideration.

In this sense they are the "gatekeeper" of the insurer's core business. Their primary goal is to achieve stability of results – particularly the avoidance of wide variations in annual loss ratios – while making adequate protection available to customers at the lowest possible cost. Expressed as a business equation, the revenues derived from insurance premiums should meet or exceed the amount paid out on account of claims, the expenses of securing and administrating their book of business, and enable a profit contribution to the insurer.

Few inside the industry responsible for overseeing the underwriting function fully appreciate how technology is changing and will continue to change the underwriting process. Underwriting decisions traditionally made with "sober reflection" must now be made for competitive reasons in closer to real time with no sacrifice of certainty in outcome. Technology and business imperatives will require that underwriters' reliance on their experience and knowledge of the "rules" must give way to a more flexible but still certain business environment where underwriting rules – permitted risk categories, rating structures, specific, specific terms, and the like – may change rapidly and continuously.

As noted by Marsh & McLennan, within the constraints of government regulation (and subject to the "suicidal" impulses of insurers seeking to expand market share without regard to underwriting costs and losses) traditional "ratings" or sledge hammer approaches to broad classes and categories of risk will increasingly be replaced by customized insurance solutions tailored as to terms to specific customer types and specific industry requirements. Ironically, this objective runs counter to traditional underwriting approaches of diversifying and spreading risk. As a result, the "underwriting procedures manual" of the future is far more likely to be a complex series of nested business rules compiled electronically and continuously optimized and updated for "risk blending" to reflect an insurer's analysis and knowledge of all relevant

data to the risk being underwritten and managed across its entire organization.

The traditional approach of basing underwriting decisions on the "law of averages" through time, is being replaced by the recognition that (to paraphrase Keynes) in the long run, insurers operating solely on the "law of averages" will be out of business. The flexibility of modern technology makes far more rapid (and informed) adjustment and optimization of underwriting business rules possible. Within the remaining regulatory and self-regulatory constraints insurers face, the proactive leaders in the industry will seize on these developments for competitive advantages.

General Principles of Underwriting

In opposition to the underwriter's goal of achieving stability and profitability is the fundamental principle of "adverse selection" found throughout the field of insurance – the tendency of insurance applicants in many categories to include a preponderance of "poorer than average for class" risks. Adverse selection arises because of both moral and other hazards – the tendency of those most likely to avail themselves of insurance to seek it out. In performing his or her role and mindful of this fundamental touchstone of risk, an underwriter seeks to achieve fundamental objectives linked to sound underwriting principles. These include:

- Spreading of risk, by committing the insurer to as many different and distinct risks as possible so as to permit the "law of averages" to apply.
- Uniformity of application, by pursuing a coherent enterprise-wide underwriting policy that is designed to achieve predictability and certainty of results across the organization.
- Continuity of risk, by ensuring that the insurer develops a "seasoned" portfolio of business so that the "law of averages" has the time to work.
- Blending of risk, by taking on within each class/type of commitments underwritten by the insurer a sufficient number of commitments of similar type to produce stability of results.

Information Sources

As part of the process of reviewing and defining the terms for any risk, an underwriter, theoretically at least, has available a range of internally and externally sourced data, including applicant-supplied information, through basic application and other information submitted on an ongoing basis.

Insurer-maintained information, obtained through sales representatives (reports and recommendations), claims administration information, information on the covered risk (such as zoning, construction, municipal building code, and similar information on properties), and "site-specific" information (from

adjusters, loss prevention experts, brokers, benefits consultants, and other intermediaries involved in the insurance process), third-party-sourced information, from external data sources such as third-party administrators, as well as private reporting sources such as Dun & Bradstreet, Experian, Claritas, Acxiom, and other providers. Industry information provided by insurance bureaus and self-regulatory organizations, including "experience statistics," advisory rates, and other "ratemaking" data such as trends, equilibrium, and expense factors, and permissible loss costs.

Government information, including data made available to the insurance industry as part of the insurance regulatory process and data made more generally available such as census data, economic performance indicators and the like. This has always been the case. However, in practical terms, and in the absence of fully integrated systems enabling rapid access to and linking of all potentially relevant data, insurers have relied quite heavily on imperfect knowledge to complete such analysis and codify procedures in acceptable forms for administration. Underwriting decisions have involved a combination of the "tribal wisdom" codified in writing manuals: constructed with heavy actuarial influences; and the knowledge and experience of their underwriting professionals in interpreting and applying those rules.

In recent years – and particularly with the advent of the Internet – entirely new means exist to acquire, analyze, exchange, and act on a wide range of relevant; useful data. The underwriting function is itself being transformed – because both changing technology and changing business conditions demand this. Moving forward, underwriters (or their decision support professionals) must have access to all of this data and be able to explore, analyze, and respond to the patterns, trends, and relationships that they discover in it.

