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RISK MANAGEMENT INTELLIGENCE

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Abstract. Today various types of risk are present in any organization. The way how they are managed impacts the success of the whole organization and its activity. In order to facilitate and structure risk management in an organization, risk management standards have been developed. However, in contemporary risk management a lot of new issues arise, and there is a constant need to improve the standards, create innovative methodologies and develop adequate methods for successful risk management. A new concept and entire approach of Risk Intelligent enterprise management has been formulated, stressing that risk management should be integrated into enterprise strategy and operations. In the paper the concept of risk management intelligence is further developed in the sense that the ability to foresee and adequately model with appropriate techniques the future possible risks, taking into account the uncertainty of the situation, must be strongly embedded into the risk management process. The paper presents conceptual description of the presented concepts, as well as proposes the adequate methods and tools for implementing intelligent risk management.

Keywords: intelligent risk management, enterprise risk management, risk intelligence maturity model, optimal resource allocation.

Jel classification: G32, D81, M10.

1. Introduction

The past two decades have seen a dramatic change in the role of risk management in companies and organizations. The perception about risk management moved from merely financial or insurance-driven towards the complex integrated process creating value for shareholders. Thus it is important to further analyse various aspects of risk management in order to bring it closer to modern perception – intelligent risk management, already adopted by the leading world corporations.

The main objective of the paper is to analyse the process of intelligent risk management in an enterprise and provide a suitable means for its implementation. This is done with the help of risk intelligence maturity model which presents the methodology of enterprise moving from one step on the model further to another till it reaches the stage of enterprise risk management intelligence. In order to move through the steps, a company needs to invest certain resources, which should be allocated to the respective risk management activities. In the paper the idea and scheme of such allocation using adequate portfolio method is proposed.

2. The concept of intelligence revisited

In order to discuss risk management intelligence thoroughly, first of all, there is a need to define the concept of intelligence.

Intelligence derives from the Latin verb *intelligere* which, in turn, derives from *inter-legere* meaning to "pick out" or discern. Intelligence has been defined in many different ways including, but not limited to, abstract thought, understanding, self-awareness, communication, reasoning, learning, having emotional knowledge, retaining, planning, and problem solving.

The Webster dictionary defines intelligence as 1) the ability to learn or understand or to deal with new or trying situations, 2) the ability to apply knowledge to manipulate one's environment or to think abstractly as measured by objective criteria (as tests) (Merriam-Webster... 2012).

The definition of intelligence is in fact controversial. A group of scientists has proposed the following description of the intelligence concept in the publication "Mainstream Science on Intelligence" (1994) – an editorial statement of fifty-two researchers: "A very general mental capability that, among other things, involves the ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly and learn from experience. It is not merely book learning, a narrow academic skill, or test-taking smarts. Rather, it reflects a broader and deeper capability for comprehending our surroundings – "catching on", "making sense" of things, or "figuring out" what to do" (Gottfredson 1997a). Also, Gottfredson (1997b) describes intelligence in her own article in the same volume less broadly as "the ability to deal with complexity". However, the article of Carroll (1997), one of the signatories of the "Mainstream Science on Intelligence" statement, reviewed the numerous attempts in the academic literature to define what was meant by intelligence and found that there was no agreement. He cites experts describing intelligence as "the total intellectual repertoire of behavioral responses," "some general property or quality ... of the brain", "reaction-time and physiological measures", "many different information-processing abilities" and "the rate with which learning occurs or the time required for learning". The discussion on intelligence concept lasts till nowadays, analysing human intelligence (Schweizer *et al*. 2005; Miller, Penke 2007; Brydges 2012), as well as artificial intelligence of computer-based systems (Samaras, Matsatsinis 2004; Hernįndez-Orallo, Dowe 2010), the latter being closely related to multiagent system intelligence (Symeonidis *et al*. 2007; Xiang, Lee 2008) and artificial neural networks (Nenortaitė, 2006; Nenortaitė, Butleris 2009; Hayashi *et al*. 2010).

