Insurance Fraud Management as an Integrated Part of Business Intelligence Framework

Pavel Pešout and Miroslav Andrle

Abstract—Frauds in insurance industry are one of the major sources of operational risk of insurance companies and constitute a significant portion of their losses. Every reasonable company on the market aims for improving their processes of uncovering frauds and invests their resources to reduce them. This article is addressing fraud management area from the view of extension of existing Business Intelligence solution. We describe the frame of such solution and would like to share with readers all benefits brought to insurance companies by adopting this approach in their fight against insurance frauds.

Keywords—business intelligence, insurance fraud, fraud management

I. INTRODUCTION

FRAUDS are bounded to human community from its very beginning. It is obvious that in modern society financial institutions have to confront them and insurance industry is not an exception. Together with the rise of insurance sector, bigger choice of insurance products, and with the increasing use of insurance services, the number of frauds in this industry increases, too.

CAIF, Coalition Against Insurance Fraud, see [1], detects following range of negative impacts of insurance frauds:

- People lose their savings (by bilking out them by insurance investment schemes).
- Health is endangered (e.g. by selling nonexistent health policies).
- Consumer goods cost more (prices rising when businesses pass higher costs of their health and commercial insurance).
- Innocent people are killed and maimed (e.g. by staged auto accidents and arson).
- Honest businesses lose money (because fraud increases their costs for employee health coverage and business insurance).
- Employees lose jobs (when insurance companies go bankrupt after being looted by fraud thieves).

P. Pešout is Senior System Analyst at the NESS Czech, Business Intelligence Competency. He is also working as a researcher/lecturer with the the Department of Statistics and Probabilities, University of Economics, Prague (e-mail: pavel.pesout@ness.com, pavel.pesout@vse.cz).

M. Andrle is Solution Consultant at the NESS Czech, Business Intelligence Competency. The Financial Risk Manager (FRM®) certified by the Global Association of Risk Professionals (GARP) (e-mail: miroslav.andrle@ness.com).

- Premiums stay high (because insurance companies must pass the large costs of insurance fraud to policyholders).

The amount of money paid out due to frauds increases expenses of insurance companies and obviously is reducing their profit. The loss ratio grows and insurance companies are getting into an erratic circle. Rising of loss ratio is compensated by rising of insurance premium leading to smaller interest of customers in company's products and to deterioration of quality of insurance portfolio. On the other hand, if the premium would not change, insurance companies could face problems with liquidity. In any way, higher loss ratio or liquidity squeeze might impact their credit rating. And again, a negative rating change affects client's portfolio and might increase the probability of frauds. What is more, according to the solidarity principle, each successful fraud influences the possession of the whole insurance's portfolio.

Economical impact of insurance frauds on particular companies and the entire sector are obvious. CEA, Comité Européen des Assurances, see [2], is guessing that yearly payouts due to insurance frauds in EU are about 8 billion euro. This is approximately 2% of collected insurance premium. In certain regions the ratio of fraud activities is much higher. That is why CEA has started a contest against insurance frauds in European scale in 1993.

Unfortunately the contest of insurance companies against frauds is never ending process due to permanently changing environment in their business. In recent years it is even more complicated because of pro-client services of companies as client acquisition or accident reporting through the Internet (it has became common that clients enter into contracts online without any contact with insurance dealer). It is not obvious whether the money saved on expenses during client's acquisition or online accident reporting are not lost due to higher payouts caused by successful frauds.

The threat of shrinking profits / or increasing losses due to insurance frauds which are faced by insurance companies implies the insurance companies have to implement more effective fraud management solutions. And with regard to the CEA recommendation we identify natural role of Business Intelligence (BI) here.

II. BUSINESS INTELLIGENCE FRAUD MANAGEMENT SOLUTION (BIFMS)

Investments of insurance companies in their fraud management systems are raising interest in theoretical research of this subject. It has already its place in IT industry where there is a fast development in the area of data mining solutions

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and their anti-fraud models. New out-of-the-box software solutions of big IT players or their smaller competitors are emerging in both global and local markets. Despite of success of such anti-fraud systems, which depending on used methods, analytical experience of their suppliers, and quality of historical data, might be according to general knowledge between 30% to 90%, there are still many companies relying only on their long time established processes having low added value to the other business activities and low level of adaptability to the permanently changing conditions.