Although data mining does not hold a monopoly on insight in this area, it can offer unique means of drilling into, exploring, and understanding trends, patterns, and relationships in data. In addition to efficiently handling the garden variety data mining tasks of most interest to an insurer's sales channel (define a "good prospect," what are good predictors of a particular product sell – cross or up, what are the key indicators of attrition so that we can intervene and preserve my customer account) data mining technology can be invoked in a wide range of the areas. The following are examples of the kinds of analysis enabled by well-designed systems, which capture and leverage all available data relevant to risk:

Based on all available data we have access to, what are the key drivers, or predictors an underwriting loss with respect to common customers, categories of risk, classes of risks, or across the entire portfolio of assumed risks? What is the relationship, if any, between the "personalization" attributes of specific customers (defined by their interactions with captive agents or brokers who are submitting information to the database and ultimately by their "self-reporting" of this information on-line)?

What is the relationship, if any, between crime statistics, unemployment levels, changes in property taxes or the indicators or instability (at all levels)

and property claims for purposes of pricing a homeowner's policy in a specific area? What is the relationship, if any, between third-party auto claims for theft and vehicle types and how has this changed since last year.

What is the relationship, if any, between urban growth rates and the incidence of auto accident related claims? What is the relationship, if any, between the numbers of PC-based workers in an organization and the cost of an employer benefits plan that offers prescription eye wear?

What is the short-term stress leave claims experience for females in a company with no maternity plan compared with that of a company with a generous maternity and early childhood program? What would be the impact of a change in the deductible threshold for a particular policy or customer type based on claims experience across all classes of risk with differential deductibles? What happens when we experiment with the deductible rules?

These are illustrative examples of a wide range of analytical and exploratory techniques that can be used by underwriters to move far beyond traditional "advisory ratings" or based procedures to accept specific insurance risks.

Being able to automatically explore relevant data – to hypothesize and search for patterns, relationships, and anomalies in the context of defined business objectives – can help guide insurance underwritten in their assessment of risk and in their "yes, but" interactions with their sales channel. They can also act as "probes," guiding actuaries and decision support professionals into areas that would otherwise not have been considered as being related to relevant to risk. Even where traditional statistical measures of confidence may not have been achieved, this process of interactively exploring and understanding patterns and relationships in data can inform and improve the underwriting process because it invariably yields new knowledge to the underwriter.

Should We Go by the Book, Toss the Book, or Write New Chapters?

In virtually all large organizations, underwriting policies are established, codified, signed off on, and implemented after careful consideration and review of a range of business factors. Basic underwriting guidelines and requirements, as well as procedures for varying from them, are carefully developed, documented in manuals (and to some extent, in customized underwriting software applications), and learned through training and continuing education, as well as application in business cases. These codified rules represent the "tribal wisdom" of the specific insurer that has established them.

Data mining helps improve business decision making in large measure by identifying areas where the "tribal wisdom" documented in corporate policies, procedures, manuals, and guidelines ("going by the book") is right, and where it may be wrong – as well as exploring the shades of gray in between. As one area of investigation, then, any insurer can benefit from an exploration of its

data in the context of its existing underwriting rules and procedures currently in force.

In areas where data mining reveals that "the book" is clearly right or clearly wrong the business benefit is immediate and obvious; the necessary can be implemented or are unnecessary. In addition, as part of its ongoing relationships with its insurers, information gleaned by the underwriter from its analysis of its own can be shared to build a relationship of more long-lasting value (We know the analysis shows that where customers of the size and type introduce a "wellness" program at work their claims experience improves by X per year in Y% of the cases).

It is in the gray areas, where judgment and "domain experience" is necessary, and perhaps where the margin between profit and loss hangs in the balance, the data mining can assist the underwritten best. An underwriter equipped with the tools at his or her disposal to explore and understand these gray areas can make the judgment calls – the "yes, buts" in choosing to accept specific risks – that are the core skill set of their profession on a more informed basis.

Many insurers, for example, may have concerns over providing workers compensation or other benefits insurance to seasonal employers, industries characterized by high personnel turnover, or work forces with other specific attributes that are defined as being "higher than average" risks. But does their own support this kind of hard and fast approach across entire categories of businesses?

Joining third-party data store information – for example classification, industry information, and customer-level information from a third-party service like Dun & Bradstreet – to claims-related information from an insurer's database may reveal that this is not true, or perhaps true in enough cases to be a strong "general rule" but definitely untrue in others where business may be profitably done (for example, residential construction firms that under x employees and revenues of less than $y operating in a regional market with growth rate above z typically provide a much more stale claims profile regardless of cyclical factors that otherwise impact on risk).

Data mining technology, by rapidly exploring all claims data – whether in any specific class of business or across the entire portfolio – can illuminate for review the historical patterns and relationships between claims and all other selected data elements. This type of analysis may confirm the utility of specific riles, demonstrate that they are incorrect and unnecessary barriers to business, or provide a range of intermediate "but" exceptions that suggest the rules are generally correct but valid (or invalid) in specific instances. These intermediate rules may enable an underwriter to rapidly respond – with specific and appropriate terms – to applicants who may fall within the category of the "general rule" but also are within the "specific exceptions" to it.