Speaking about intelligence in the context of risk management, it is worth adding the attribute of "being able to adequately forecast the future", in other words – being discerning or perceptive, what is especially valuable in analysing various business processes and could help companies to increase efficiency. Thus the concept of intelligence, related with risk management in an enterprise will be used further in the paper in the latter presented meaning.

3. Business intelligence as the prototype of risk management intelligence

3.1. Business intelligence and its environment

To approach the definition of risk management intelligence, or at least risk intelligence, it would be wise to take a look at the definitions and descriptions of "management intelligence". But there is a lack of discussion on this topic. However, another close concept to management intelligence, namely – the business intelligence – gains quite a big attention in scientific literature (Azma, Mostafapour 2012; Popovič *et al.* 2012), as well as in practical publications and even in the names of service-providing companies and their offered products (SAS 2012; Business Intelligence 2012). The separate functions or attributes of business intelligence are being established in most successful companies thus fostering their competitiveness and quality of products and services (Azma, Mostafapour 2012).

However, business intelligence more often becomes a category of information systems and intelligent decision-making. The term business intelligence (BI) can refer to various computerized methods and processes of turning data into information and then into knowledge (Lönnqvist, Pirttimäki 2006), which is eventually used to enhance organizational decision-making (Williams, S., Williams, N. 2007). In a decision-support context, business intelligence systems (BIS) have emerged as a technological solution offering data integration and analytical capabilities to provide stakeholders at various organizational levels with valuable information for their decision-making (Turban *et al.* 2010). Thus the process of information turning into knowledge can be divided into certain steps, in other words, business intelligence assets, that will be described in the next section.

3.2. The framework of business intelligence – assets

In essence, business intelligence can be properly analysed by distinguishing its assets. Analysing business intelligence assets, we can notice that business intelligence is a means for adding value in production or service delivering process. Usually it is accepted that business intelligence activity can be applied in order to drive business value to such business functions: measurement, analytics, reporting/enterprise reporting, collaboration/collaboration platform, knowledge management (Rutkauskas *et al.* 2011).

But do business intelligence assets really exist? To find an answer to this question the definition of the word "asset" should be fully disclosed. It is a resource with economic value that an individual, corporation or country owns or controls with the expectation that it will provide future benefit. It can be also seen as a tool or a platform, something you can use over and over without using it up. In fact, it's something that gets better the more you invest.

Nowadays there is a possibility to drive business value also through the business intelligence activities, so the business intelligence activities become the means which help to provide and generate benefits and could be treated as assets in the

process of portfolio formation of business intelligence assets. Business intelligence assets could be also accepted as the elementary business intelligence activities.

It is not easy to define what are the main business intelligence activities. Some scientists are sorting business intelligence activities as: reporting, analytical process, statistical analysis, forecasting, and data mining. Others point out five key business intelligence activities: planning, measuring, analysis, communication, and action (Activities… 2012).

A typical business intelligence solution includes data sources where transactional data is accumulated, data warehouses/data marts, reporting and visualization tools, as well as predictive analytics and modeling (Brannon 2010).

The business intelligence cycle defines the basic steps of the business intelligence process, and consists of four phases (Müller *et al*. 2010):

- *Planning and direction*: in this phase the business intelligence cycle is structured;
- *Collection of data*: in this phase the necessary data sources are identified and data is collected. After that the collected data can be converted, edited, aggregated, and stored in a structured way;
- *Analysis of data*: in this phase the data is used to produce information, by providing context to the collected data, or by discovering patterns and connections in the data;
- *Distribution of information*: in this phase the produced information is forwarded to the right people in an appropriate format.