We truly believe that for insurance companies there is another way to more effective fraud management. It is the path of building custom Business Intelligence Fraud Management Solution (BIFMS) upon their Data Warehouse (DWH), see [3]. Inmon's DWH, see [4], integrates corporate application-oriented data from different sources systems, making a unified view of the data to the end users. Such data storage can be used for different business tasks, which is the meaning of BI, see [5]. Gartner, see [6], defined BI as "an umbrella term that spans the people, processes and applications/tools to organize information, enable access to it and analyze it to improve decisions and manage performance".

An effective BI, see Fig. 1, is mutual intersection of three areas that fraud management also intersects: business, analysis and IT/IS. Fraud management is typical example of an area that belongs to the BI solution with its nature and belongs to this intersection.
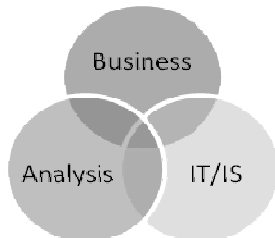

Fig. 1 BI integration area

What is more, the integration of fraud management as one of the BI Decision Support Systems, see [7], has all well known benefits of BI, defined in the so-called IRACIS model:
1) Avoid Costs – meaning effective management of operational risk expenses.
2) Increase Revenue – meaning reducing losses from unsuccessful or avoided frauds.
3) Improve Services – meaning related benefits in process of liquidation of reported insurance events, fraud investigation and customer care.

We advise that now (if not already implemented) is the right time to build the BI infrastructure with broad usage of consolidated information (based on top of company DWH), since very similar changes are to be required by the insurance regulators. As well-known, insurance companies must comply with Solvency II regulation, see [8], starting on 31st December 2012 (in EU). This regulation brings rules to calculate reserves, Solvency capital requirement for different risk types and also focuses on operational risk management. Claim fraud,

employee theft, claim fabrication, bad faith, system interruptions, are only a few operational risks that must be quantified under Solvency II.

The suggested solution of fraud management in the DWH infrastructure as a BI service (the BIFMS) has the following advantages:
1) It can be effectively developed by taking into account existing processes and applications.
2) It can be done iteratively and tailored to the business (and the financial capabilities) of company and regularly adjusted according to market situation.
3) The BIFMS extension can be one of the key components of the entire operational risk management.

III. THE SCOPE OF THE BIFMS

The BIFMS should be used as data and process base for all stages of fraud management cycle, see [9], which are:
- Deterrence (stopping fraud before it happens).
- Prevention (keeping from doing and hindering the fraudsters from performing fraudulent activity).
- Detection (identifying and locating fraud prior and completioning the fraudulent activity).
- Mitigation (stopping fraud when it occurs).
- Analysis (evaluating the impact of fraud management and identifying fraud despite previous stages).
- Policy (creating and evaluating the deployment of fraud policies to reduce the incidence of fraud).
- Investigation (obtaining information to stop fraudulent activity and providing support for the prosecution and after that conviction of the fraudster).
- Prosecution (processing of prosecuting).

For the purpose of the BIFMS we can reduce these stages into Prevention, Detection, and Investigation. It can be described as a cycle of the interconnected processes, see Fig. 2, sharing consolidated information (client and contract based) stored in DWH. It is using some of common BI techniques: mainly Data Mining, Customer Intelligence, Corporate Reporting and Master Data Management.

Fig. 2 The BIFMS stages

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Generally from the view of information coverage the BIFMS must contain the following components, see Fig. 3:

1) Reporting – What did happen? (What frauds have been committed? What is the performance of insurance dealers and claims adjusters?)
2) Analyses – Why did it happen? (What are the fraud indicators? How to avoid frauds or detect them as soon as possible?)
3) Monitoring – What is happening right now? (What are the current frauds? How big is the loss from occurred frauds? How effective is the fraud investigation and how this is performed?)
4) Prediction – What could happen in future? (What is the probability of the fraud? How big are the expected losses from frauds? How will be effected P&L of the company in future?)

Fig. 3 The BIFMS levels

From the contract life and its phase's analysis point of view the BIFMS has to include all periods from the application to the conclusion. It is thanks to the BIFMS integration in the DWH with consolidated contracts and client's data from different source systems.

