

Applying Ontology to Risk concepts

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Abstract

This case story covers the concept of applying the Risk Ontology which is part of the Global University Alliance Business Ontologyⁱ and how the principles can be applied in a complex environment of an Insurance organization. An environment where risk engineering, modelling, and architecture are applied to build a basis for a structured Way of Thinking, Working, Modelling, and Implementation of Risk concepts. It illustrates how to organize and structure the viewpoints and objects associated with Risk relations and Risk stewardship within the various processes.

1. Introduction

The aim of this case story is to show how Business Process Management concepts can be used across multiple aspects of a business. How it can relate risk aspects, service aspects and financial aspects to the concept of processes to manage its business and its risks. The reason we chose the Insurance We already know from the Risk Ontologyⁱⁱ that risk relates in multiple ways to processes. When we talk about risk in general terms we mean: 'The combined impact of any conditions or events, including those caused by uncertainty, change, hazards or other factors that can affect the potential for achieving objectivesⁱⁱⁱ.' Modelling risk has been a very challenging aspect, especially since the behavior and the relations of risk to the various aspects of the organization is very different. Below are a short abstract and example of Risk and the semantic relations to organizational entities^{iv}:

Meta Object	Semantic Relations	Meta Object
External Force & Drivers	trigger	Risk
Value Indicator (Critical Success Factor)	are influenced by	Risk
Value Expectation from stakeholder	are threatened by	Risk
Value Proposition of the organization	is threatened by	Risk
Organizational Vision & Mission	is threatened by	Risk
Strategy (Strategic Business Objective)	is threatened by	Risk
Goals (e.g. business, application, technology)	are threatened by	Risk
Objective	are threatened by	Risk
Quality	is threatened by	Risk
Security	mitigates	Risk
Report	records	Risk aspects
Timing	bounds	Risk
Organizational Construct	the design and role influenced by	Risk
Enterprise Capability	selection influenced by	Risk
Business Resource/Actor	selection influenced by	Risk
Business Function	threatened by	Risk

Meta Object	Semantic Relations	Meta Object
Cost	threatened by	Risk
Revenue	threatened by	Risk
Product	design influenced by	Risk
Contract	design influenced by	Risk
Business Rule	design influenced by	Risk
Business Compliance	monitors	Risk aspects
Location	selection and design influenced by	Risk
Business Workflow	design influenced by	Risk
Event	Is triggered/influenced by	Risk
Business Service	design influenced by	Risk

Table 1: Example of Risk and the semantic relations to organizational entities

We do realize that not all these aspects matter in the context of a process. They are what we call secondary relationships, thereby playing a role between risk and process, but not with a primary relationship. The decomposed risk relevant meta-objects listed in table 1 can be used in risk oriented process architecture as well as in risk oriented process engineering concept, as they allow for risk and process decomposition^v. These fundamental risk concepts can be combined with auxiliary/secondary concepts to produce the semantic richness needed by practitioners to relate it to various relevant concepts. These auxiliary concepts are called risk composition meta-objects and represent various risk aspects like external forces, strategy, goals, objectives, quality, reporting, timing etc. Together the risk composition and decomposition meta-objects provide a structuring mechanism that facilitates the developments of a holistic risk ontology i.e. application ontology^{vi}. For example, the link between the decomposition meta-object 'process' and the decomposition meta-object 'risk' invites practitioners to think about the risks associated with each meta object they identify. For example, the specific meta object can have multiple types/forms. This is illustrated in figure 1, the context of the meta object 'Event', can both be an attack, incident, shutdown, response or a disaster.

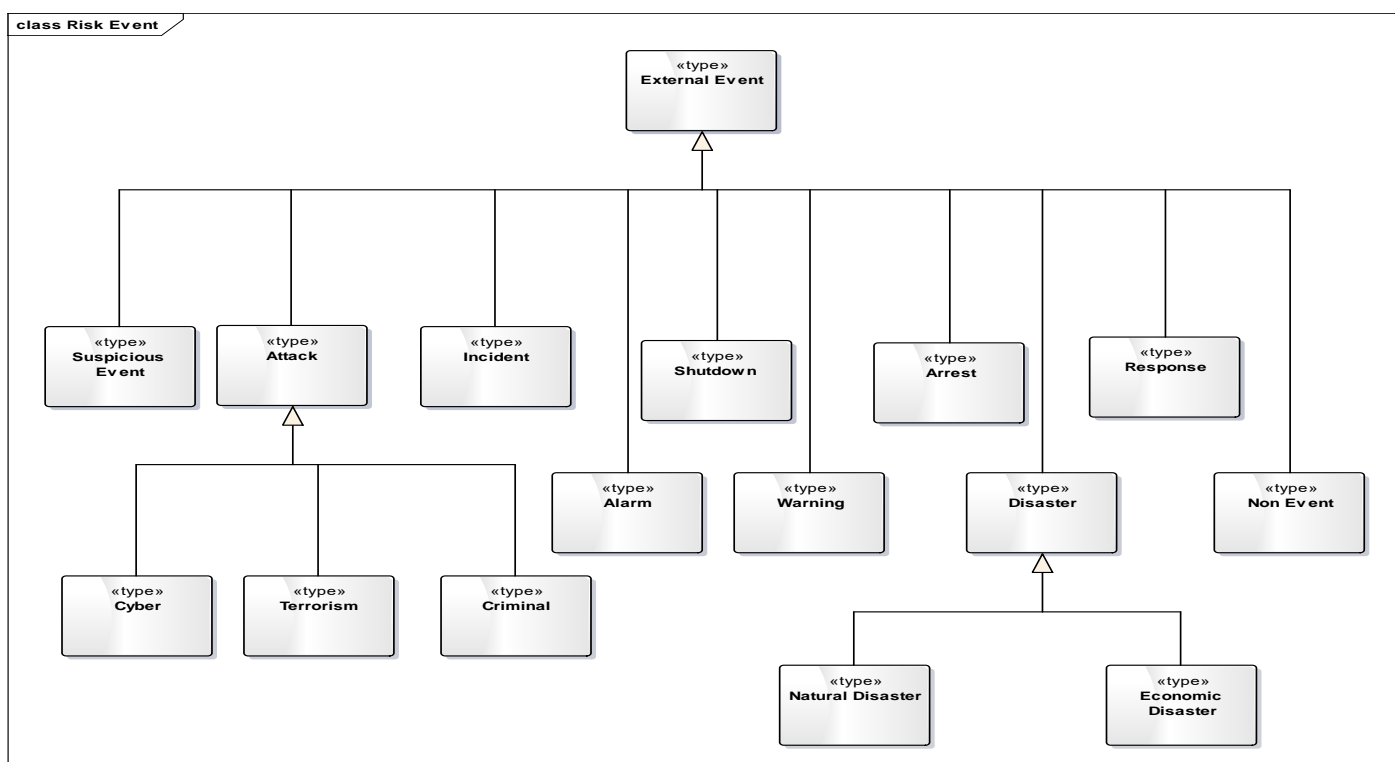


Figure 1: An illustration of various forms of Events related to risk

Therefore the relationships between decomposition and composition meta-objects and their types that are relevant to the context are considered an essential part for any practitioner working with and around innovation and transformation across various relevant risk subjects (versus siloed modelling, engineering and architecture view)^{vii}. Below is a meta model view of the risk and how it semantically relates to various aspects of processes^{viii}.

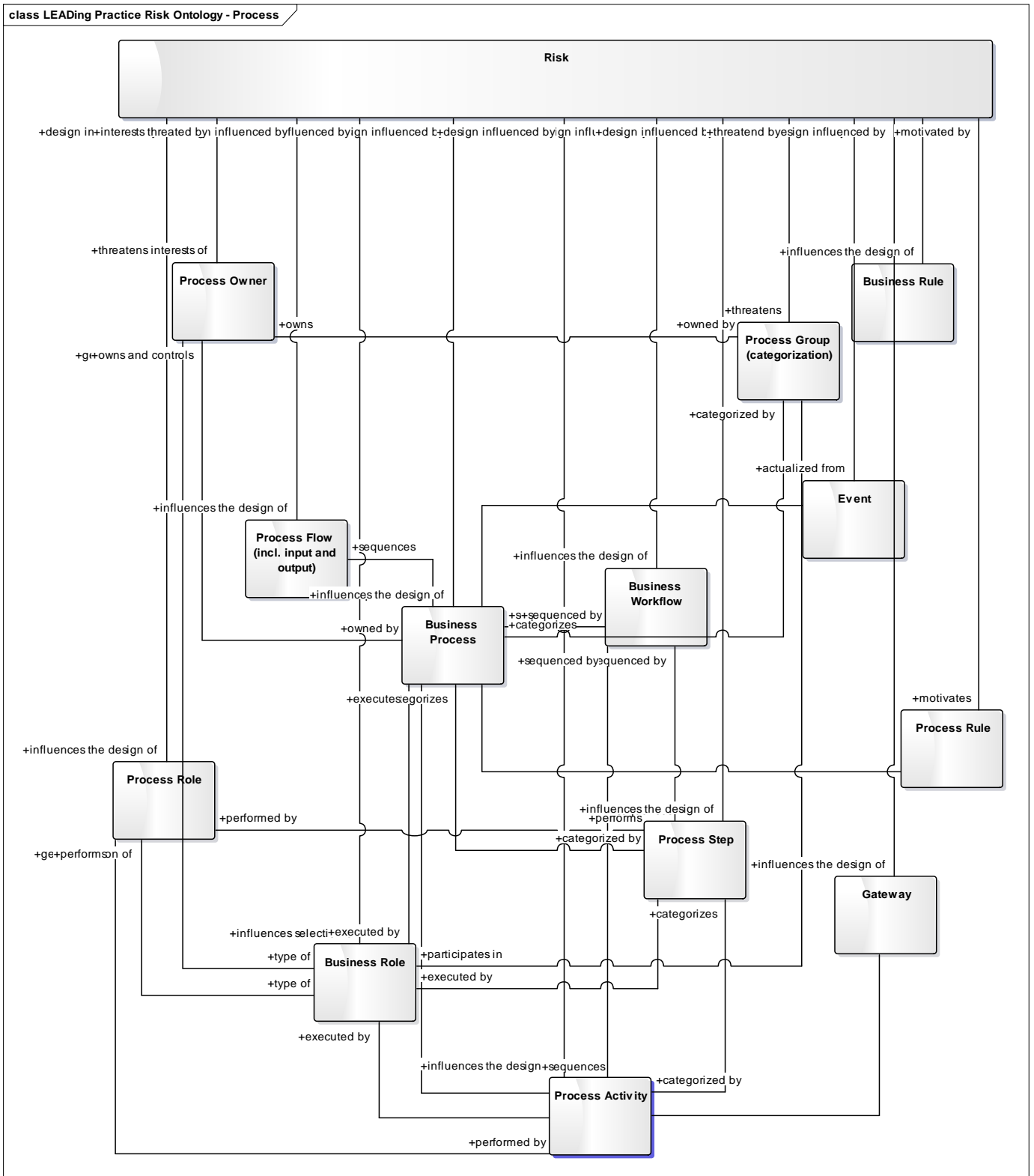


Figure 2: Risk Oriented Process Meta Model^{ix}

In order to apply the concepts discussed in a structured way of thinking, working and modelling

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throughout this case, we will:

- Define the classical insurance types
- Specify the different financing methods
- Pin point the different reasons why the establishment of a risk management function is so difficult
- Outline an Insurance Risk Map
- Specify Key Insurance Processes and their risks
- Identity: the insurance process areas involved.
- Classify Capital Allocation and Planning Process
- Identify Economic Capital Calculation Process
- Categorize Investment processes
- Categorize Product Design processes
- Categorize ALM and Bonus setting process

The lessons learned and the exciting journey of linking risk modelling aspects the necessary process centric transformation with and through IT is aimed to be described in an overview on the following pages.