Similarly, an insurer may wish to analyze its entire portfolio of residential homeowner policies by captured dimensions – geocoding, household data elements, claims experience, advisory ratings, and application information

– to determine if there are useful predictors that impact on a variable pricing mode for a commodity insurance product. This analysis may be used to implement a set of business rules deployable "on-line" in real time to enable their captive brokers to have much broader "binding authority" over more business lines with some level of control and balances (more sophisticated electronically embedded underwriting rules).

The principle of "utmost fidelity" of the insured in an "e-business" insurance world can also be used to advantage by indicating to customers and prospects that pricing and delivery of insurance products to them is based on the accuracy and completeness of the information they have provided. Over-reliance on misplaced confidence in external data sources is always in "x factor" worth remembering. However, on balance the business benefits of having access to richer data dimensions far outweighs this potential concern.

At the core of the current evolution in the underwriting process is the recognition that traditional underwriting approaches have generated – on balance – a poor record of performance, and that the underwriting process is itself changing as technology and business imperatives force more rapid decision making involving the administration of larger classes of risk, which must be assessed in the context of ever-growing volumes of potentially relevant data.

By adopting and implementing data mining as a decision support function in the underwriting domain insurers are not seeking to displace personnel with "model managers" or "underwriting robots." They are seeking to substantially improve the overall "intelligence" of their decision support system so that today's "tribal knowledge" can be refined (and redefined) tomorrow and dynamically thereafter based on what has happened today and every day prior to today.

What Challenges Does an Underwriter Face?

The underwriter can currently be seen as the "fulcrum" between the sales and risk management functions within an insurance organization. "Sellers," whether captive agents or independent brokers or other intermediaries, are mandated with the responsibility of generating new business (including renewal business). This group seeks confirmation of insurance availability as quickly as possible at the most competitively attractive rates in order to ensure market share growth (and their personal compensation). Risk managers, on the other hand, are mandated with the responsibility of ensuring that the insurer's policies and procedures for the assumption and sharing (through reinsurance) of risks are appropriately implemented.

The underwriter stands between the sales force in the field (give the best pricing; it is war out there) and the actuarial and risk management personnel (have we identified and assessed exposures associated with this piece of business based on claims experience and have we managed this risk?). In the world where the largest insurance firms are consolidating, and where on-line/real-time quotations, pricing, and placing of insurance are becoming a new and

viable distribution channel for various insurance products, the time dimension of the underwriting process has its own significance.

20.1.3 How is the Underwriting Function Changing?

The goal of underwriting, expressed as a simplistic formula ignoring such factors as time, the investment P&L and indirect enterprise costs, can be roughly stated as follows:

$$P = A + B + C$$

where P is the premium income from a class of risks, A is the acquisition cost of the business, B is the direct cost of administering the business, and C is the loss experience/payout on the business Looking back at the industry trends highlighted earlier, a sustained (and arguably unsustainable) disequilibrium has existed for many years in this equation (largely offset by a large "G" – the gains delivered from investing premium streams – and small "L" the category of "catastrophic losses"). In increasingly competitive markets there is pressure (tightening) on premium income, which means the addressing of chronic underwriting losses must be addressed through other means.

Unless insurers are content to generate continuing unacceptably high loss ratios on their underwriting business (a result that the "law of averages" suggests would have significant adverse consequences in circumstances where their offsetting investment gains decline, or where catastrophic losses materialize) changes must occur in the cost dimensions of the equation. The corresponding changes in operations this result necessitates are:

- Improving efficiencies in the acquisition of business (acquiring complementary business lines; providing "on-line" channels for attracting new business, and establishing systems to differentiate at a far deeper level potentially good risks versus bad one, are good examples)
- Lowering the administration costs associated with the business (merging operations, outscoring noncore functions of giving up "back office" entirely; as well as improving efficiencies in the administrative of the business by automating process, etc.)
- Improving the loss claims ratio and reducing claims by a range of proactive polices (from "barring" certain types of risks from the underwriting process, through loss prevention and loss reduction, to focused investigation and analysis of claims fraud and abuse)

20.1.4 How can Data Mining Help Underwriters Make Better Business Decisions

Despite the role that data mining – as an analytical solution – can play, we believe it is a mistake to assume that underwriters are going to become or indeed should be "data miners." The nature of their role makes this impractical.

However, underwriters should be direct and substantial consumer of data mining outputs – both descriptive analysis and predictive models; prepaid for their assessment and refinement by decision support professional in insurance organization tasked with this responsibility.

In addition, to facilitate both the process of model generation (a decision support task) and model consumption (an underwriting function) insurance organization should have a long-term action plan in place to exploit key evolutions in technology that are directly relevant to their needs and competitive success. This means not only developing underwriting solutions as "dynamic, expert systems" with a higher level of data mining intelligence built into them, but also implementing complementary technology improvements in other organizational areas to ensure that the data analysis functions central to "next generation" underwriting system across the organization can be preformed continuously, quickly, and efficiently.

