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THE BALANCED RISK MAP AS A MEANS OF MAPPING THE PROCESS OF ANALYSING AND DETERMINING RISK LEVELS IN ENTERPRISE

Abstract

This article attempts to present the results of research into risk analysis and assessment. The proposed method is a compilation of methods based on a risk map as well as strategic management instruments such as the Balanced Scorecard of Robert S. Kaplan and David P. Norton.
The research resulted in the creation of a multi-criteria method of risk analysis based on five risk scorecards - the Balanced Risk Map (BRM). The results obtained from the risk scorecard analysis, transferred to the complete risk map, lead to an assessment of the level of risk in numeric form with plus and minus signs.

Key words: risk, risk management, risk analysis, risk map, Balanced Scorecard

Commodum eius esse debet, cuius est periculum
– He who takes a risk, stands to gain

Introduction

The most common applied analysis techniques and risk assessments include:

- analytical methods (mainly probability, Pareto analysis, VaR analysis),
- simulation methods (Monte Carlo, historical simulation),
- graphic methods (risk map, Ishikawa diagram, fault tree diagram, probability tree diagram, Bow-Tie),
- descriptive methods
- brain storming.

For analysing and assessing risk in enterprise, a new method is proposed, which combines the Balanced Scorecard risk management method as well as probability methods of assessing risk levels. The result is presented using graphic methods i.e. risk maps. Thus this new method of analysing and assessing risk, which the authors call: The Balanced Risk Map, is a combination of three existing methods. The effect of this synergy is an assessment of the level of risk expressed numerically. Observation of changes in the risk level values indicates the need to maintain or make amendments to the activities and undertakings of the assessment in the process of mapping risk.

The analytical method is used in the technique of risk management in the form of a risk scorecard, and this is derived from the Balanced Scorecard method. This is used as a tool for transferring the strategy to a specific business activity and directs managers towards realizing the objectives therein. On the card, the industry's mission and strategy is broken down into a coherent set of efficiency indicators, which form the framework of a strategic management system. Emphasis is placed not only on realizing financial goals but also takes account of factors influencing the achievement of these goals (factors of future success).

The Risk Scorecard

The construction of a balanced scorecard leads to an integrated approach to management in four basic areas of business activity: finance, customers, internal processes as well as development through the introduction of scientific elements (including the application of innovative solutions). Such a scorecard makes it possible to look at business activity from the four most important perspectives:

- Finance
- Customers
- Internal Processes
- Science and Development

Each of the above areas is studied from a defined perspective. By achieving cohesion and by balancing objectives, actions and results in these four areas it is possible to mark out the organization's strategy as a whole.

Thus one of the components of the new method is risk scorecards modelled on the Balanced Scorecard.

In the new BRM (Balanced Risk Map) method, five so-called particle Risk Scorecards are used:

Scorecard 1 Financial risk

Scorecard 2 Internal processes risk

Scorecard 3 Customer risk

Scorecard 4 Development and growth risk

Scorecard 5 Stakeholder influence risk

This last scorecard, scorecard 5, is a special scorecard addressed to the line of business analysed. It takes into account the influence of social attitudes, the rotation of owner representatives and other aspects specific to enterprise. In the case of other economic sectors or organizational forms, scorecard 5 makes it possible to define any number of risks which accompany market activity and which are characteristic of the business analysed.

The table below presents a set of particle risks entered on the five scorecards.

Insert Table 1 about here

The Probability Method

The second component of the BRM method is an analysis of historical data, and thus events which took place up until the moment of risk assessment based on normal distribution, i.e. the Gaussian curve. This is a probability method which has been used for analysing data since the beginning of the nineteenth century. In order to systemize data and establish weightings for influence and effect on the factor currently being analysed – particle risk – we use the Gaussian distribution. The normal distribution is also the most intuitive statistical distribution. It describes the situation in which the majority of incidences are near the average result, and the more the result deviates from the average, the less it is represented. The further we get from the average result, the less incidences there are. Thus if we want to define the probability of a particle risk occurring, from very low to very high, we can do so by determining the standard value of deviation.