Introduction to the complexity of the insurance industry

As a result of globalization, deregulation and terrorist attacks, the insurance industry has gone through a tremendous transformation over the past decade. In the simplest terms, insurance of any type is all about managing risk^x. Which is one of the reasons, we chose this industry, to illustrate Risk oriented modelling. As you will read in the case story examples, within life insurance, the insurance company attempts to manage mortality (death) rates among its clients. The insurance company collects premiums from policy holders, invests the money (usually in low risk investments), and then reimburses this money once the person passes away or the policy matures. A person called an actuary constantly crunches demographic data to estimate the life of a person. This is why characteristics such as age/sex/smoker/etc. all affect the premium that a policy holder must pay. The greater the chance that a person will have a shorter life span than the average, the higher the premium that person will have to pay. The most common competencies involved in this are illustrated in figure 3:



Figure 3: Common Life Risk Management competencies^{xi}

The competencies involved, service delivered and process created are virtually the same for every other type of insurance, including automobile, health and property.

In order to better understand life insurance it is essential to provide some context about the economic need for life insurance and its reason for existence.

As for all types of insurance and reinsurance, life insurance provides financial protection in case a random event happens. The risks cover death (e.g. term insurance), longevity (e.g. annuities) and also various types

of health and disability. Besides these pure risk type products there are also so called savings products, where there is a saving component which allows policyholders (i.e. the customers of the insurance company) to have some savings when they retire.

The life insurance market offers a wide range of different policies. It is, without expert knowledge, hardly possible to differentiate between these policies. Life insurance can be understood as a bet: either one gets a benefit or one pays the premium without getting anything in return. From this point of view life insurance mathematics is a part of a probability theory.

Since life insurance deals with monetary benefits and premiums, it is also part of the financial market and the economy. In this context one should note that insurances whose benefits are unit-linked, e.g. the payout depends on the performance of a fund, they actually rely on the modern theory of financial markets.

From a legal point of view, a life insurance is a contract between the policy-holder and the insurer. Life insurance policies are characterized by their abstract matter and their diversity. Since their content is abstract their value is not intuitively obvious. This is due to the fact that a life insurance policy is usually only bought once or twice during a lifetime. In contrast, for example, one buys a loaf of bread on a regular basis and thus one has a feeling for its correct value.

Life insurance - in particular an individual policy - is a long term contract. Take for example a thirty year old man who buys a permanent life insurance. Now suppose he dies when he reaches ninety, then the contract period was sixty years. Due to the long duration of the contract and the risks taken - for example changing fundamentals - it is necessary to calculate the price of insurance with care and foresight.

Types of classical insurance

- **Insurance on life or death** - insurance guaranteeing a specific sum of money to a designated beneficiary upon the death of the insured, or to the insured if he or she lives beyond a certain age.
- **Liability Insurance** - The miscellaneous category. This insures property such as automobiles, property and professional/business mishaps.
- **Health insurance.** - Insurance against expenses incurred through illness of the insured.

An insurance on life or death the essential event is the survival of the insured person up to a certain date or death before a certain date. Furthermore, these insurance types can be classified by the causes of death which yield a payout (e.g. a life insurance which pays only in the event of accidental death). Concretely, various kinds of survivor's pensions and pure endowments are insurances on life or death.

For a permanent disability insurance the essential criterion is the (dis)ability of the insured at a given date.

For insurances on health, the payout depends on the health of the insured. This class of insurance contains modern types of policies, such as long-term care insurance. The latter only provides benefits if the insured is unable to meet his basic needs (e.g. he is unable to dress himself).

Besides a classification based on the insured event, one can also classify the insurance based on the benefit. This can either be paid as an annuity or as a lump sum.

In the following we give some typical examples of life insurances.

Pure endowment: A pure endowment insurance provides a payment from the insurer to the insured, if he reaches the age of maturity of the policy. Otherwise there is no payment.

Term/permanent life insurance: A (term/permanent) life insurance is the counterpart to a pure endowment insurance. In contrast to the latter, a life insurance does not yield a payout to the policyholder if he survives until maturity of the policy. In the popular case of a term life insurance there is no payout if the insured reaches the age of maturity of the policy. But if the insured dies before that age his heirs receive a payment. A special case is the permanent life insurance, which yields a payout to the heirs no matter how old the insured is at the time of his death. This insurance is, in some countries, very popular since it can be viewed as an investment for their off-spring.

Endowment: The endowment insurance is the classic example of a life insurance. It is the sum of a pure endowment insurance and a term or permanent life insurance. This means that it yields a payout in the case of an early death and also in the case of reaching the fixed age of maturity.

Pension: A pension policy constitutes that the insurer has to pay an annuity to the insured when he reaches a certain age (age of maturity of the policy). Then the pension is paid until the death of the insured. The payment of the annuity is usually at regular intervals: monthly, quarterly or yearly. Moreover the payment can be made in advance (at the beginning of each interval) or arrears (at the end of each interval). Since the pension is only paid until death, one can additionally agree a minimum payment period. In this case the pension is paid at least for the minimum period. (This type of pension contract provides the desire of the insured to get at least something back for the premiums paid in.)

All these classical insurance types are, in principle, based on the assumption that the minimum interest which is earned on the fund is guaranteed and that the insurance benefits are almost fixed at inception of the contract.

Methods of financing

We have looked at the different types of insurances. Now we are going to discuss the different financing methods and the ideas on which they are based. The main principle of life insurances state that the value of the benefits provided by the insurer are equivalent to the value of the policy for the insured. Obviously, one needs to discuss this equivalence relation in more detail. This is covered in any book about life insurance mathematics. There is also a precise definition of the equivalence principle which can be used to calculate premiums. The two most common methods of financing are:

- Financing by premiums,
- Financing by a single payment (single premium).

Financing by premiums requires the insured to pay premiums to the insurer at regular intervals. This type of financing is called a regular or level premium. This obligation usually ends when either the policy age of maturity is reached or if the insured dies. The other option is to finance a life insurance by a single payment. Often a policy incorporates a mixture of both financing methods.

Pricing – Actuarial Approach

In order to understand the valuation of insurance liabilities, the corresponding principles of mutualization and equivalence are important to understand. Life insurance started in ancient Rome with the so called “collegia funeratica” (Burial Guilds). Since funerals were very costly some of the less wealthy Roman

population created burial guilds in order to mutualize the corresponding costs. Hence the collegia funeratic provided some sort of a term assurance cover. At that time insurance was paid on a pay as you go scheme, meaning that the expenses which occurred were shared between the different members of the guild.

Insurance Principles


- **Mutualisation:** there is risk diversification within a homogeneous collective. Mutualisation can occur:
 - within one time period (“mortality”), and
 - over several time periods (“with-profits funds”)
- A collective of individuals equalise over time.
- Example: Collegia funeratica in the ancient Rome: people supported each other for their (costly) funeral ceremonies.

Insurance is based on mutualisation.

Only later, in the 17th century, did the underlying mathematics allow the calculation of a “fair” premium. One of the first mathematicians to calculate a fair insurance premium was Leonard Euler. The concept of “fair premium” is closely linked to the “equivalence principle”, which states that, on average, the payments of the insurance company are equal to the ones of the policyholder. Hence in a big cohort the payments to the insured are equal to the payments from the insured.

Example Equivalence Principle

L. Euler



- Take a dice. Assume that “6” means death. How can we price a death benefit of 100'000?
- We repeat throwing the dice n -times, and denote with d the number of observed deaths, based on the throwing of the dice. Then we get the following:

n	d	\hat{q}_x	Price
10	3	0.300	30'000
100	20	0.200	20'000
1000	175	0.175	17'500
10^6	166950	0.167	16'695
∞		$\frac{1}{6}$	16'667

- What we see is that due to randomness, the number of “6” varie and converges only after many throws to its theoretical average of $\frac{1}{6}$.
- Hence the equivalence premium is $16666\frac{2}{3}$.

Figure 4: Example Equivalence Principle

Relevance of Risk Management in Insurance

According to the most recent Swiss Re sigma study (sigma 3/2014) the total world insurance market (in terms of premiums) has grown from 2012 to 2013 by 0.7%. As of 2013 the yearly amount of premium paid

amounted to USD 2608 billion. Sigma estimates that this amounts to USD 27 000 billions of funds invested. This is about 150% of the gross domestic product for the European Union for 2013 and indicates clearly from a financial point of view the relevance of the life insurance sector worldwide. It is also worth pointing out the purpose of these money. Ultimately a great part of the money serves the policyholders to save for retirement in order to allow the a decent living after their retirement. Hence a private life insurance complements the mandatory state driven retirement systems. Keeping in mind, that for many developed states the value of the pension scheme represents the biggest part of the assets for the individual policyholder, it becomes clear that adequate measures need to be taken to safeguard this money. This is essentially done by risk management on hand and regulation requiring the insurance companies to hold capital against these risks on the other. In section 2 we will have a closer look to the variety of risk an insurance company is exposed to. For the moment it is sufficient to mention that the majority of life insurance policies offer long term interest rate guarantees for the next 20+ years and that in consequence the insurer has to ensure an asset mix which can yield this guarantee without taking undue risks. In order to illustrate the magnitude of this risk assume that a life insurance company has outstanding liabilities of USD 100 billion with a guaranteed interest rate level of 4% and a so called duration of 12 years. One can think of duration roughly as the time how long it takes to pay out the insurance claim. We know that as a consequence of the 2008 financial crisis interest rate in the USD have fallen considerably. We assume for the moment that the relevant interest rate has fallen 2%. It is now possible to estimate the financial impact without taking any risk management or risk management actions. In order to do this one has to multiply the reserves times the duration times the change in interest rates, resulting in a pro forma financial loss of USD 24 billion which would exceed the shareholder equity of almost any such company. In consequence the company would default. In this case we have assumed that the company has invested all its assets in cash, which is clearly not realistic. How would a more realistic picture look like. Well, the insurance company would invest their assets in say bonds, with a duration of say 10 years (hence slightly shorter than the insurance liabilities). Again we can calculate the impact of the interest rate movement on the assets using the same formula and we see that in this case the assets have gained value of about USD 20 billion and in consequence the insurance company would have suffered an economic loss of USD 4 = 24 – 20 billion. This example clearly tells us that there are big risks involved in the day to day management of life insurance companies, which need to be adequately managed. More generally risk management is considered as a strategic factor which allows life insurance companies to be more successful.