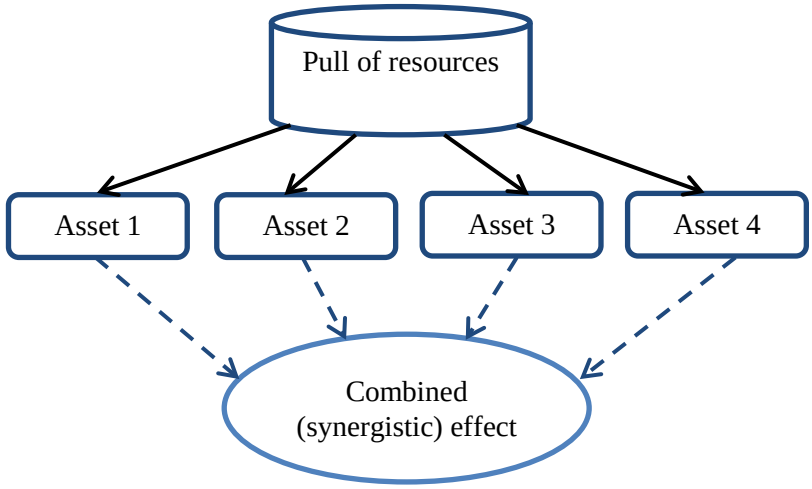

Fig. 1. The scheme of resource allocation and its effect
(Source: compiled by author)

Using any of the presented classifications of business intelligence assets and aiming to improve the general effect of business intelligence, the resources assigned for this issue can be allocated to any number of the determined intelligence assets or groups of assets. With the help of resources assigned, the mentioned assets should improve their performance in respective areas, as well as have a combined positive effect – *a synergistic effect* – on the business intelligence performance, which definitely is higher than just the sum of three, four of five separate effects (assets) (Fig. 1).

Recalling that the main objective of the paper is to analyse risk management intelligence, further a description of risk intelligent enterprise will be provided, presenting a parallel between risk intelligence assets and business intelligence assets.

4. A move towards Risk intelligent enterprise management

4.1. Contemporary trends in enterprise risk management

A corporation can manage risks in one of two fundamentally different ways: (1) one risk at a time, on a largely compartmentalized and decentralized basis; or (2) all risks viewed together within a coordinated and strategic framework. The latter approach is often called "enterprise risk management," or "ERM" for short (Nocco, Stulz 2006). Other definitions for this approach are: integrated risk management, corporate risk management, holistic risk management or enterprise-wide risk management. Thus risk management is now moving away from a silos perspective of risk towards a holistic way of looking at risk, in which all risks are managed jointly and analyzed across the entire enterprise (Korombel 2012).

Enterprise risk management according to the Committee of Sponsoring Organizations of the Treadway Commission (COSO) is „a process, effected by an entity's board of directors, management and other personnel, applied in strategy setting and across the enterprise, designed to identify potential events that may affect the entity and manage risk to be within its risk appetite, to provide reasonable assurance regarding the achievement of entity objectives" (COSO 2004). According to Hopkin (2010), however, the ERM approach means that an organization looks at all the risks that it faces across all of the operations that it undertakes. ERM is concerned with the management of the risks that can impact the objectives, key dependencies or core processes of the organization.

Currently, many organizations and institutions all over the world deal with the development of integrated risk management standards (Knight 2002; Raz, Hillson 2005; Aven 2011). The most popular ones include: IRM 2002 (The Institute of Risk Management), COSO II - Enterprise Risk Management – Integrated Framework, developed by The Committee of Sponsoring Organizations of the Treadway Commission in USA (COSO 2004); ISO 31000:2009 Risk management – Princi-

ples and guidelines (ISO 2009), which replaced the Australian – New Zealand standard AS/NZS 4360:2004 Risk Management (Australian… 2004).

The aim of risk management process is to identify potential events which, if occurred, could have a negative impact on the achievement of objectives set by an enterprise, to assess their effects and probability of occurrence, as well as to indicate ways of limiting them. Naturally, occurrence of an event may also have a positive impact on company objectives, but in practice the events that cause negative deviations from the objectives set are mainly considered (Korombel 2012). The process of risk management in companies usually consists of such steps as risk identification, risk assessment, risk response (treatment), communication, monitoring. Sometimes additional steps at the beginning of the process are added, such as analysis of internal company environment or objective setting (COSO 2004). Also, risk analysis, as well as risk identification, can be seen as a "substep" of major risk assessment step (IRM 2002).