In the board sense, an organization commitment to data quality and an understanding of the importance of gathering, analyzing and communicating knowledge derived from data analysis is key to success. Specific examples of areas where the "data capturing" infrastructure can be finetuned to assist include the following:

- Common application forms across the organization for each type of insurance product we offer containing "required filed" data entry to fuel the analysis engine. Emphasis on continuous incremental improvement in the scope and accuracy of data captured of data captured is key. Sales and distribution channels, as well as customers, must be "plugged in" and be given incentives to collaborate in this process.
- Making applications and related processes for the delivery on insurance products and related serious as much as possible an electronic process, with flexible and robust interfaces.
- Enabling channel representatives – captive agents and brokers – to access and submit data with respect to applications electronically.
- Ensuring that supporting personnel – such as adjusters, site inspectors, and loss prevention experts – also are plugged in to insurer database and incentive to collaborate; filing reports electronically and capturing additional supplement data relevant to risk.
- In personal line businesses, ensuring that customers and prospect interactions take place at a "household" level and that these interactions also capture data relevant to both risk and future potential sales or services opportunities.
- In business lines, tracking customers and prospects by multiple data elements, including standard dimensions that permit cross comparative analysis (e.g., number of employees, D&B DUNS identifiers, and "key indicator" scores).

20.2 Business Intelligence and Insurance – Application of Business Intelligence Tools like Data Warehousing, OLAP and Data Mining in Insurance

What is the most important pre-requisite in today's volatile marketplace? The answer is rather straightforward – "information," or more precisely, "actionable information." For no other industry is it as important as for the insurance industry, which is almost totally dependent on current and insightful information. This is exactly what business intelligence (BI) tools like, data warehousing, data mining, and OLAP seek to provide. A close look at the insurance value chain suggests that BI can play a crucial role in almost every aspect of the chain. It can help identify the right customers for target marketing and analyze the reason for customer attraction. It can help the insurer better manage its agents and sales force and improve the effectiveness of actuarial and underwriting functions. BI forms the most critical component of claims management, helping in fraud detection and claims estimation. On the asset management side, it can lower the insurer's risk through sophisticated risk models developed using data mining tolls. And most importantly, BI tools can help insurers provide crucial information to corporate clients, which can go a long way in cementing the insurer's relation with the clients.

Late seventeenth century was an era of growing international trade. New shipping routes were discovered and adventurous sailors brought exotic products from strange and alien lands. But their journeys across the oceans were fraught with danger and unknown risks. This gave rise to a new breed of entrepreneurs – marine underwriters – who agreed to cover the losses in return for a fixed amount of premium. Their business depended on current information about the sea routes, pirates, political condition, weather patterns, conditions aboard the ship, and consumer tastes for exotic products. In order to acquire business information, many marine underwriters began to frequent Edward Lloyd's coffeehouse in London. This was the place where they could share business intelligence with other underwriters and captains of trading to form a society that went on to become the most famous of all insurance companies – Lloyd's of London.

The very "business intelligence" that brought together the marine underwriters at Lloyds' is, if anything, much more crucial for the insurance industry today. It pervades almost every aspect of the value chain and technology has the potential of making it ubiquitous across the organization. Today, an underwriter would not go to a coffeehouse to gain business intelligence, but, probably, to get away from it. And one thing is sure: she cannot afford to stay in the coffeehouse for long.

20.2.1 Insurance Industry Overview and Major Trends

The insurance industry is quite diverse in terms of portfolio of products provided by different companies. The products can be broadly classified into two

product lines: property and casually (P&C) and life insurance. Life insurance product line can be further subdivided into life insurance, health insurance, and annuity products.

Growing consolidation and change in the regulatory framework has led many insurers to add new products to their portfolio. This presents its own unique challenge to the insurer in leveraging its greatest asset data. A number of other trends in the insurance industry have also exponentially increased the importance of an effective business intelligence environment; at the same time, these trends are responsible for increasing the complexity of building such an environment.

Growing Consolidation: Consolidation is a major force altering the structure of insurance industry, as insurers seek to create economies of scale and broaden their product portfolios. The aggregated value of mergers and acquisition was $55.7 billion in 2000, up from $41.7 billion in 1999, and a mere $8.5 billion in 1993.

Convergence of Financial Services: Mergers and acquisition of insurance companies with other financial service providers like banks have led to the emergence of integrated financial services companies.

New Distribution Channels: New distribution channels are fast catching up with the traditional insurance agent. Though these channels are not a major threat as yet, they are rapidly changing the way insurers and customers interact with each other.

Focus on Customer Relationship Management: The only viable strategy for insurers today is to focus on the needs of the customers and strive to serve them better. Customers have extremely differentiated needs and, also, the profitability of individual customers differs significantly; hence, an effective CRM strategy becomes the most vital component of an insurer's overall business strategy.

20.2.2 Business Intelligence and the Insurance Value Chain

During the last three decades, insurance companies acquired significant product development capabilities; but they lagged behind in truly understanding the customer. This led most firms to develop products that they could, rather than those required by their customers. But during last few years, deregulation and growing competition has forced insurance companies to move from traditional product-centric operations to customer-centric operations.