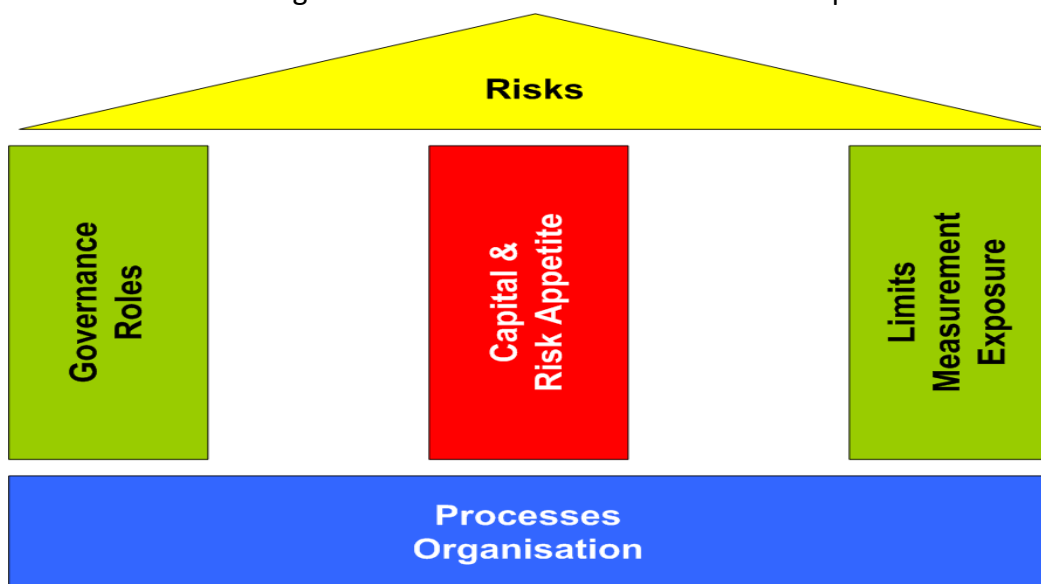


Figure 5: Overview of relevant risk components in the insurance world

In order to understand the need for risk management it is in a first step necessary to look at the different building blocks of a holistic risk management. Figure 5 tries to decompose the risk management into its generic components. The overarching aim is to manage the risks a company is facing. All employees in the company are expected to some bigger or smaller extent to manage risks in order to limit a potentially adverse outcome and to generate profit and stability for the stakeholders of the company. The corresponding risk culture is of paramount importance. An open communication and a clear and unbiased view in respect of the risks is essential in order to become the leader in each market we choose to compete.

In order to control these risks it is in a first step necessary to analyse and categorise the risks into its components. After understanding the risks and their impact on the stakeholders, it is essential to understand which are the foundations and the pillars which allow us to operate in such a manner that we manage risks in an optimal manner. The fundamentals of each company are its organisation and its processes. Therefore it is necessary to define the relationship between these foundations and the risks. The other foundation of each organisation are its processes. Here the escalation processes are particularly important, since they define how to behave in the case a risk "gets out of control" and "needs to be fixed".

The three pillars which ensure that risks are taken in a conscious and value enhancing way are:

- Governance and Roles,
- Capital and Risk Appetite, and
- Measurement, limits and exposure.

Each of the pillars has a particular purpose:

Governance and Roles: In order to ensure a "fit and proper" management it is essential to have an adequate governance in place. In a first step a common understanding of the various parts within the organisation is of paramount importance. Together with the generic governance principles they form the corner stones of the governance structures.

Capital and Risk Appetite: Risk can be defined as a potential adverse outcome, and it can normally be measured in monetary terms. The capital resources available to the company serve as a buffer in order to limit the need for fresh capital to prevent bankruptcy. Hence it is of utmost importance to know the available resources (which can serve as buffer) and to ensure that the risk appetite is commensurate with the company's strategic aims (e.g. rating, capital level, etc.) and the limits imposed by the company's stakeholders (Board of Directors, regulators, etc.).

Measurement, Limits and Exposure: The last pillar defines how to measure risks. This is particularly important in order to have reliable information for knowing the actual risk profile. To ensure that the company operates within its risk appetite, some of the risks are limited by a *limit system*. An example could be, that the company does not want to invest more than 10 % of its assets in shares.

Having all of the before mentioned five parts in place, means that the insurance is a professional risk taker, which aims to outperform the market and its peers. This can *only* be achieved if everybody is responsible for risk management. The risk management function acts as an enabler and consolidator.

2. Situation

The need for analyzing and structuring insurance processes in the concrete set up was a consequence of Solvency II, a Pan-European insurance supervisory regime. Solvency II and the corresponding regulatory changes necessitated the establishment of a proper 3 line of defense model:

The first line of defense is the line management which manages the risk on a day-to-day basis. Besides line management there is also the risk function with the duty to provide reliable challenge to the first line of defense and to measure adherence to risk limits and appetites.

The second line of defense helps to ensure that the company stays within the previously agreed risk limits.

Finally the third line of defense is the internal audit function which provides independent assurance.

In order to understand the necessity for such an elaborate system of checks and balances, it is important to see the economic importance of the insurance sector. In many countries life insurance companies account for a large part of the private old-age provision for the working population. In consequence, there are highly developed supervisory regimes and ring-fencing mechanisms to protect the policyholders from and, in case of, default. The systematic establishment of risk functions (second line of defense) in life insurance companies is something rather recent in Europe, where Chief Risk Officers, together with the respective functions, started to be established in the late 1990's.

It is worth mentioning that establishing a risk management function means analyzing the main insurance processes to determine how the first line and the second line of defense interact and to determine the hand-offs and hand-ons. This work also identifies the areas where the most challenge is needed.

What makes the modeling of risk in insurance industry so difficult?

There are different reasons why the establishment of a risk management function is difficult. Besides cultural changes to the organization, the most important challenge is the intrinsic complexity of the life insurance industry. Not only the complex administration of contracts lasting for half a century and more, but also the economic risks the insurance companies face are far from trivial. On one hand, life insurance companies face insurance risk, such as mortality, morbidity and longevity. On the other hand, life insurance companies invest money in their function as a principal, e.g. they invest in the entire possible investment universe, starting from rather simple investments such as cash and treasury bills, and ending at the very extreme end such as the various types of alternative investments (such as private equity, hedge funds, ...) and (exotic) derivatives.

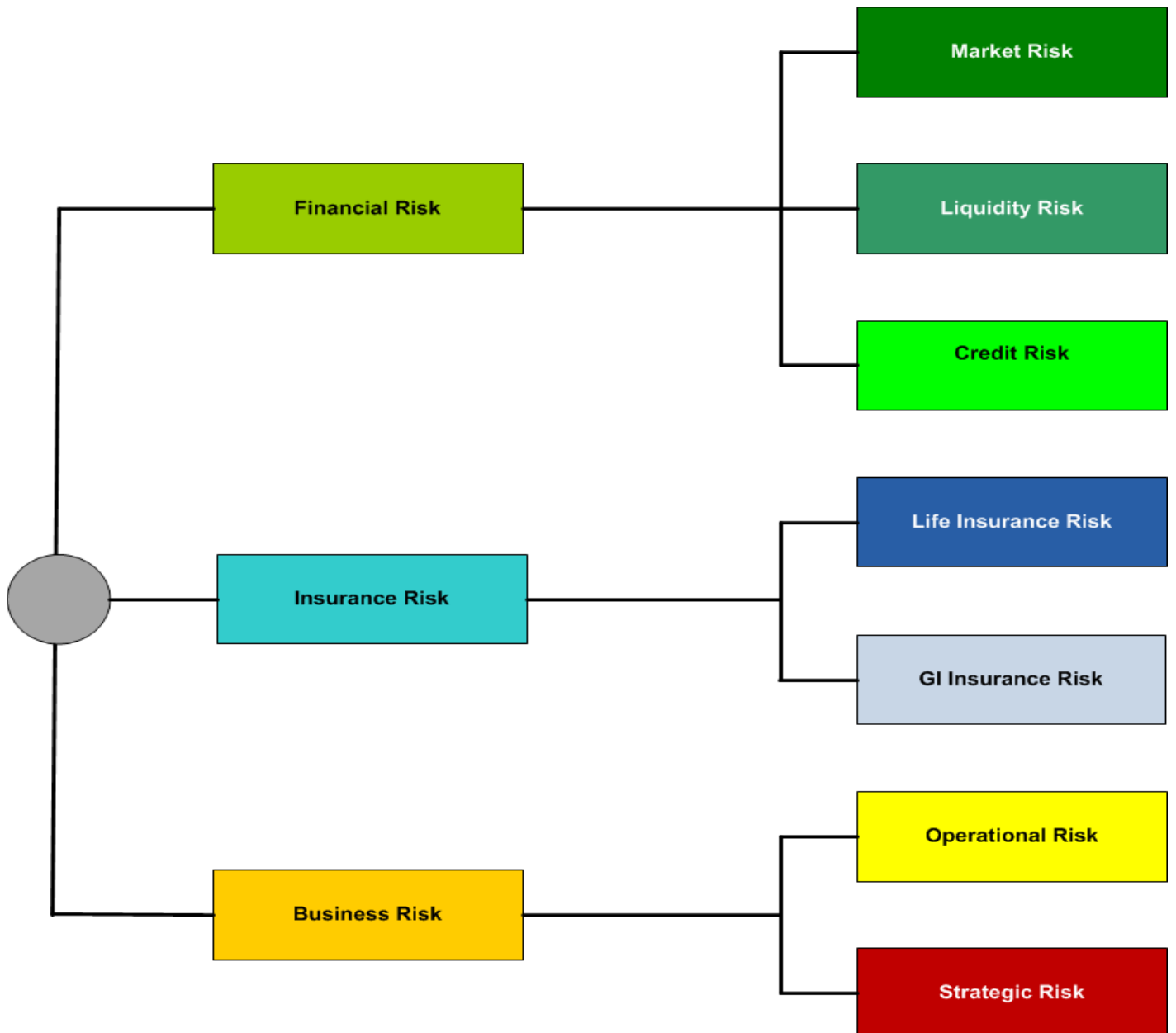


Figure 6: Insurance Risk Map

The need to have an integrated view over the various insurance risks and the respective asset and liability management (ALM) makes the management of risks in a life insurance company particularly difficult.