The abscissa axis shows the percentage share of incidences falling within individual ranges measuring one standard deviation.

In the Gaussian distribution, the probability of finding a random number of this distribution in the range $\mu \pm \sigma$ is 0.68, where μ indicates the average value or the expected value, and σ indicates the standard deviation. In the Gaussian distribution, the probability of occurrence in the ranges $\mu \pm 2\sigma$ and $\mu \pm 3\sigma$ is important. Collected historical data i.e. events preceding the moment of risk analysis and assessment is often the total or average of many small, random factors. Irrespective of the distribution of each of these factors, it can be assumed that the distribution of the analysed data will be close to the normal distribution. And thus let us assume that this is a normal distribution with mathematical values such as: density function, distribution function, moments, cumulants, characteristic function, moment generating function and cumulant generating function.

The density function in the normal distribution with an average μ and standard deviation σ (balancing: variance σ^2) is an example of the Gaussian function and is described in Example 1.

$$\phi_{\mu,\sigma}(x) = \frac{1}{\sigma\sqrt{2\pi}} \exp\left(\frac{-(x-\mu)^2}{2\sigma^2}\right) \quad (1)$$

In all the normal distributions the density function is symmetrical in terms of average distribution values. Around 68.3% of the field under the bell curve can be found at a distance of one standard deviation from average, around 95.5% at a distance of two standard deviations and around 99.7% at a distance of three. This dependence is termed the three-sigma rule and is shown in Figure 1.

The standard deviation can be used as a measure of the probability of the occurrence of particle risk. We assumed that the historical data used to designate the particle risk assessment values have a normal distribution. This assumption is never completely proven, but nonetheless it comes sufficiently close.

Thus in order to define the probability of the analysed particle risk occurring and the strength of its impact, let us use this normal distribution called the Gaussian curve, constructed on the basis of events which took place in the period preceding the moment of risk level assessment. If the event of a defined particle risk falls at a distance less than a one standard deviation, we count it as a very high risk occurrence, between one and two standard deviations as medium and between two and three as low. Over three standard deviations is counted as very low. This division is imposed by the abscissa axis. Meanwhile the ordinate axis shows the number of events. If this exceeds 35%, we count the impact strength as very big, and if it is lower than 5%, very small. This is shown in detail in Figure 1 and Table 2.

Insert Figure 1 about here

Insert Table 2 about here

Caution: the medium probability value corresponds to $\sigma=2$ marked by the bold line on the table 2.

The complete risk map

Using the above method we defined the particle risks on five risk scorecards, indicating for each one the probability of them occurring and their level of impact. It remains to graphically present the results obtained. For this purpose a risk map is used. A risk map is a point graph drawn on XY axes, where the abscissa axis shows the level of impact and the ordinate axis the probability of occurrence. Individual points on the graph represent individual particle risks. An important modification of this risk map is doubling i.e. the generation of a positive twin risk map. The Balance Risk Map utilizes graphic notation of risk on a negative risk matrix and a positive risk matrix, in other words on a so-called complete risk map. Both maps border the axis at a very high probability of particle risk occurrence. Figure 2 presents the diagram used in the BRM method.

Insert Figure 2 about here

The position of particle risks on the complete risk map can be colour coded: red – priority risks, orange – unlikely catastrophes, yellow – common trivial incidents, green – unimportant, acceptable risks

Risk level assessment

In order to fully analyze risk in industry in the case of planned operations it is necessary to work out three scenarios: basic, i.e. a picture of the firm on the day of risk assessment, an optimistic scenario, i.e. anticipating rapid development resulting from new investments, markets etc., as well as a pessimistic scenario implying a lack of development and activity aimed only at remaining solvent on the market. Thus each scorecard generates particle risk assessed from the perspective of at least three scenarios. Naturally, the complete risk map is prepared separately for each scenario. When completed, the maps - bringing together factors which influence risk levels - give a full picture for the industry in the form of scenarios. It can be assumed that the green fields represent a stable position for the enterprise with a minimal level of risk. The yellow fields indicate that the enterprise is in an active sate which may bring benefits- shown on the right side, or losses – on the left side. The red fields indicate the highest risk levels, which may result in spectacular success – on the right, but also complete disaster – shown on the left.