The BIFMS has to span all phases of contract life from the client acquisition to the end of the contract life. During the life of contract its risk weight indicating probability of commitment of a future fraud should be assigned or adjusted. Risk weights assigning model is presented on Fig. 4.
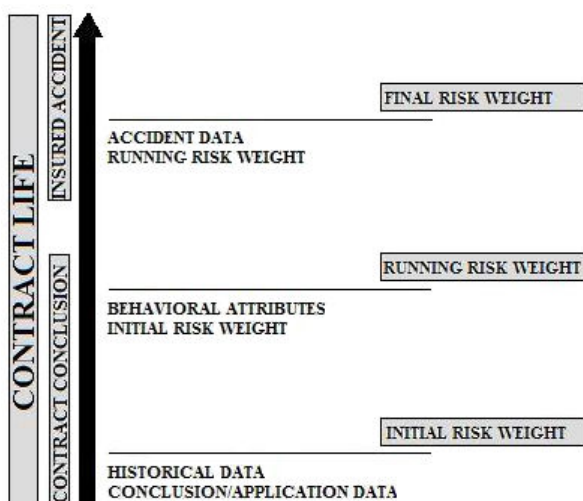

Fig. 4 The BIFMS contract life model

In the case of insurance event, the probability of future fraud will not be assigned (as it is common in anti-fraud systems) but only adjusted according to historical (ideally already in DWH) and current data.

Thus, the whole BIFMS model is more transparent, decentralized processes are spread out in several phases and the fruitfulness of fraud detection increases.

IV. PREVENTION OF FRAUDS, THE ROLE OF THE BIFMS

One of the fundamental steps on mission not only against insurance frauds is prevention. It is always better to avoid problems *ex ante* than to solve them *ax post*. Unfortunately, the main preventive steps are not in hands of insurance companies and thus can't be covered by the BIFMS. E.g., the perception of insurance fraud as something illegal (usually insurance frauds are not judged such negatively as other illegal activities).

From the insurance company point of view main preventive measures can be divided into two groups:

1) Internal prevention – its aim is to increase the loyalty of company employees (because a lot of frauds are caused by company employees) and setting up control processes to minimize frauds caused by own employees and contracted dealers.
2) External prevention – its aim is to prevent the entrance of potential fraudsters in company portfolio, or if not possible to exclude them, at least to assign appropriate (high) risk weights to their contracts.

The area of internal prevention is well documented and theoretically known. It concerns organizational structure, motivational programs, accidental controls etc., see details in [10].

Considerable accent should be given on the establishment of centralized call centers for reporting the insured accidents and establishment of unified (and strictly kept in the company) manual for the processes of contracts acquiring, adjustment and fraud investigation.

Also it can be seen that the implementation of the basic internal processes for fraud prevention is usually not connected with high costs but on the other hand it usually needs the considerable willpower in the company management to improve them.

The role of the suggested BIFMS in the area of internal prevention is the following:

1) Expansion of Corporate Reporting – reporting of performance or activities of claims adjusters, dealers or detectives.
2) Improving methodology of decision processes (claims adjustment, client acquisition or investigation) and its integration.
3) Integration of well-known efficient data mining techniques – e.g. text mining is recommended nowadays and becomes more and more popular in order to detect specific word connections (indicating frauds) in email communication of the employees.

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Corporate Reporting should be always one of the main building stones of company BI solution to cover information (strategic aims, indicators, trends) needed for supporting of decision processes there, see [11].

Its integration within the BIFMS has a couple of significant advantages:

1) It is centralized, thus
   a. Its approach is strategic with appropriately defined aims – to report the activities of the agents and adjusters (or detectives) and to quantify these activities primarily to identify fraudulency.
   b. Structures of input data are integrated in DWH (with all its rules).
   c. One truth is reported – the consolidated data of DWH are the source, the solution is stable and trustful, which is especially important in the phase of investigation and argumentation of the fraud guilt.
2) It is an integrated component of the whole Corporate Reporting solution and may assist to making reports more effective and valuable.
3) It can be iteratively extended (as the whole BIFMS) and can be fitted to actual needs.
4) Its form and type (e.g. dynamic, static) can be fitted to the company's methodology of its Corporate Performance Management's reporting (fraud management influences the company's financial performance).
5) The solution can be integrated with OLAP (On Line Analytical Processing) database (so called multidimensional cubes), see modern trends of reporting in [12].
6) Its functionality can be extended including Key Performance Indicators (for agents, detectives, managers or adjusters) definitions easily.

V. EXTERNAL PREVENTION, THE ROLE OF THE BIFMS

External prevention is actually the first stage of the process of detection insurance frauds, which starts at the beginning of contract life.