Figure 6 gives a risk landscape showing the risks a life insurance company is exposed to.

3. Description: Key Insurance End to End Processes and their risks

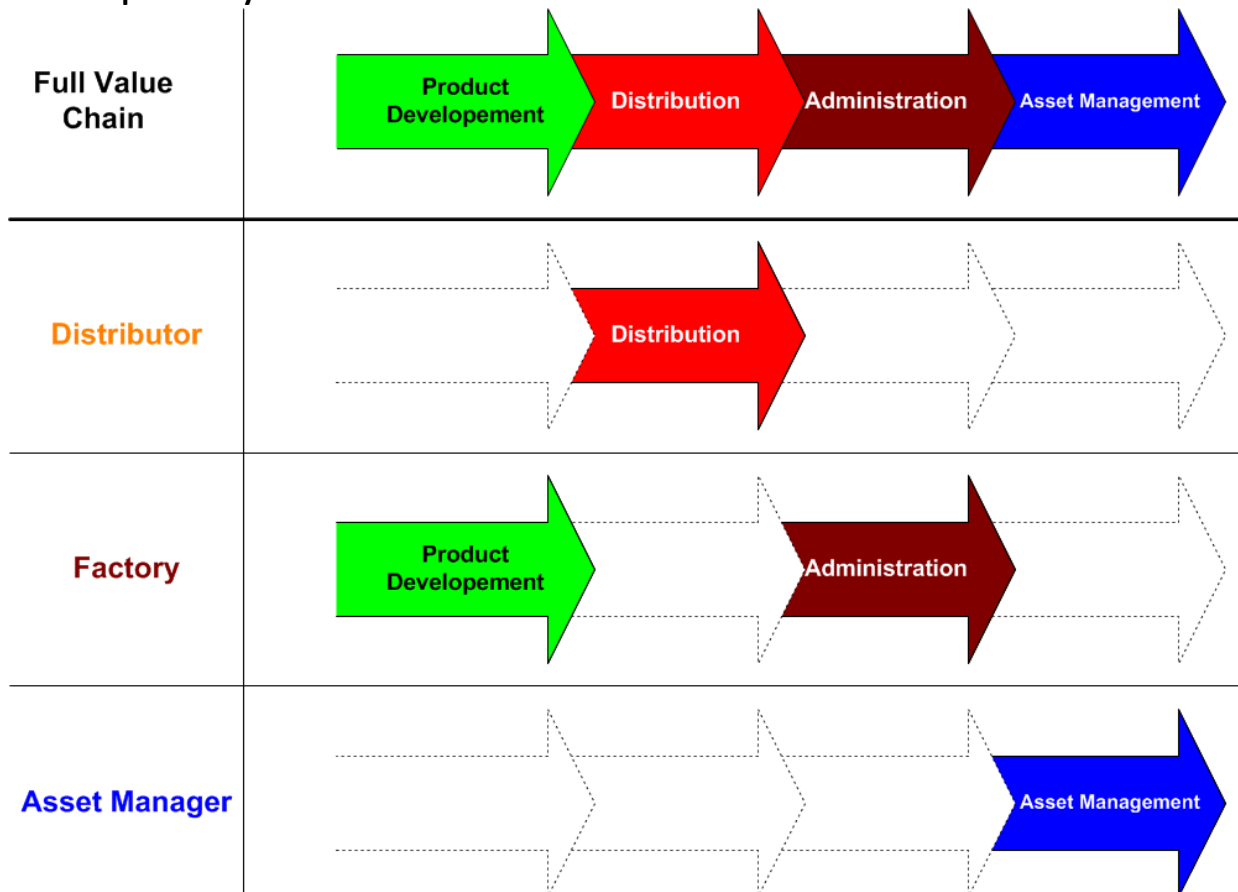


Figure 7, Value Chain of an Insurance Company

The aim of this section is to highlight the main processes in an insurance company in order to decompose them. The main question here is 'which part of a process has to be done by the first line of defence (line management) and which parts should be done by the second line of defence (risk management)'?

As with all organisational set-ups, there is no right or wrong but there are different possibilities which could work, depending on the corresponding environment. In this sense the decomposition into processes and the split between the first and second line of defence needs to be considered as examples and there may be good reasons to have a different organisational set up.

Before we start to decompose the different processes, we need to look at the different levels of intrinsic tension within an organisation. One could, in principle, define some three different levels of independence.

1. *No independence.* The whole management is done within the first line of defence. One could, for example, consider sustainability as such an area. The reason for putting processes in this category might be that the corresponding risks are less relevant or that the time until they materialise is longer.
2. *Limited challenge from the second line of defence.* In this category we may have risks which are more relevant than in the above category, be it in terms of timing or in terms of severity. Here the challenging of the second line of defence is limited since there are no dedicated experts who could

do this job but there is rather a higher reliance on the first line of defence expertise. An example could be business protection.

3. *Full independent challenge from the second line of defence.* The corresponding risks are highly relevant for the company and in consequence the subject matter expertise in the second line of defence has the same level of professionalism as within the first line of defence. Risks which fall into this category are normally very important for the profitability and strategy of the company and normally include all types of financial risks such as Market and ALM risks. In some legislation there is a need for some segregation of duties, for example in doing independent valuation of OTC derivatives, etc.

Since it is obviously not possible to decompose all processes of an insurance company we limit ourselves to some key processes which normally form part of the third category.

Each of the Risk Functions and their process will be decomposed in the same way:

- Description of the Process,
- Main Risks,
- Organisational Design,
- Key Learnings.

3.1 Capital Allocation and Planning Functions

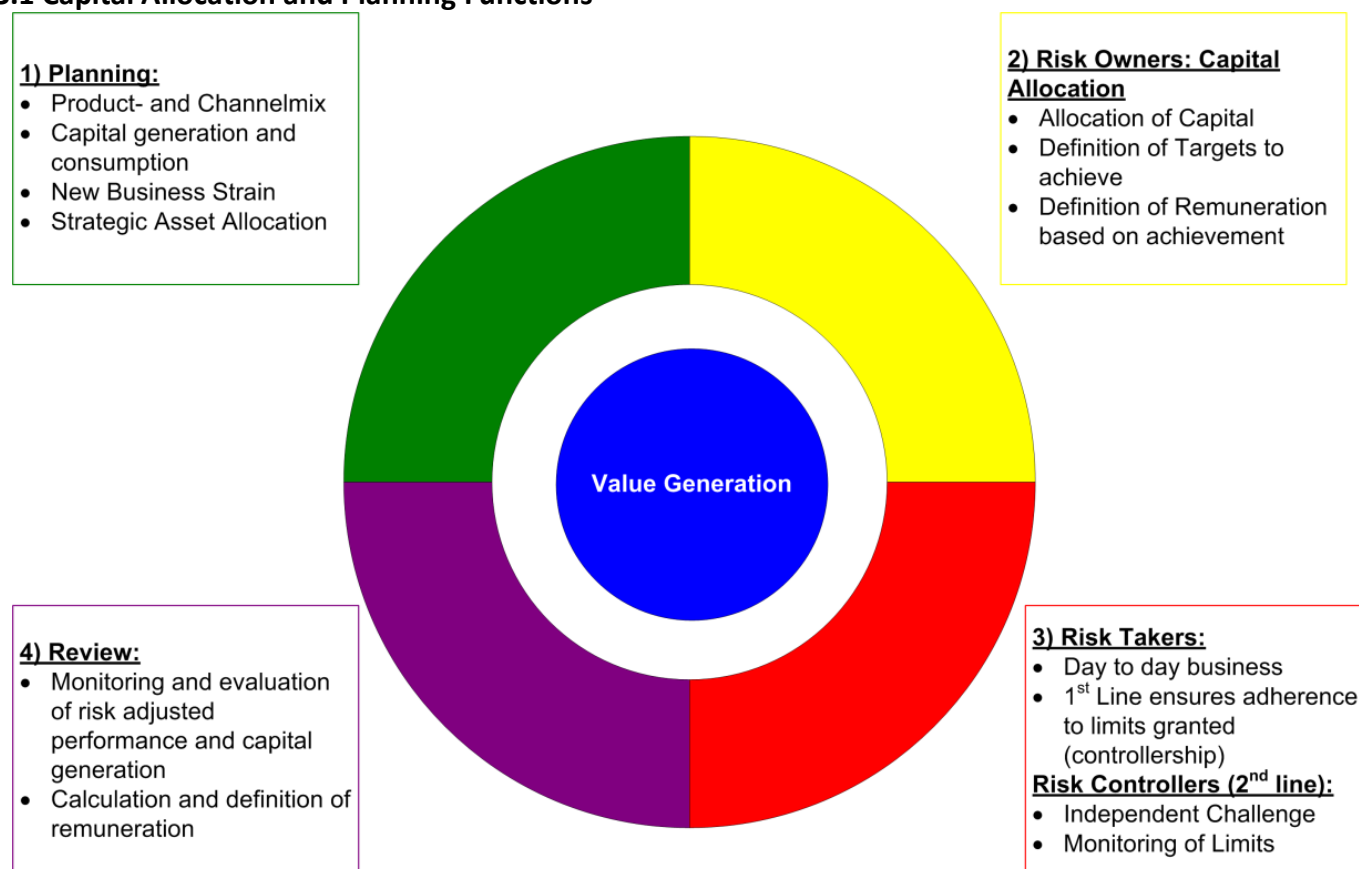


Figure 8: Capital Allocation – Generic Organizational Function with the main Process Areas