The final stage of the Balanced Risk Map method is to calculate numerical values assessing risk for a chosen scenario. Keeping to the colour code method to indicate the position of particle risks on the complete risk map, we can assign the following numerical values:

- Red fields – 5 points
- Orange fields – 4 points
- Yellow fields – 3 points
- Green fields – 1 point

Positive risks receive points with a minus sign.

A second weighting is the use of a multiplication factor of 2 for the points awarded to the financial risk scorecard as well as technological risks on the internal processes risk scorecard. The particle risks on these cards have a much greater impact on the condition of the organization. However, analysing enterprises such as public utilities it is necessary to use the multiplication factor on the stakeholder risk scorecard for ownership decision risk and local social attitude risk.

Assessment of the probability and effects of particle risks on the example of Scorecard 5 Stakeholder influence risk.

While the majority of particle risks can be assessed subjectively based on the experience and practice of the auditor preparing the risk map, in the case of risk on the stakeholder scorecard statistic the use the above-mentioned normal distribution is not the appropriate tool.

The following example is a good illustration of a situation where the nature of the particle risk is simultaneously positive and negative.

Let us assume that we are analysing the particle risk on Scorecard 5 – Stakeholder influence risk for the central heating supplier which is planning to build a biogas plant on its own land e.g. on the outskirts of a town numbering 10 000 inhabitants in central Poland.

The stakeholder scorecard encompasses diverse, but closely related categories of facts and phenomena. In planning an investment enterprises make use of official data, which can be obtained from the documents of local government institutions, data obtained from social entities (community organizations, inhabitants) as well as data obtained by observation of the site where the investment is planned. A cursory, but multi-dimensional profile of the local community is more helpful in determining social risk than research surveys of social response to the investment. Surveys are usually configured to show the number of supporters and opponents to the venture. A multi-dimensional profile makes it possible to establish the possible dynamics of change in the attitudes of inhabitants. Researchers of attitudes towards environmental issues and the introduction of new technology point out that surveys are ceasing to be useful as a tool in forecasting risk [6].

It is worth pointing out that in the last few decades the significance of environmental protection has changed as well as the language in which the environmental issues are expressed. Public discourse mentions various ‘polluters’, ‘pests’, ‘guilty parties’ and ‘suspects’ depending on how one sees the hierarchy of the ‘burning issues’, how the natural world is defined and how the human sense of subjectivity is understood. In other words, the environmental question – so-termed only recently – is gradually taking on an ever more symbolic dimension in modern society and is becoming ever more deeply rooted in identity structures. ‘Environmental issues’, although seemingly obvious, since everyone wants clean air, water and green spaces, do not simply exist as a distinct group, but overlap with numerous other sensitive problems such as social inequality, gender conflict, world view differences, trust in expert opinion and modern democratic institutions. The fact that there is a common language for speaking about the environment should not hide the diversity that exists in how key concepts of this discourse are understood. In fact, there are many doubts as to whether there really is a common language and whether obvious concepts such as the environment, balance and harmony ‘belong’ to all, and even if they do, are they understood in the same way [4,5]. Language used to talk about the environment, and also the language of surveys is – as we might expect – language recognized as the property of, and the controlling and influential tool of, the media, ecologists, people in authority and privileged circles.