Thus it often happens that companies which succeed in creating an effective ERM have a long-run competitive advantage over those that manage and monitor risks individually. By measuring and managing its risks consistently and systematically, and by giving its business managers the information and incentives to optimize the tradeoff between risk and return, a company strengthens its ability to carry out its strategic plan. Also, ERM can add value for company shareholders.

4.2. Maturity of risk management – the risk intelligence

Besides recent improvements in risk management process and development of enterprise risk management and risk management standards, one more innovative trend has been noticed – the so-called Risk intelligent enterprise management (Risk Intelligent... 2010). This approach considers risk as a key input into leadership decisions versus as an outcome to be managed after the fact.

It is worth to contrast the risk intelligent enterprise management with the way many companies are approaching ERM today. Many companies have implemented ERM programs in response to investor and regulator demands for more effective risk management. These ERM programs are intended to evaluate, monitor, and document an organization's risks, bringing some degree of structure to what might formerly have been a disparate set of information-gathering and risk mitigation processes. But while an ERM program can help an enterprise better organize its risk-related activities, it is not, in itself, enough to embed a thoughtful, sustainable consideration of risk into the organization's key decision-making processes. Risk intelligent enterprise management, unlike many companies' approach to ERM, treats risk management as an integral part of managing the enterprise's strategy and operations, not as a separate, siloed process. In Risk intelligent enterprise management, executives understand that every action that could create value also carries the potential for risk. They recognize that the discussion of risk and value cannot be separated, and they therefore view risk as a decision driver rather than as a con-

sequence of decisions that have already been made. Knowing this, they endeavor to make risk-intelligent choices that expose the enterprise to just the "right" amount of risk needed to pursue value creation. They consider risk on the front end of every decision they make, both to identify potential threats and to strategically select the risks they choose to take in order to pursue value.