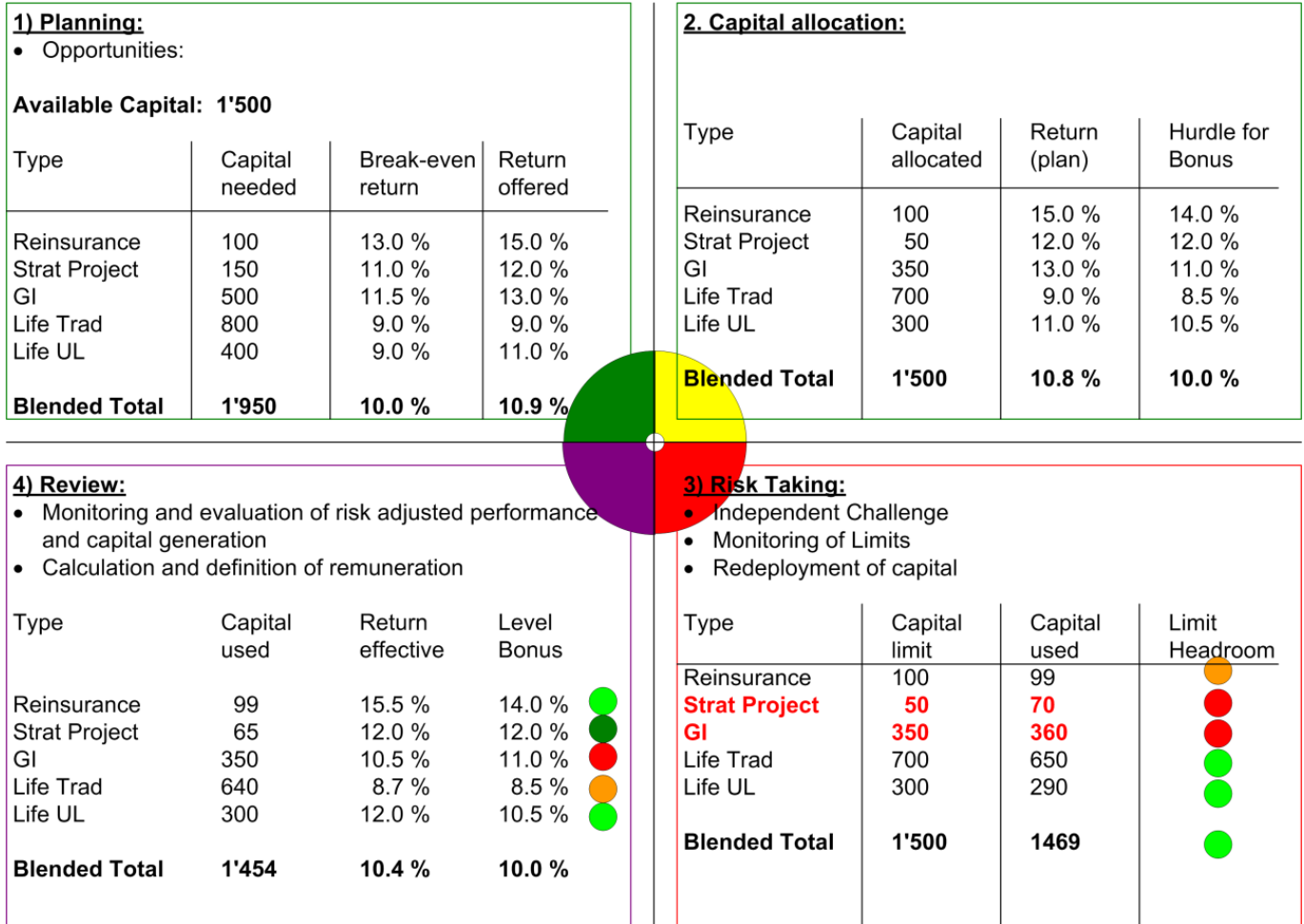


Figure 9: Capital Allocation – Example

Description of the Process: The capital allocation and planning process is the main economic process in an insurance company. All other economic processes are dependent on it. This process is described in figure 8 with an example in figure 9.

It is particularly important to understand that such processes need to have feedback loops and hence this type of process never ends. Normally one starts with the amount of capital available and with a portfolio of business opportunities. The aim is to define an optimal product and channel mix which is in line with the strategic objectives and the risk appetite of the company. One has to weigh the capital consumption against new business strain and determine the strategic asset allocation which fits best. For each business opportunity one has to have a view on the required capital and the corresponding expected returns. In a normal environment there is a scarcity of capital and hence it is not possible to execute all business opportunities. But there may be situations (for example in a reinsurance company when entering a softer market), that there are not enough business opportunities that yield the required return and it is not possible to deploy all capital. In these circumstances the company may also decide to give some capital back to its shareholders.

After gathering all the required information, one enters the next step of the process, where the risk owners decide how much capital is allocated to each of the business opportunities. This decision process is normally based on the pure economic facts but there are also some softer considerations, such as the strategic ambitions and considerations in respect of the insurance cycle. When allocating the capital, it is also important to define the hurdles which need to be met in order that the corresponding managers receive a bonus. It is important they are based on risk adjusted metrics. It is also here, where the risk

appetite and the corresponding limits are defined and anchored. After this second step, which normally happens before a new financial period, we enter into step number three, the risk taking. Here the line management aims to optimally deploy the allocated capital in order to generate superior returns and to meet the defined hurdle rates. At the same time they ensure that they operate within the risk limits granted to them. The second line of defence challenges key decisions taken by line management and independently monitors the adherence to the limits granted. In case of a limit violation the corresponding escalation mechanisms are indicated in order to bring the situation back to within the agreed risk appetite. In some cases it will not be possible to deploy all capital or there is a need for more capital for an interesting opportunity. In this case the risk owners reallocate capital as described in step number two. At the end of the financial period, we enter into the review phase, where the actual achieved results are compared with the targets and where the risk adjusted returns are determined. As a consequence, the variable compensation of the line managers in the function of their performance is defined.

Main Risks: Since this is a critical organizational function and the main process we also face all possible risks, which are mainly underperformance due to a wrong capital allocation, suboptimal business opportunities and the taking of undue risks, for example as a consequence of an ill-behaved remuneration structure and missing limit systems.

3.1 End to end Capital Allocation Value Chain & Processes

Capital Allocation Process

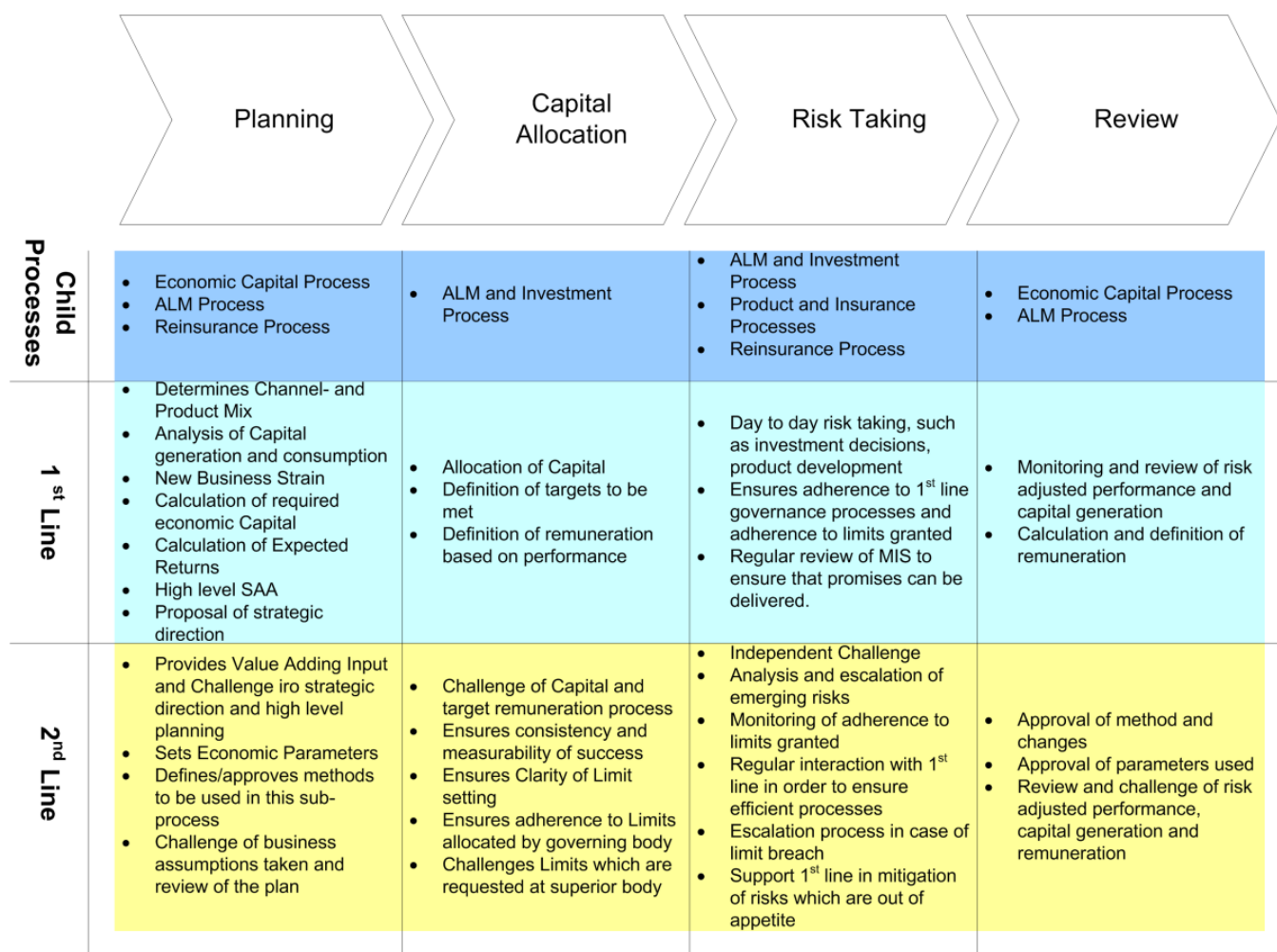


Figure 10: Capital Allocation Value Chain and split Processes between 1st and 2nd line of defence

Organisational Design: Because this is a particularly important process, it is necessary to have a clear segregation of duties between the first and second line of defence. Figure 11 shows a possible subdivision of the process between the first and second line. The main principle is that the persons who are remunerated according to metrics should not be able to determine how this is calculated. Hence it is one of the main tasks of the second line of defence to ensure the clarity in limits and bonus setting. They furthermore ensure an adequate challenge of the risk adjusted performance numbers in order to avoid self-fulfilling promises. It is key that the risk owners (who have the final responsibility for the business) define the risk appetite and the allocation of capital. Here the risk management function acts as an enabler providing value adding insights and challenges. There are another two important points to make. It is expected that the second line of defence also provides valuable input to the strategic dimension of the process. This is particularly evident since strategic errors have, in many cases, a large adverse effect. Finally, it should be stressed that the second line of defence should not only check limits in order to fulfil the corresponding compliance requirements, but in case of a material limit breach or if the risk appetite is exceeded in a material manner, they should provide help to bring things back within the risk appetite. This fact needs to be stressed, particularly in respect to financial risks that the corresponding know-how within the risk management function can be of considerable help.