It is not enough to say that people’s attitudes are particularly changeable these days, and society as a whole has become unpredictable, and therefore surveys are not a good tool. It is rather that a certain way of integrating individuals called identity, involves the continuous searching for, construing, destroying and restoring of equilibrium, as well as the resolving – when necessary – and ignoring or subduing – when possible – of conflicts. To these doubts we can add another, namely, the uncertainty as to what the survey represents to the respondent. We know that for the researcher, the survey is a research tool used to discover current attitudes and through which it is hoped to predict future attitudes. However, have no certainty as to what the survey means to the respondent. The fact that in the survey respondents 'only declare something' unsettles researchers, but for those taking part in the survey, it may be an opportunity to say something important about oneself. If a respondent claims that he sorts rubbish and disposes of electrical waste responsibly, even if in reality he does not, in his mind this answer is more correct than an answer which reveals what he actually does. He marks the answer in the affirmative, because the reason why he doesn't sort rubbish is because he 'doesn't get round to it', and he would do it if it was made easier 'like in other countries'; or he might consider the affirmative answer to be correct because 'compared to others' he is more likely to sort rubbish in the future.

Attention should be paid to the dependence between the decision to allow or refuse an investment to go ahead (RI1) and the attitudes and specific character of a given local community (RI2, RI3, RI4, RI5, RI6). The decision depends on plans relating to the short and long term development of a given municipality or town. Acceptance depends both on how the local authority sees and recognizes the needs, expectations and attitudes of the community. The authority has various types of numerical data at its disposal, but in making a decision it is driven equally by intuition. Its diagnosis may be accurate or not, as regards the expected community response to a new investment. In other words, the local authority uses its own imagination when it comes to community matters.

Therefore, the possibility of managing risk begins with a diagnosis by the not necessarily accurate imagination of the local authority on community matters. At this stage of planning or execution of an investment we should emphasize this imaginary character of prognosis concerning the possible reaction from the community. This type of circumstance influencing the decision shows that the local community, without taking any form of action – at least directly – influences the possibility of realizing an investment. The attitudes and character of a community have a decisive role in the first stage of realizing a venture, and also in the further removed perspective of its operation. The intention to manage social risk requires us to see in these attitudes this quality that can, to a certain extent, be changed.

Among issues related to social capital, which have been the subject of considerable interest for some time, we can see the profile of local communities in terms of the success of certain ventures. Official documents, but also interviews with inhabitants make it possible to reconstruct environmental history with particular attention to recent years and show when, and in what circumstances, this social capital was mobilized. This action also allows us to identify key people in the environment, figures of authority, members of the elite. This reconnaissance can also be useful especially in crisis moments of a venture's operation. It is generally thought that social capital resources which could support a venture either exist, or for various reasons, do not exist. It is worth remembering, that various conditions must be fulfilled in order for the social capital of a given local community to show itself. Nor can it be said that a given community will want to use its social capital to support a venture. The close-knit ties, common history and trust which inhabitants share can also be used to oppose it.

The risk scorecard of stakeholder influence, shown in Table 3, provides a schematic picture of the factors contributing to social risk related to the realization of a venture.

Insert Table 3 about here

The particle risk parameters from Table 3 are transferred to the complete risk map – Figure 3 .

Using the given calculation method, the risk assessment was calculated for Scorecard 5 Stakeholder influence risk.

Scorecard 5 Stakeholder Influence Risk multiplication factor 2.
Negative risk: 3 x 5 x 2 +2 x 4x 2 +1 x 3 x 2 = 52
Positive risk (minus sign) 3 x(-5) x 2+3 x (-4) x 2+1 x (-3) x 2 = -60
The risk assessment level for Scorecard 3 comes to -8.

Insert Figure 3 about here

This means, that the risk is positive in character and the realization of the planned venture is not threatened by the negative attitude of the owner and the local community. In managing risk it is necessary to pay attention to the fact that on Scorecard 5 there were no 'green' risks and thus risks which are unimportant, not requiring attention. This is a clear sign that stakeholder interest has a strong impact, although with a low to very high probability of occurring.

Table 3 presents diverse factors which generate social risk related to the realization of a venture, grouped into a number of categories. In order to better facilitate risk assessment and risk management, it is worth discussing some of these in more detail.