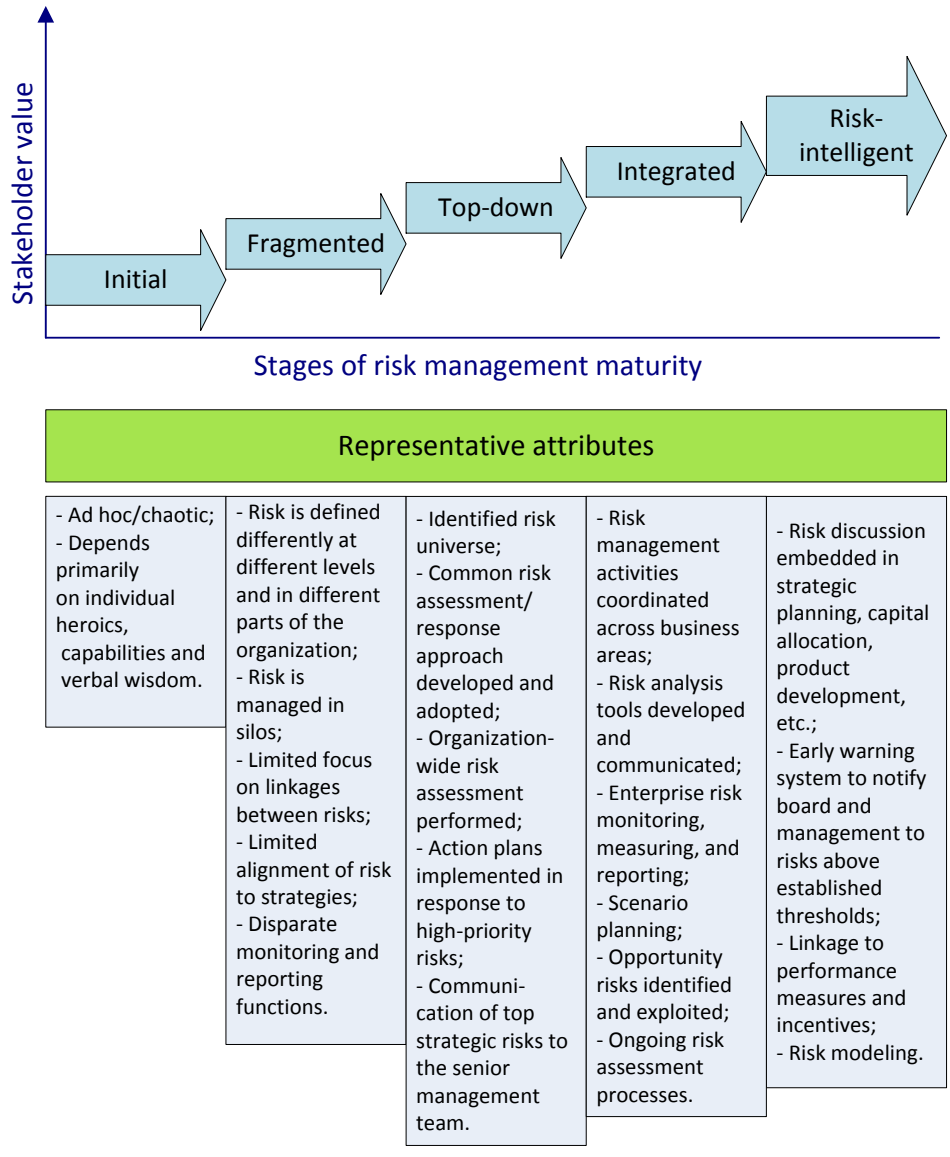

Fig. 2. Risk intelligence maturity model (Risk Intelligent… 2010)

In order to start implementing, or at least moving towards a risk management intelligence, a risk manager in a company should understand in what place exactly the company or organization is on the way to intelligent risk management. This can be done with the help of risk intelligence maturity model (Fig. 2).

Thus depending on the way how risk management is performed in the company, it can find its place on the axis showing direction towards an intelligent risk management. At companies which only begin to manage risk and lack appropriate knowledge and experience, or may be haven't faced such a necessity yet, risk management is implemented chaotically, differently at different parts of organizations and has little in common with the corporate strategy. The more we move towards the maturity of risk management, the more integrated, reasonable and quantitatively-based it becomes. The risk-intelligent approach to risk management requires the four main factors to be taken into account:

1. Risk discussion included in strategic fields of company activity;
2. Early warning system about high risks;
3. Linkage to performance measures and incentives;
4. Risk modeling.

Here a problem of optimal resource allocation between the mentioned factors appears. An assumption can be made, that a company assigns a certain amount of resources to manage risks. However, if a company identified itself being in initial or fragmented stage of risk management (Fig. 2), then it should gradually pass all further stages, and first of all assign resources to the activities of every subsequent stage. After the greatest possible effect of the current stage is achieved, the company moves to the next stage and so on till it reaches risk management intelligence. The attained risk management activities on every stage of risk management can be treated in the same manner as business intelligence assets in Section 3, when the adequate allocation of resources among them increases the general synergistic effect.

As the initial step of risk management generally does not need resources to be allocated, and on fragmented step the separate and occasional activities conceptually hardly can be treated as assets, let us begin the analysis from the third stage. On the third stage there are 5 activities, on the fourth stage – 6, and on the fifth – 4. Thus a respective portfolio can be formed out of 5, 6 and 4 assets.

For optimal allocation of resources and portfolio formation the method of adequate portfolio should be applied (Rutkauskas 2006; Rutkauskas, Stasytytė 2011a, 2011b). The individual effects that can be achieved after investment of one unit of resources in each asset can be found out by historical observations of such effect's formation, but usually there is no history or experience of effect measurement of risk management activities, or it is hardly accessible. In such a case the experts of this field determine the effect, namely – its mean value and standard deviation; as such an effect cannot be determined unambiguously by one particular value.