External prevention consists of two related and overlapping areas as described on Fig. 5:
1) Integration of client application data check.
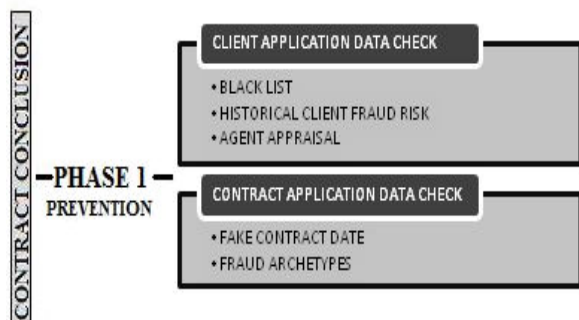2) Integration of contract application data check.

Fig. 5 The BIFMS detection phase 1

The outcome is to assess possible fraudulency of contract/client with the help of application and historical data stored in DWH. According to degrees of riskiness initial risk weights are assigned to contracts/clients which are later used in next stages of fraud management. If the process of taking out insurance by clients allows – such contracts should be rejected.

Unfortunately it is very common that the short term benefit of cashing the premium is above the concern about the quality of client portfolio. Negative consequences of bad portfolio will appear assuredly. There is a sum of money given as the claims on undetected frauds, but also as salaries of detectives and as expenses of proofs record.

Core factors impacting the fraud probability are following directly from the contractual data. The external prevention process should ideally expose two sets of contracts:
1) Contracts containing false information and increasing the possible benefit payout or pretending low probability of possible claim.
2) Contracts having archetypes of possible future fraudulency.

To discover false information written on a contract is not always possible. That is the reason why false detection often has to hold off to the phase of fraud investigation (if the process is able to evaluate the contract as high risk and is assign for investigation).

On the other hand the typical frauds can be detected. For most of them there exist archetypes which indicate higher probability of future fraud behavior (e.g. the combination of lower client's income and contract with extra high capital assured and related extra high insurance payments). By establishing algorithms using pattern analysis or generally by application of scoring on new contracts/applications it is possible to assign higher risk weights to potential future contracts/frauds.

On the client level the following is used for assigning client risk weight:
1) Black list filtration including link analysis of relation (economical, familiar) between clients/applicants and known fraudsters.
2) Clients database creation with historical risk weights – it must be take into account the possibility of recidivism of the clients with higher past risk weights (although with not a proved fraud).
3) Agent's appraisal system (internal prevention) – it must be take into account whether the contract is given by suspicious agent.

In the process of external prevention the BI is used in the following several areas:
1) Establishing the process of client risk weight assessment in company Customer Intelligence solution (black list, historical risk weights, relations between clients, relation between clients and agents).
2) Gathering and consolidation of required data from available sources – integration with public registers (also

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debt registers as for example Leasing & Loan Credit Bureau, personal data verification), or with mother/daughter or sister companies if it is allowed by local law, in order to verify contract and client data (multiple insurance, often alternating of insurance company etc.)

3) Data Mining – definition of fraud archetypes and assignment of risk weight depending on the "distance" to defined archetypes.

For the BIFMS it is convenient to use the Customer Intelligence principles of unified client and its consolidation across all company divisions or services (often with using for marketing purposes and Customer Relationship Management for clients profiling, mitigation of their retention, and prediction of their behavior), see [13].

Unified client and consolidation of all its contracts is very important for fraud management, especially in cases when insurance companies sell also other types of products such as credit cards or mortgages. Through the other sold products to the same client insurance company can collect information about missed payments or client's income. Also it is less probable that a client with more types of products would be a future fraudster.

VI. DETECTION, THE ROLE OF THE BIFMS

Insurance fraud detection is a continuous process taking place during the contract life. This process can be refined into three phases:

1) External prevention – risk weight assignment at the beginning of contract life, as described n section V.
2) Risk weight adjustment – this is happening during the contract life.
3) Final risk weight assignment and grading for investigators – this happens during claims settlement.

The scheme of risk weights correction (adjustment) solution – the second detection phase – is presented on Fig. 6.

Fig. 6 The BIFMS detection phase 2

During the second phase of fraud detection all contractual and client events are monitored and initial risk weights are adjusted accordingly. It is important to mention that risk weights are usually not only one-dimensional. It is recommended to use multi-dimensional approach and assign risk weight to each of the dimensions, also attributes. One of these attributes may be e.g. payment moral appraisal (and emergent payment affairs). This approach allows creation of appropriate scorecards, see [14]. Helpful rule in such a scoring is the fact that atypical behavior often presents enhanced risk.