Key Learnings: From this process it becomes apparent that a clear vision of what needs to be done in the first and second line of defence is key. Furthermore, it is equally important to have the corresponding governance in place when making the abstract process living. This is done by exercising which means that in case of governance committees, a frequency is required that is high enough so that people get used to the different concepts and tasks. It is also important to have reliable and robust processes and methods in place. Finally it is very important that this process is done with an action oriented focus in a structured manner.

3.2 End to end Economic Capital Calculation Value Chain & Processes

Capital Allocation Process

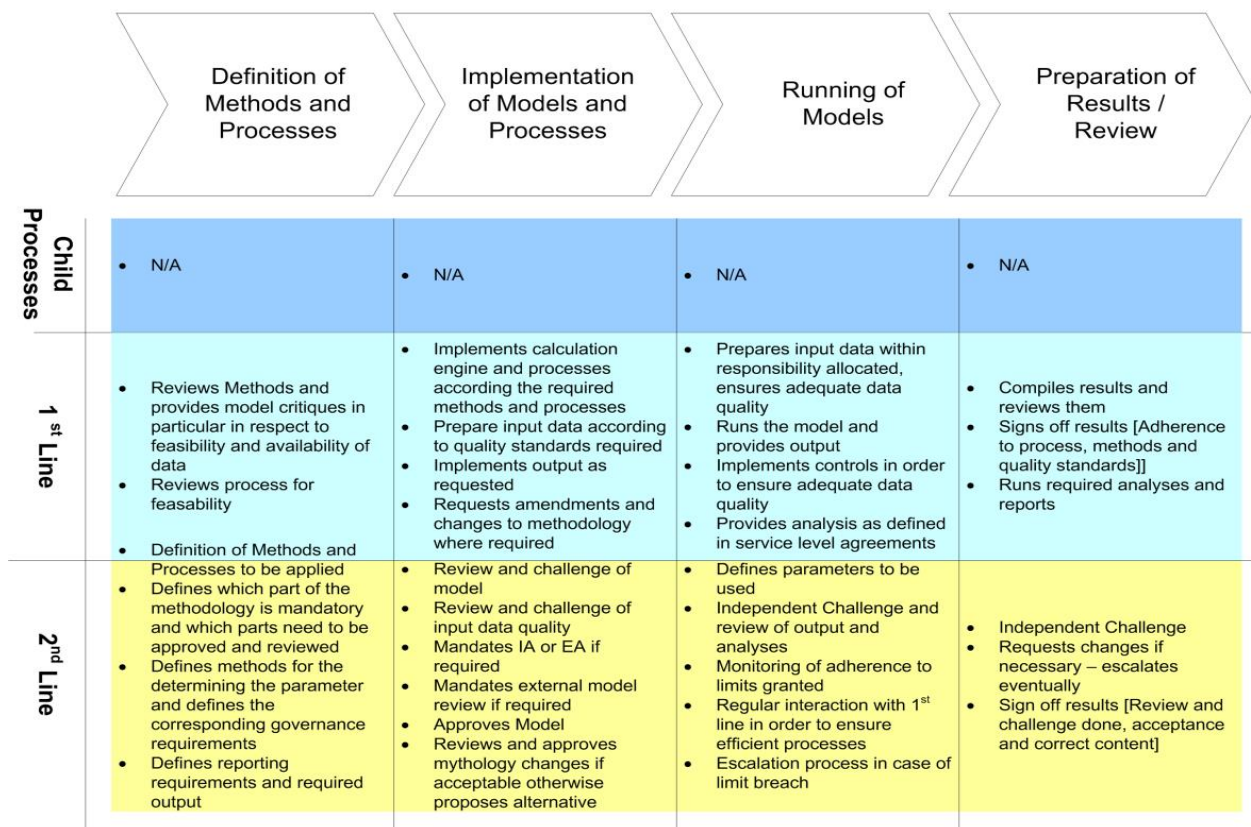


Figure 11: Capital Allocation Value Chain and split Processes between 1st and 2nd line of defence

Description of the Process: The process of calculating the economic capital is split into two parts, the calculation of the *available* economic capital and the calculation of the *required* economic capital. This process also assesses the risk adjusted profitability as mentioned in the capital allocation and planning process.

The characteristics of this process are very technical and therefore very important. From a very high level point of view, it is the measuring process without which an objective assessment is impossible. As a consequence, particular care needs to be applied to the split between first and second line of defence. It is also important to recognise that the separation is not trivial, since the design and the implementation of the corresponding models need to be split. In the same sense the people determining the parameters need to be different from the people approving them. The split within this process is shown in figure 3.4.

Main Risks: As mentioned above this process determines the "economic capital meter stick". There are two risks which could materialise if the process is not implemented correctly. The first is that a wrong measurement either under or overstates capital, which leads to taking undue risks and suboptimal performance respectively. The second is that the meter stick is adjusted only for the purpose of better returns during the assessment phase. Intrinsic to this risk is the abuse of the management framework and the payment of undue bonuses.

Organisational Design: Since this process is the core of the economic risk measurement and valuation, there are different stakeholders who participate in this process and two things need to be ensured. On one hand we need to have enough tension in the system to get reliable and unbiased results and on the other we need to have stable processes which safeguard consistency with the financial accounts and so confirms the link to the business and finance. Obviously, different design principles could be applied to the one proposed here (see Fig 3.4) which is aligned to Solvency II.

Risk people define the economic capital model while the actuaries implement it and run it on a day-to-day basis. Similarly, while the actuaries propose the model's parameters, risk people sign them off along with the results generated. It is this separation of duties that creates reliable checks and balances and thereby prevents the generation of self-fulfilling prophecies.

Key Learnings: The key learning is that the economic capital models are very complex and it is essential to have checks and balances intrinsic in this process to ensure adequate results. It is necessary to use the results in many areas of the business in order to embed economic thinking in the company and to meet the requirements of the "use test" imposed by Solvency II.

3.3 End to end ALM and Bonus Setting Value Chain & Processes

ALM and Bonus setting process

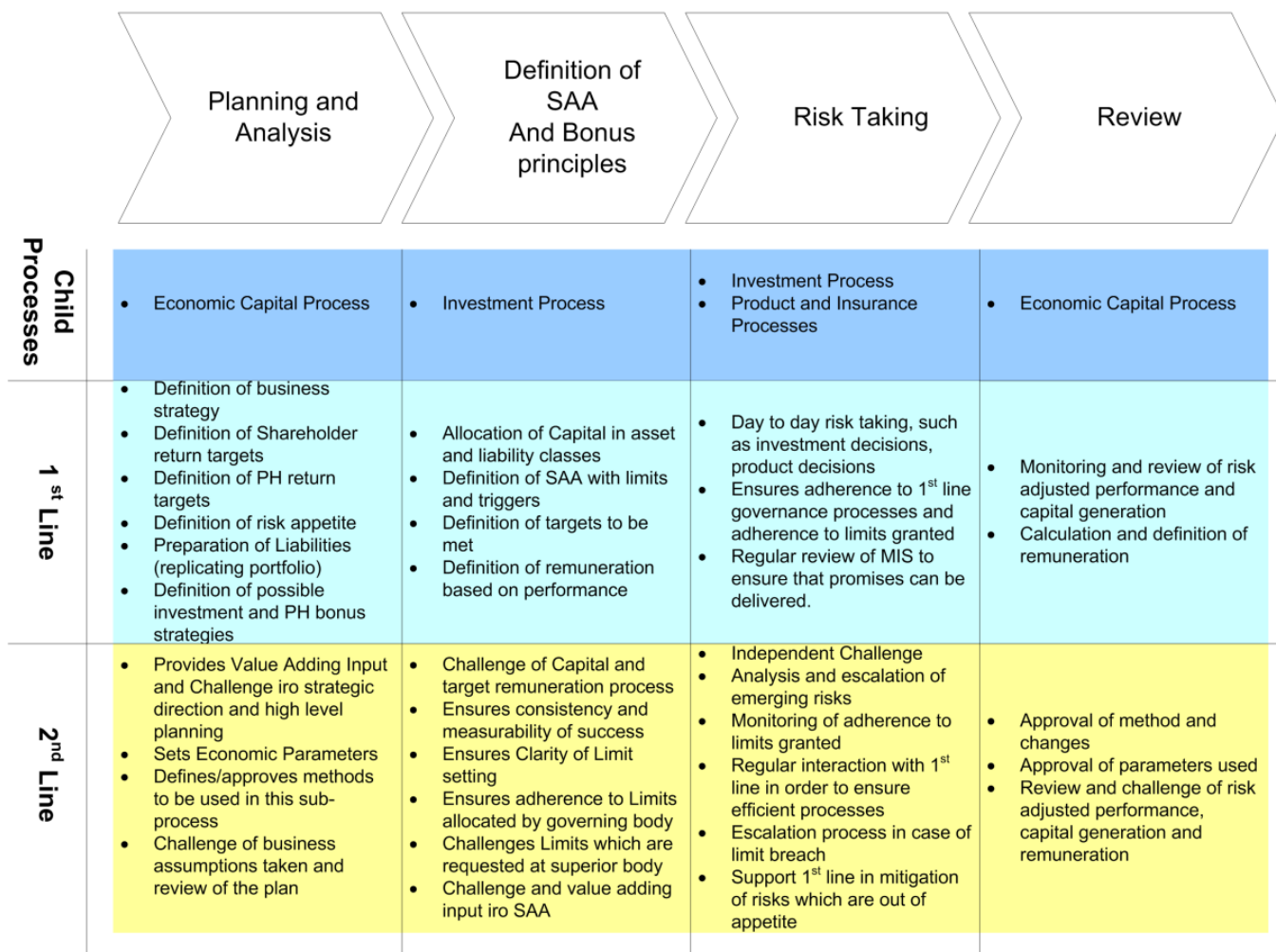


Figure 12: ALM and Bonus setting Value Chain and split Processes between 1st and 2nd line of defence

Description of the Process: If we go down one level from the capital allocation and controlling process, the next most important process is the ALM and Bonus setting process. Before entering into details it is necessary to understand why we bind these two processes together. In a lot of cases ALM and Bonus setting are considered as separate tasks. The aim of this process is to steer the assets and liabilities in order to provide an optimal return for both shareholders and policyholders. Technically, the liabilities given by insurance policies are compared with current assets. As a next step, one has to do two things to define the bonus strategy and the target asset allocation, optimising the relationship between assets and liabilities. During the year the investment strategy is implemented adhering to the limits allocated during the ALM process and is based on the capital allocated to this task. At the end of the year two things take place. Firstly the performance is measured and any excess generation of economic wealth is split between shareholders and policyholders. This process is called the bonus setting process.