To succeed in this market, insurers have to analyze their customer's needs and tailor all the business processes in the value chain to effectively meet their unique requirements. Implicit in this argument is the assumption that insurance companies have the ability and policies to change theminto actionable information. Business intelligence tools like data warehousing, OLAP, and data mining can significantly help in almost all the aspects of the value chain

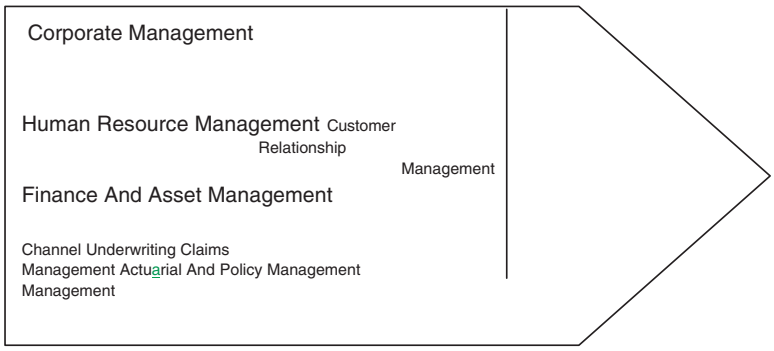

Fig. 20.1. Insurance Value Chain

to achieve this objective. Figure 20.1 illustrates the insurance value chain. In the following discussion we focus on some of the business intelligence applications in each block of the value chain.

20.2.3 Customer Relationship Management

A typical insurance company has a huge customer base, varied product lines with a number of products with each line, many distribution channels, and a market spread across geographies. To effectively interact with customers and design suitable products, the insurer's CRM strategy has to fully utilize the potential of technology. The insurer has to leverage the vast pool of data at each step in the CRM process, and the use the insight gained for developing new products and services to meet the ever-changing needs of the customers.

The CRM process is an insurance company and has three steps:

1. Identify the most profitable or potentially profitable customers for future interaction.
2. Understand their needs and buying patterns, and
3. Interact will them so as to meet all of their expectations.

Figure 20.2 illustrates the role of business intelligence in each step of the CRM process. Right from identifying the most profitable customers to improving the overall quality of customer interaction, BI tools can go a long way in making the insurer's CRM strategy a roaring success.

Customer Profitability: Rather than simply acquiring new customers, it is vitally important to retain and increase the profitability of existing ones. Identifying the most profitable customers is the first step in that direction. To arrive at the overall profitability of a customer, insurers must quantify (a) the costs involved in serving the customer over a period and (b) the revenues realized from the customer during that period. The results of customer profitability analysis can point toward the reasons behind why some customers are not

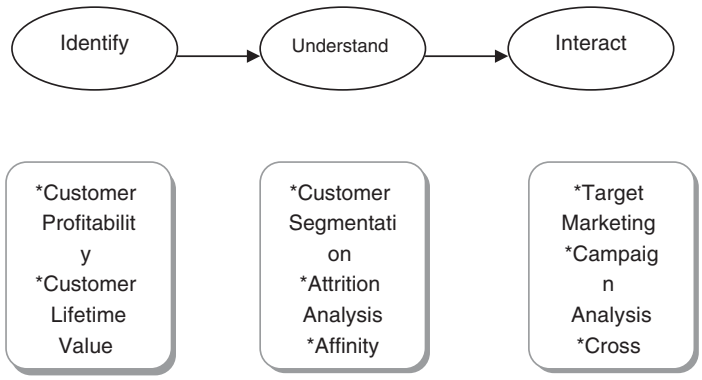

Fig. 20.2. Business Intelligence and CRM

as profitable as others are. For example, a customer might be unprofitable because the products used by her do not match her risk profile. Customer profitability analysis can significantly help in developing new product and customizing existing products for a customer or customer segment.

Customer Lifetime Value: Customer profitability is not the sole measure of a customer's value to the insurance company. A customer may have the potential of buying profitable products in the future; she may also serve as an excellent reference for more profitable customers. Customers lifetime data (LTV) is, hence, a more insightful measure. Often data mining tools are used to model customer lifetime value, taking into account all the factors that have a bearing on the customer's value over the entire course of her relationship with the insurance company.

Customer Segmentation: Segmentation is used to segregate customers, who exhibit common characteristics, in different segments. These segments can then be treated as distinct entities and the future interaction with them can be tailored accordingly. Customer segmentation can save a lot of marketing effort, which would otherwise go waste. Often data mining tools are used for customer segmentation. These tools use "clustering" algorithms for segmenting the entire customer base into clusters, identified on the basis of various demographic, and psychographic factors.

Attrition Analysis: Studies have shown that across industries, acquiring new customers is much more costly than retaining existing ones. This is especially true for insurance. Typically, buying an insurance product is a long-term decision for a customer; and if she decides to switch, it is very likely that she will not come back. Hence retaining the existing customers is of paramount importance; customer attrition analysis is the first step in this direction. It involves analysis of data captured during individual customer contacts at the various touch points. For attrition analysis, customer contact data is coupled with other data sources like claims and policies; the resultant data set is then

associated with customers who have switched to analyze the possible reasons behind this decision. The results can also be used to improve the performance of customer touch points.