In the BIFMS detection stage is used the same procedure as

in prevention – the Customer Intelligence solution is actively extended (refreshing of consolidated information, typical client behavior profile) and Corporate Reporting also (reporting of current risks in insurance portfolio). The core functionality – risk weight adjustment – is achieved by the following two BI techniques:

1) Master Data Management (MDM) – identification and management of key data (indicators) for risk weight adjustments.
2) Data Mining – process of algorithmization of risk weights adjustments.

MDM, see its role in data management [15], in the scope of fraud management comprises business definition of key data – contracts, clients, data affecting the probability of fraudulent activity and their centralized registering in the company data warehouse.

The role of MDM and Data Mining are close when defining indicators affecting probability of future fraud. These indicators are different according to the insurance's types, although they are broadly well known. Their determination is necessary for the success of any predictive model.

Well known procedure of setting the relevant attributes is following:

1) Defining the basic wide set of attributes that could be powerful factors – this wide set should be given in cooperation of fraud management expert and data analyst with broad knowledge of statistical modeling
2) Later on the set is reduced to ones which have the biggest influence on the final result. This can be achieved by contingency table approach, discriminant analysis or principal component analysis, see some modern studies in [16].

From its definition Data Mining is, see its usage and methods in [17], giving the answer to the question "What will happen?" In the case of the proposed BIFMS we can extend the question to "What is the probability of a fraud event?" Data Mining approaches to risk weight adjustments include broad family of models, starting with simple expert rules and ending by sophisticated scoring models (support vector machines, neural networks, cluster analysis, discriminant function etc.)

The last phase of detection process is accountable for successful detection of insurance frauds. It is the final risk weight assignment and grading for investigation what happens during the claims adjustment, see Fig. 7.

Fig. 7 The BIFMS detection phase 3

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This phase's outcome is to highlight the insurance events for investigation (suspicious as possible frauds) and the remaining part for settlement. For this purpose the following processes are taking place:

1) Data Mining of insurance events entries.
2) Checking registered historical entries of contract/client risk weights and previous insurance claims – this is taken into account in final decision.
3) Checking client behavior – to consider if e.g. client is stressing very quick settlement of insurance claim.

Which entries of insurance contract should be assessed is known from the previous experience of claims adjusters or detectives, see [18]. Assessed must be absence or large number of submitted documents, difference between lifestyle of client and claimed losses, etc.

Integration of the third detection phase of the BIFMS (and all its components such as reporting, methodology, etc.) brings to insurance company the following benefits:

1) One unified methodology of insurance claims adjustment/settlement.
2) Cost reduction of claims adjustments (due to automatization of Data Mining processes).
3) Reduction of claims adjusters' personal accountability – internal prevention and decreasing number of human errors.
4) Improvement of Customer Relationship Management – faster claims settlement.
5) More effective internal/external audit of fraud (transparency), see [19].

What is more, the implementation of the BIFMS results in more effective fraud detection/investigation of insurance fraud, mainly from the following reasons:

1) Frauds are detected with higher probability and then are transferred to investigators with the risk weight information.
2) Investigation might take shorter time (the case might be solved before the settlement date prescribed by contract or regional law).
3) Investigators have access to consolidated data on insurance claim, contract, and its client and his historical behavior.

VII. CONCLUSION

As in every commercial company the long-term aim of insurance company is to have a reasonable profit and company market growth. One of the obstacles encountered on the road to achieve this aim are insurance frauds. High expenses settling false claims affect insurance premium and cause decreasing competitiveness of insurance companies. Therefore, insurance frauds are a serious problem in the entire insurance industry.

Insurance companies are still looking for new and better methods how to protect themselves against insurance frauds. The fundamental approach is establishment of high-quality fraud management together with the benefits of information technologies. This article encourages the idea that a very effective model of fraud management can be with many other benefits to company built within structures and processes of DWH and related BI services.

Integration of anti-fraud management in BI solutions of insurance companies is a very useful decision and brings many other benefits to them. In comparison to some boxed anti-fraud systems it allows iterative extension of the functionality and to cover current trends in industry and particular needs as new types of frauds to which the company is exposed. This integration with consolidated approach of contract/client risk assessment goes through many BI activities such as reporting, monitoring, analysis or prediction and leads in functional improvement of BI covering Data Mining, Customer Intelligence, Corporate Reporting or Master Data Management.

The insurance companies understand that in the dateless fight against insurance frauds they will surely never win completely. Nevertheless, investment in an efficient and complex solution within the frame of BI can improve their position in this fight and it allows significant improvement of their processes of prevention, detection and investigation of insurance frauds.

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