Main Risks: There are many different risks inherent to this process. The main ones are a suboptimal investment strategy which either does not deliver the business objectives required or only meets the required returns by taking excessive investment risk. Another significant risk is the possible disjoint between the assets and the liabilities. This risk is normally manifested by granting too onerous bonus promises to the client, which cannot be realistically achieved without taking excessive investment risks. The crisis which hit a lot of insurers in the years 2001/02 is a consequence of this disjoint.

Organisational Design: Normally the issue is not that people are taking undue risks on purpose. The main issue is that they are not speaking to each other because either they do not understand the issues of the other key player or because they speak a very different language. Furthermore the whole question around ALM and bonus setting is not only highly complex from a technical point of view but also requires a deep understanding of insurance products and customer needs. There are very few people who understand these relationships and the corresponding pitfalls in detail. It is absolutely essential therefore to work in a team, where the main functions that have a stake in this question are involved. This means that an ALCO committee with the following participants: distribution, products, finance, investment and risk is set up.

Key Learnings: Since this process is highly complex it is necessary to work in an interdisciplinary team, where the different team members are able to understand the language of the other and where the whole process is based on a structured process supported by concise action oriented and relevant management information. It is clear that the ALM process and its decisions need to be broken down further in order to have a meaningful investment process, as illustrated in figure 12.

3.4 End to end Investment Value Chain and Processes

Investment process

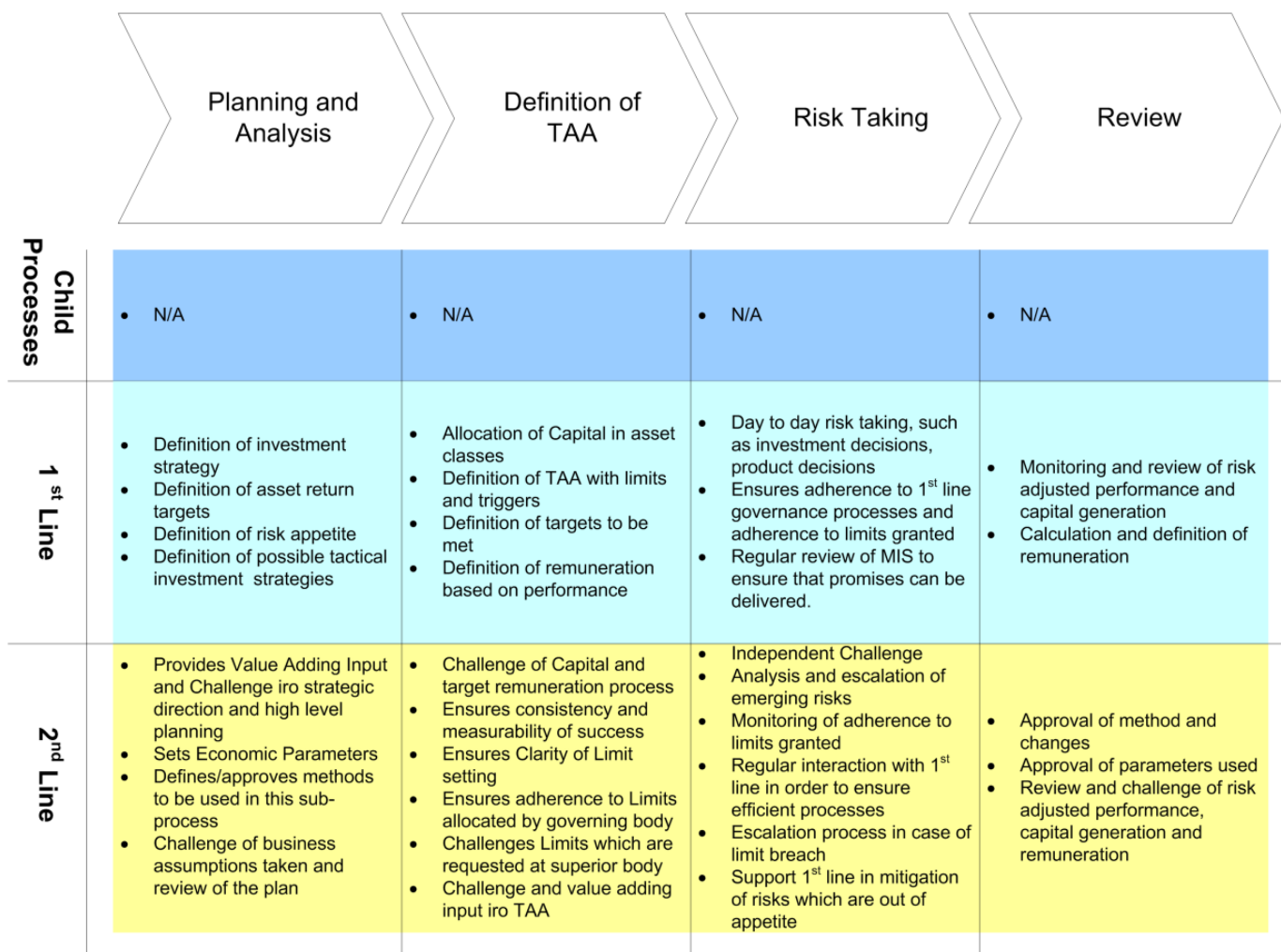


Figure 13: Investment Value Chain and split Processes between 1st and 2nd line of defence

3.5 Product Design Value Chain and Processes

Product development and review process

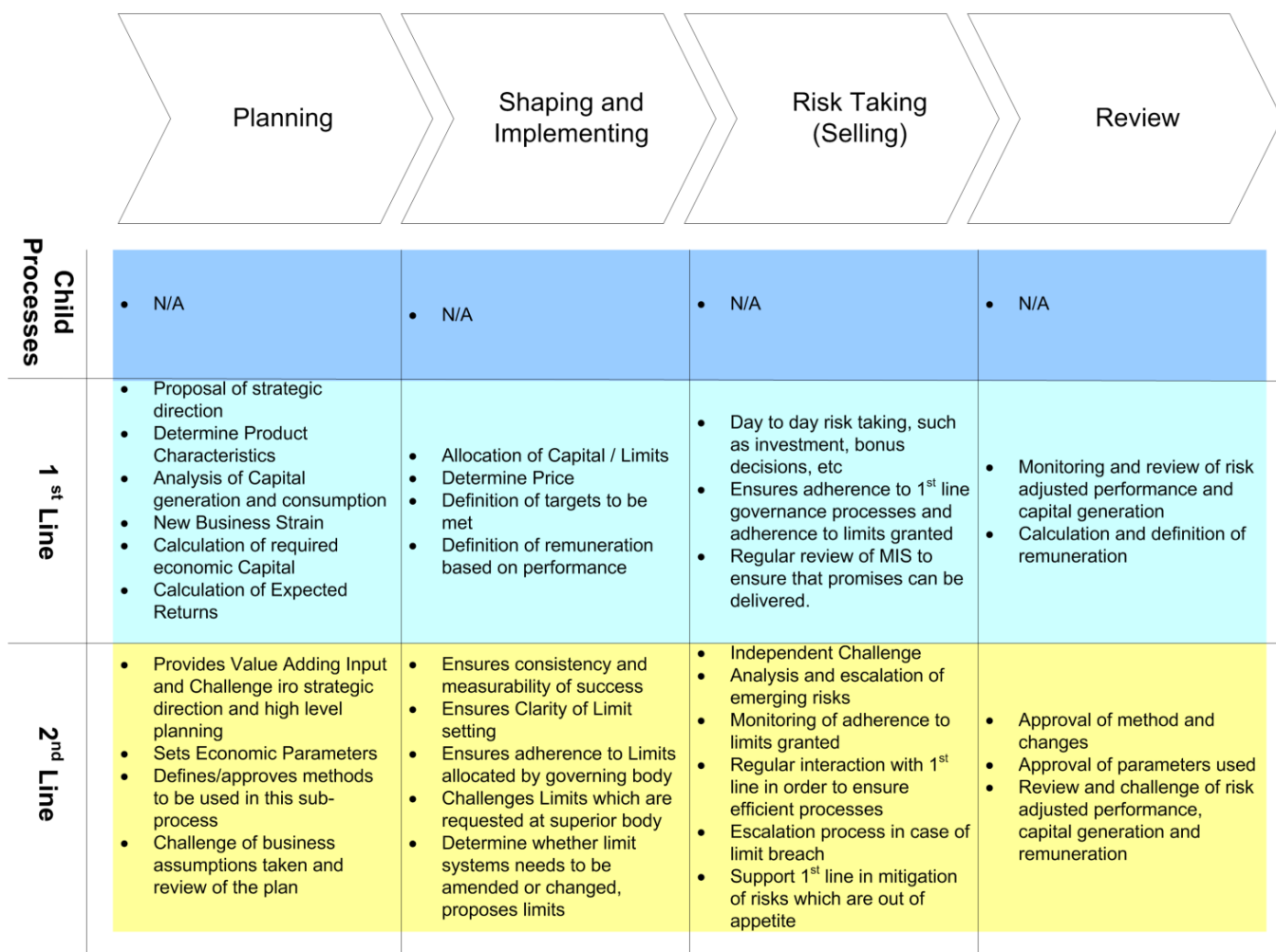


Figure 14: Product Development Value Chain and split Processes between 1st and 2nd line of defence

Description of the Process: It is known that the product design process is another root cause of potentially big losses and problems in an insurance company. In contrast to investment risks, where gains and losses occur on a daily basis, losses as a consequence of a wrong product design can be considered as rare events with high severity if they materialise. The aim of this process is to develop and introduce new, or to change and improve, existing products. Improvement in this context does not only mean increases in profitability but also increases in sales volumes. Every new product starts with an idea, which can come from either looking outside the company, asking clients' demands, etc. Next, one has to shape the product and to look at the different angles, such as product design, product implementation, customer needs and asset liability management for the product, risks intrinsic to the product, pricing of the product etc. After having defined the corresponding boundaries one develops a concept paper and then a technical documentation of the product, before implementing it. In parallel, the supporting material and training for the distribution channels is prepared in order to sell the product.

Main Risks: There are two main risks within the product design, namely a wrong structural design and wrong pricing. Both effects can lead to either selling too few policies or too big losses. Failures in relation to products can lead to considerable losses for the insurance company.

Organisational Design: The main cause for ill-behaved product designs are, from a structural point, almost the same as for the ALM and Bonus setting process with the only difference being that the same people

are not necessarily needed at the table. It is therefore important to create a product approval committee which overview the issues in relation to products. Adequately skilled people are needed who are able to foresee the insurance products.

Key Learnings: As indicated before, the key learnings are very similar to the ones of the ALM and bonus setting process.