Affinity Analysis: It is often referred to as market-basket analysis. Certain products show an affinity toward each other and are likely to be bought together. For example, a man in his early thirties who buys a life insurance policy might also be interested in a certain type of annuity. These affinities can be, at times, extremely difficult to unearth and often data mining tools are used for this purpose. These tools use a technique called "association analysis" for arriving at the right combination of products and services for a customer or customer segment.

Target Marketing: Target marketing – marketing to a specific customer group – is a natural outcome of customer segmentation. Once distinct customer segments are identified, BI tools can be used to study the products likely to be bought by the segment. Often data mining is used to develop predictive models to establish the buying propensity of a segment toward various existing or new products. Armed with this knowledge, marketing managers can design specific campaigns targeted at individual segments.

Campaign Analysis: Campaign analysis is used to analyze the effectiveness of marketing or promotion campaigns. The effects of particular campaign on sales of the promoted product can be tracked using BI tools. Often the surge in sales of the promoted product can result in decrease in sales of other related products. BI tools can also help identify such relationships. The campaign data is stored in a data warehouse and can be used to predict the effectiveness of similar campaigns in future.

Cross Selling: Cross selling is a major source of revenue for insurance companies. For effective cross selling, an insurer can leverage the data – housed in the data warehouse – to quickly zero down on the new products that would be required by its existing customers. These can then be offered to them during the next contact.

20.2.4 Channel Management

Traditionally, insurance companies have relied on independent agents, brokers, and direct sales force for distributing their products. These are still the primary distribution channels and are likely to remain so in the near future. Internet is emerging as a popular distribution option for each certain type of insurance products like auto insurance. But most of the insurance products have not been that successful on the Net, primarily because of the complex nature of transactions involved. Fear of channel conflict has also prevented many insurers from fully exploiting its potential. No wonder, most of the traditional insurers currently use the Internet only to provide information about their products. But one thing is sure: insurers will have to quickly integrate

the Internet with their existing channels. At the same time they will have to improve the overall distribution effectiveness via the traditional channels. BI tools allow insurers gain insight into the various distribution channels to help them intelligently address the various issues channel management:

Agent and Sales Force Deployment: Based on geography of its customer base, insurers can optimally deploy the right number of agents and sales persons in different locations. This analysis should also include the potential customers for new and existing products offered by the insurer.

Agent Development and Relationship Management: BI tools can leverage the sales data – stored in the data warehouse – to analyze the selling behavior of agents and sales persons. This analysis can identify the best agents and sales people who can then be adequately rewarded. The analysis can be extended to include more subtle behavioral aspects, which can be used to design training programs for agents. For example, some agents might just be selling certain products and totally missing out on others. This may indicate need for product specific training.

Channel Analysis: This involves calculating the performance of various channels. Using BI tools, insurers can compare the performance of various channels and drill down to the level of individual agents and products. The performance should be tracked over time so as to measure the effectiveness of corrective/developmental actions undertaken by the insurer.

E Business Development: A variety of analytics can be done on customer and transaction data captured via the Internet. This data should be integrated with data collected from traditional channels for a more meaningful segmentation of customers who buy policies over the net. This "e-segmentation" can help in designing campaigns specifically for the online customers. There is another source of potential useful data that can significantly help in improving online operations: Web log files. Web log analysis includes

Site Navigation: An analysis of the typical route followed by the user while navigation the Web site. It also includes an analysis of the most popular pages in the Web site. This can help in site optimization by making the Web site user friendly.

Referrer Analysis: An analysis of the sites, which are very prolific in diverting traffic to the insurer's Web site.

Error Analysis: An analysis of the errors encountered by the user while navigating the Web site. This can help in solving the problems and making the browsing experience more pleasurable.

Keyword Analysis: An analysis of the most popular keywords used by various users in Internet search engines to reach the insurer's Web site.

20.2.5 Actuarial

The actuarial function forms the crux of the insurance business. It involves estimating risk pertaining to the asset that is being insured. In case of life and health insurance it involves calculating the probability of accident or death based on various demographic, psychographic, and environmental characteristics. The task of an actuary is extremely complex and has strategic implications for the insurance company; it often takes up to ten years to become a certified actuary. An actuary can use sophisticated mathematical models – developing using data mining tools – to calculate future premiums and to allocate portions of a book of business for reinsurance:

Risk Modeling: Actuaries can develop predictive models using data mining tools, for identifying risk profiles of various customer segments. These models can include risk measures like mean claim amount, claim frequency, and loss ratios. For example, rich men who show propensity toward drinking and drive sports cars constitute a high-risk profile group. Various risk measures can be calculated for this customer segment, which can, then, be used for calculating at the right premium amount.

Reinsurance: A reinsurance company can take up a part of the insurer's risks in return for a part of the premium. In case of a claim, the reinsurance company will pay the corresponding claim amount. Actuaries need to decide the right amount of reinsurance in order to maximize the returns for the risk acceptable to the insurance company. Data mining tools can develop predictive models to arrive at the reinsurance level for the book of business based on the historical claims data residing in the data warehouse. These predictive models can identify suitable policies for reinsurance based on the loss experience of similar policies in the past.