For expert valuations the formula of effect expression as a stochastic variable is used:

$$E = D(m, s), \tag{1}$$

where: E – effect; D – probability distribution; m – mean value; s – standard deviation.

In the analysed case transition from stage 4 to stage 5 the following expert valuations have been given:

$E_1 = D(0,95; 0,25)$,

$E_2 = D(0,83; 0,15)$,

$E_3 = D(0,81; 0,28)$,

$E_4 = D(0,92; 0,20)$.

Further the combined synergistic effect of portfolio of four risk management activities is described. The method of adequate portfolio generates a set of effect possibilities, measured by three parameters: effect possibilities, their reliability and standard deviation (Fig. 3). Also, depending of the company utility function, one optimal solution can be found under which the best possible combination of four activities could be determined (Fig. 4).

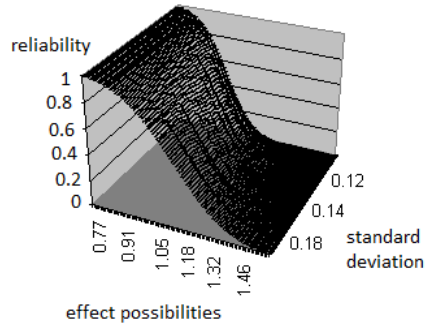

Fig. 3. The efficient surface
(Source: compiled by author)

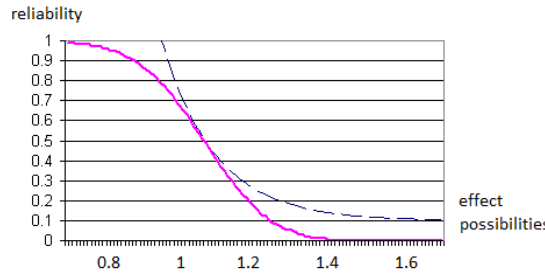

Fig. 4. Finding the optimal solution
(Source: compiled by author)

Of course, such procedure of resource allocation planning is quite time consuming and probably reasonable to undertake only by big enough companies that have already realized the necessity of risk management and a desire to go further through risk management maturity model. But still those who would accept the proposed methodology could get higher than average effect and profit from optimal resource allocation getting better risk management results than they would otherwise get.

It should be noticed, that in the paper only the broad scheme of resource allocation possibility was presented. The analysis of individual companies' cases with unique expert valuations and various transitions (from 2nd to 3rd and from 3rd to 4th stages) could give different comparable results, and such type of analysis is a field for further research of the author.

5. Conclusions

1. The concept of intelligence has gone through many stages of perception during a long period of time, and nowadays still its definition raises discussions on academic, as well as on practical level. In the risk management field intelligence should be understood as "the ability to adequately forecast the future".
2. Risk management is now moving away from a silos perspective of risk, towards a holistic way of looking at risk, in which all risks are managed jointly and analyzed across the entire enterprise, giving rise to a concept of Enterprise Risk Management (ERM). Moving further a definition of Risk intelligent enterprise management appears, seeking to embed a thoughtful, sustainable consideration of risk into the organization's key decision-making processes and forcing the executives to understand that every action that could create value also carries the potential for risk.
3. According the risk intelligence maturity model, a risk-intelligent company management could be achieved by identifying on what risk management step the company currently stands and designing a strategy of moving forward to the next step till it reaches the risk management intelligence. The successful moving to the subsequent step involves optimal allocation of resources, intended for risk management in an enterprise, to the activities representing the particular step.
4. The problem of optimal resource allocation is being solved using the adequate portfolio method, treating the effects of separate activities as stochastic variables with their mean values and standard deviations, which are determined by the experts. The general portfolio made out of all the activities of the particular step results in a set of possibilities of the general synergistic effect of all the activities and is represented by the effect possibilities, their reliability and standard deviation.
5. The enterprise accepting the proposed methodology can profit from effective resource allocation by getting better risk management results than it would otherwise get. The company could move forward according the risk management maturity model and reach the risk-intelligent enterprise management stage.

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