4. Lesson Learned

Based on a solid Risk Ontology, there are so many important lessons around risk oriented modelling that are relevant. In the following we have taken us the time to summarize how to get started and how to ensure that you as the practitioner follow a structured way of thinking, working and modelling to ensure consistency and success. Important, while there might be multiple ways of how to start to do risk oriented modelling, we have a clear recommendation: ‘use an integrated artefact approach’. An artefact in this context is a documentation product such as a risk competency map, risk capability list, risk process map, risk information model. Critical is that the artefacts are integrated to each other. With out the integration, you will silo the risk relevant components in multiple artefacts. Below are some examples of such artefacts.

and then the process model where the risk aspects are integrated within the BPMNotation. Such templates are called different by various practitioners, where an engineer calls them models and an Enterprise Architect will call them Artifacts. While different names, they are basically the same. The purpose of starting with such a template, is to capture, relate and structure the viewpoints and meta objects associated with the various disciplines and to bring them together to create a common understanding. Standard process templates are very important, because they establish the elements of the artefacts, i.e. the relevant process objects to be addressed when the template is used^{xii}.

Below in table 2 is an illustration of such a template where the risk aspects are related to process relevant aspects. Such a risk-process matrices show the relationship between two specific sets of decomposed (broken down) objects in a process centric context. The core idea of such a risk-process matrices is that they each consists of a set of meta objects that semantically have primary and thereby direct natural relations to each other. The result is that these are always in the form of two lists (a row and a column) which the process objects with which they share a relationship each being rated to them within the body of the matrix.. This allows within the risk-process matrix to relate the unfamiliar to the familiar, thus connecting risk aspects to the process relevant aspects (composition).

Risk Factor	Risk #	What specification:			Who/Whose specification:			
		Business process	Process Steps	Process Activities	Stakeholder involved	Process Owner	Managers involved	Roles/ Resource involved
Risk aspect1	#							
Risk aspect 2	#							
Risk aspect N	#							

Table 2: Example of a risk-process matrix showing how process relates to performance indicator

Once the information has been collected an organized where the process maps are used to relate the risk, creating a risk-process matrix, a process model i.e. BPMN may now be crafted to connect enable the

complex set of resulting information to be used in different disciplines and within this to be communicated more easily to stakeholders, management, and leadership. The fully integrated and standardized process templates enable the practitioner to work and model with the risk related process objects throughout all the aspects of the enterprise (business, application, and technology) with more confidence in the completeness and alignment of their information. Not only are their semantic relations and connection governed the objects, but also by the risk and the process modelling rules and tasks, which ensure how and where the process templates interlink and share common process objects. In the below claims handling example we will illustrate how risk applies to processes, events, gateways, various process roles as well as business roles and different workflows such as process, services and information flow. The figure 15 example is based on 5 specific Risk Management processes; Perform Risk Assessment, Investigate Claim, Perform Fraud Protocol, Update Litigated and Forward to State Fraud Division. It illustrates clearly how risk is interlinked across the various insurance claims handling:

- Processes flow aspects, represented by the manual and automated tasks
- Service flow aspects, represented by the manual and automated services
- Information flow aspects, represented by the information objects, information stores and the dotted line

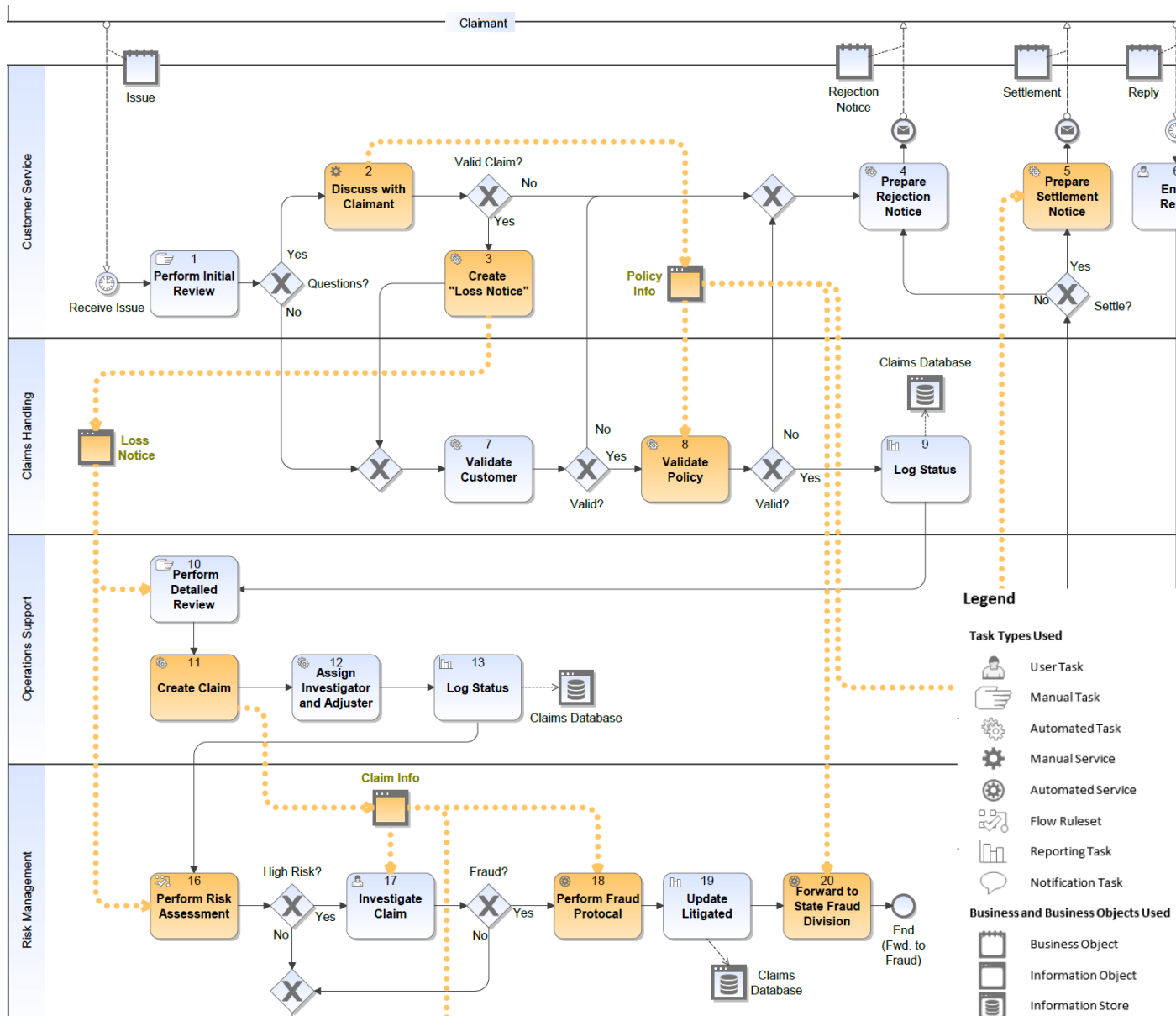


Figure 15: Illustration of a claims handling example^{xiii}

While the various insurance organization might do it more or less effective, the figure 15 example of a claim processes are practically the same for any insurance organization. While the above example is simplistic in nature it illustrates the relationship between risk and various aspects within the insurance organization. This case story will elaborate on the ability to apply and model risk management functions into the insurance processes. To both understand the very nature and relationship of risk aspects and have the ability to understand, capture and model risk better. It identifies the semantic relationships within the insurance process areas and groups, the business workflow, roles and rules involved. Thereby using risk and process ontology and semantic principles to identify which risk aspects relate or should relate together in order to better manage business risk, insurance risk and financial risk. Provide a starting point that can be used to guide the analysis, decomposition, composition, and construction of Risk in a complex environment.

5. Conclusion

Writing this case story, has in many ways been an exciting and challenging journey, especially since it tackles one of the most complex modelling disciplines, namely Risk oriented modelling. Therefore, this case story should be seen and used as an example of how such principles can be applied in a complex environment. Even though it does not address all aspects of Risk engineering, modelling, and architecture, it attempts to build a basis of a structured Way of Thinking, Working, Modelling, and Implementation of Risk concepts within an Insurance organization. It tries to illustrate how to organize and structure the viewpoints and objects associated with Risk relations and Risk stewardship within the various processes. We therefore hope that this example sets out guiding principles to establish a common way of thinking and modelling for creating, interpreting, analysing, and applying Risk concepts to a particular domain and/or layers of an enterprise or an organization.

For further information, we refer to:

- The Global University Alliance Business Ontology
- The Global University Alliance Risk Ontology
- For further details regarding risk management in life insurance we refer to M. Koller, Life Insurance Risk Management, Springer, 2011.
- The LEADing Practice Insurance Reference Content: Few examples of the reference content, can be found under this link: <http://www.leadingpractice.com/industry-standards/finance/insurance/>
- The chapter on Risk oriented modelling, The Complete Business Process Handbook Volume II, Elsevier 2015
- The LEADing Practice Risk Reference Content (LEAD-ES10017AL)

ⁱ von Rosing, M., Laurier, W. (2016). Introduction to the Business Ontology, International Journal of Conceptual Structures and Smart Applications (IJCSSA), IGI Global Publisher,

ⁱⁱ von Rosing, M., Risk oriented modelling, The Complete Business Process Handbook Volume II, Elsevier 2015

ⁱⁱⁱ The LEADing Practice Risk Reference Content, 2010-2015

^{iv} Based on the Global University Alliance research and analysis around Risk Ontology

^v von Rosing, M., Kemp, N., Hove, M., & Ross, J. W. (2015). Process Tagging—A Process Classification and Categorization Concept. In M. v. R.-W. S. v. Scheel (Ed.), The Business Process Management Handbook (pp. 123-171). Boston: Morgan Kaufmann.

^{vi} von Rosing, M., Laurier, W., & Polovina, S. M. (2015b). The Value of Ontology., The Business Process Management Handbook, Volume I, (pp. 91-99). Boston: Morgan Kaufmann.

^{vii} Polovina, S. M., von Rosing, M., Laurier, W. 2014, Conceptual Structures in LEADing and Best Enterprise Practices, Graph-Based Representation and Reasoning, Lecture Notes in Computer Science, Springer

^{viii} The LEADing Practice Risk Meta Model, 2015, based on the Global University Alliance research and analysis.

^{ix} LEADing Practice Risk Management Reference Content LEAD-ES10017AL, 2015

^x The Industry Handbook: The Insurance Industry, Investopedia, 2015

^{xi} Taken from The LEADing Practice Insurance Reference Content: <http://www.leadingpractice.com/industry-standards/finance/insurance/>

^{xii} von Rosing, M., Hove, M., von Scheel, H., Foldager, U., (2015b). Why work with Process Templates, The Business Process Management Handbook, Volume I,. Boston: Morgan Kaufmann.

^{xiii} Model illustrated with iGrafx Enterprise Modeler