Profitability Analysis: Profitability of the existing products can be tracked along various factors like product line, geographic region, agency, customer segment, etc. This is often that first step in predicting the viability of new products. Based on historical profitability, actuaries can also develop more sophisticated predictive models – using data mining tools – for estimating the marketability of new products and identifying the most profitable customer segments for those products.

20.2.6 Underwriting and Policy Management

An underwriter decides whether the risk undertaken by insuring a client is acceptable or not; and if it is acceptable, she determines the right amount of premium to be charged. Business intelligence tools can leverage the claims, loss, and others stored in a data warehouse – to help improve underwriting and policy management. Following are some of the business intelligence applications in this area:

Premium Analysis: Premium income is the primary source of revenue for an insurance company. Premium analysis allows the tracking of premium performance by a product or product line, a geographical region, an agency or a particular agent, and by a branch office. A variety of reports and analysis can be generated by "slicing and dicing" the data.

Loss Analysis: For some products or product lines, the premium revenue might be less than the cost of serving them. This loss, often termed as *underwriting loss*, may be due to inaccurate initial risk estimate. Insurers need to constantly monitor the loss data to determine the cost of getting new customers and renewing old ones for those products or product lines. This can help in improving profitability of underwriting programs and help insurers salvage their book of business.

20.2.7 Claims Management

The importance of claims management cannot be overemphasized. Speedy and effective claims handling forms the basis of sound customer relationship management. At the same time, the insurer has to guard against the ever-increasing specter of fraudulent claims. Insurance fraud is now very common in America, as a recent study by Insurance Research Council (IRC) pointed out that almost 36% respondents believe that it is acceptable to inflate claim amount to make up for the premium paid over the years. According to another study by the Insurance Information Institute, in the US alone P&C fraudulent claims amounted to a mind-bogging figure of $24 billion or 10% of the total claims in 1999. The figure for health insurance is believed to be almost four times that. Most of this addition cost due to fraud is passed on to the consumer as higher premium.

The opportunity cost of ineffective claims management is extremely high – hasty claim settlement can result in increased fraud-related costs and, at the same time, slow fraud detection can increases the overall claims cycle time, leading to higher customer dissatisfaction. No wonder insurance companies around the world are looking at technology for that "right" claims management solution. Experience of various companies suggests that without sophisticated analytical capabilities such a solution would remain an elusive dream. Following are some BI applications in claims management.

Claims Analysis: Claims analysis is one of the most common BI applications in the insurance industry. It involves analysis of the claims data coupled with other data sources like underwriting and policies. It is primarily used to gauge claims processing efficiency, which has a direct bearing on customer satisfaction.

Claims analysis is also used to understand subtle business trends in claims, which would have been otherwise difficult to spot. Typically OLAP tools are used to analyze and drill down to the detailed level for a better understanding of these trends. For example insurers can use this data to analyze trends in

claims and loss patterns, which can help optimize reserve management, leading to lower risk and more available funds for investment. Claims analysis can also help in spotting fraud by analyzing above normal payoffs along different factors like geographical region, agent, and insured party.

In cases of health insurance, claims analysis can reduce abuse by analyzing the behavior of various practitioners. It can spot practitioners who have been consistently prescribing expensive medicines and tests in cases where they are not required. The analysis can also include other procedures and practices like the average length of hospital stay followed by the practitioner.

Fraud Detection: The likelihood of fraud in a claim can be detected by sophisticated analysis of claims data coupled with other internal or external data like payment history, underwriting, and ISO Claim Search Database. Data mining tools are typically used to develop models that can spot patterns in fraudulent claims. A claim, which shows fraud-related symptoms, can be sent to the Special Investigations Unit (SIU) for further investigation before the actual payment is made.

Claims Estimation: The actual value of claims cannot be known beforehand when a new product is launched. In such cases, an estimated value has to be set aside in the form of cash reserves; and such funds cannot be used for long-term investments. The accuracy of these estimates has far-reaching impact on the profitability of the insurance company. OLAP tools can be used to do an analysis on the claims data across geographies and customer segments to arrive at better claim estimates. For higher accuracy, data mining tools can also used to develop sophisticated claim estimation models.

20.2.8 Finance and Asset Management

The role of financial reporting has undergone a paradigm shift during the last decade. It is no longer restricted to just finances required by the law; increasingly it is being used to help in strategic decision making. Historically, interest earned on investments has been a major source of income for insurers and this income has greatly contributed to the overall profitability of insurance industry; at the same time underwriting costs have drastically brought down profitability. To compete in this market, insurers need to increase their return on investments and bring down underwriting costs. This requires ready access to financial data for analysis purposes. Many companies, in an attempt to improve financial reporting and decision making, have integrated their financial data in a financial data warehouse (FDW).

Budgeting: Data warehousing facilitates analysis of budgeted versus actual expenditure for various cost heads like promotion campaigns, underwriting expenses, commissions, etc. OLAP tools can provide drill down facility whereby the reasons for cost overruns can be analyzed in more detail. It can also be used to allocate budgets for the next financial period. Various activity-based costing models can be developed for better costs control and allocation.

Asset Liability Management: Models can be developed using BI tools to measure the insurer's exposure to various risk factors like change in the interest rate structure, share market volatility, etc. These models can be used to predict the performance of portfolio different economic scenarios and predict future liquidity needs of the insurer.

Financial Ratio Analysis: Various financial ratios like debt–equity, liquidity ratios, etc. can be analyzed over a period of time. The ability to drill down and join inter-related reports and analyses – provided by all major OLAP tool vendors – can make ratio analysis much more intuitive.

Profitability Analysis: This includes profitability of individual products, product lines, underwriting activity, and investments. A major component of profitability analysis is a thorough analysis of costs incurred during underwriting, which has been a major factor in bringing down the overall profitability of insurance companies.

Web Reporting and Analysis: Swift decision making requires ready access to financial data via an intuitive interface. Increasingly companies are providing executives concerned Web-based access to financial data – stored in the financial data warehouse. Almost all the standard OLAP tools have a Web interface that can greatly facilitate ad hoc querying report distribution.

20.2.9 Human Resources

Data warehousing can significantly help in aligning the HR strategy to the overall business strategy. It can present an integrated view of the workforce and help in designing retention schemes, improving productivity, and curtailing costs. Some BI applications in HR are:

Human Resource Reports/Analytics: Reports and analysis can be generated to support an integrated view of the workforce. Various analyses include staff movement and performance, workforce attrition by department, workforce performance by department, compensation and attrition, and other customized analyses and reports. The HR data can be integrated with benchmark figures for the insurance industry and various reports can be generated to measure performance vis-à-vis benchmarks.

Manpower Allocation: This includes allocating manpower based on new product launches. According to increased requirement, agent sales people can be deployed in specific regions where demand projections are high or likely to increase.

HR Portal: Employers need to maintain accurate employee data, which can be viewed by the employees the information about compensation, benefits, retirement facilities, etc. Payroll data can be integrated with data from other human resource management applications in the HR data warehouse. This data can then be made visible within the organization through the HR portal.

Training and Succession Planning: Accurate data about the skills sets of the workforce can be maintained in the data warehouse. This can be used to design training programs and for effective succession planning.

20.2.10 Corporate Management

The top management of any insurance company has its own business intelligence requirements. The MIS department is typically responsible for providing all the reports to them. It is also responsible for providing statutory reports to various outside agencies and any other information requirement within or outside the company. This may include information given to its customers in the form of various reports and analysis. A business intelligence environment that leverages data collected across the value chain is possibly the only effective solution for MIS.

Dashboard Reporting: Performance measures like product line profitability, overall underwriting costs, ROI on investment portfolio, etc. can be presented in dashboard reports to the top management to facilitate decision-making process. Also alerts can be triggered if any performance measure reaches a predefined threshold level. These reports can incorporate insurance industry benchmarks, provided by third-party researchers.

Statutory Reporting: Insurers have to provide a number of statutory reports to outside agencies, government bodies, and trade consortia. These reports can be easily generated from the business intelligence environment.

Customer Information Services: Historical claims data can be very vital for institutional clients like those offering workers' compensation against accident. It can help the customers identify major trends in claims and implement suitable corrective actions. Customer information services can not only reduce claims related costs for the insurance company, it can also go a long way in cementing insurance company's relations with its customers.

20.3 Summary

In summary, moving from a traditional "hard copy" underwriting manual with "tribal knowledge" as the guiding force in decision making is inevitable. The long-standing record of sustained industry – wide underwriting losses – expressed in another way – can be seen as a proxy for underinvestment in the technology and personal resources required to improve this core decision-making process. Being able to properly assess and price and ever-growing range of risks requires access to all requires information. In the past this access has been imperfect. It has also been limited within the organization to a relatively small group of users (actuaries) disconnected to the core drivers of insurers businesses and the core consumers of their services – to make better

business decision in the underwriting domain is clearly necessary. We think data mining can play a useful role here.

The insurance industry is extremely divided in its adoption of business intelligence environment based on technologies like data warehousing, OLAP, and data mining. Quite a few insurance companies are in an advanced stage of their business intelligence initiative; yet there are many that are oblivious of its benefits. Some insurers have gone for nonscalable temporary solutions, which often fail to leverage the ever-increasing volumes of data. Hence, recognizing the need for an effective business intelligence environment based on the right architecture is vital. But it is just the first step. The real challenge is to make the BI environment an integral part of the decision-making process. Efficiently gathering the information requirements of all the user groups is thus extremely critical for the success of any data warehouse. The belief is that "we build it, they will use it" is wrong. Also a data warehouse cannot be the answer to all the information requirements; hence it is also very important to set clear business objectives for the business intelligence solution with total top management support.

20.4 Review Questions

1. How is data mining used in insurance companies?
2. What does an insurance underwriter do? State the principles of underwriting.
3. What are the various information sources available for mining in insurance sector?
4. How does data mining help underwriters to make better business decisions?
5. Give an overview of mining in insurance industry and about insurance value chain.
6. Discuss in detail channel management, policy management, chain management, finance, and asset management.
7. Explain corporate management technique.