Risk marked as RI2 encompassing inhabitants' earlier experience of ecological investments concerns issues such as:

A) The reaction (positive or negative or no opinion) of inhabitants to the investment enterprise operating on a given site.
B) The town or municipality is not a recreational or health resort and does not anticipate such investments in the future.
   The profile of the given community in this respect includes permanent changes which have been brought about by previous investments.
C) The presence on the local market of ecological products as well as orders placed for certain products, the willingness to pay more for everyday products (food, cleaning products, clothes, toys), if they are labelled as 'environmentally friendly'.
D) Availability of ecological packaging and shopping bags etc.
E) A greater sense of safety due to road improvements, the creation of safe pedestrian crossings, newly renovated bus stops etc.

F) The creation of new recreational spaces and opportunities to spend time outdoors (enlargement of green areas, better pavements, benches etc.)
G) Providing a solution to a local problem, which hitherto seemed impossible to solve (e.g. the clearance of piles of scrap metal)

Risk marked as RI3 concerns the quality of life of inhabitants determined by those factors which are poorly institutionalized and which create relational capital. Large relational capital enables the creation of institutional forms to protect the interests and needs of the community. The presence of relational capital facilitates the communication process and can protect the venture from sudden changes in opinion and attitudes. The presence of relational capital is evidenced by:

A) Inhabitants belonging to organizations (religious, cultural, voluntary, blood donation),
B) Inhabitants lending each other money, equipment, land, looking after pets during holidays.
C) Helping neighbours with shopping, giving lifts to work or to the doctor'
D) The presence of announcements, leaflets and information in public places,
E) Inhabitants enjoying their weekends without having to travel to a larger nearby town,
F) The organization of after-school activities,
G) Housing associations operate without having to hire firms to administrate them,
H) Inhabitants choose local food produce,
I) Private spaces 'acknowledge' public space (balconies, gardens, windows are periodically or regularly decorated)

Meanwhile, relational capital is reduced by:

A) A large number of inhabitants not having work experience (particularly young men),
B) The presence of gated estates.

Risk marked as RI4 concerns the presence or lack of local organizations and media (news bulletins, school newspapers, information leaflets). A clearly structured local community can lower the risk of an unpredicted reaction occurring. A well-organized community, as a form of social capital, is usually expected to encourage investment. However, it should be remembered that, while the presence of such social capital facilitates communication with the community, it is not a guarantee that the initiative will be well received. On the contrary, well organized inhabitants may be very effective in taking action to ensure that the investment is moved elsewhere.

Risk marked as RI5 concerns the quality of work of the public administration in the opinion of inhabitants as well as the quality of relations between the administration and local organizations. This risk includes the following issues:

A) The presence or lack of cooperation between the public administration and cultural and community organizations (evidenced not only by declaration, but also by use of the word "us" as well as the fact that the administration and organizations do not duplicate the same activities and initiatives),
B) Administration workers do not use language associated with administrative jargon in their responses'
C) Phrases are used referring to direct, sensory experience (stench, allergy, asthma rather than numbers and generalized risk categories),

D) The present is sometimes prioritized, but in responses the present is extended (5 years minimum),
E) The municipality has never performed a study or consultation, but workers are convinced that they know how inhabitants will react to a new situation.

Risk marked as RI6 is fundamental in identifying the important factors which increase the risk related to an investment. An 'exchange' of inhabitants, for example the departure or arrival of middle class inhabitants do a given neighbourhood should be taken into consideration in the planning the running and potential development of an investment.

Risk marked as RI7 concerns the possibility of integrating economic efficiency and social efficiency. The promotion and implementation of mutual support between the investor and the stakeholders can reduce risk because it allows the investment to be assimilated into the identity and history of the local community. This mutual respect and integration with the community realized through various means is particularly important in relation to new technology which requires continuous effort and cooperation from inhabitants. This type of risk is determined by:
A) the possibility of showing that benefits will be rapidly felt by inhabitants,
B) the possibility of involving the investors in local cultural projects and community action.
C) The possibility of proposing or getting involved in activity aimed at improving public spaces (improving access to public areas, extending public areas, improving the aesthetic appearance of public spaces).

Conclusions

In this article we present a new method of performing risk analysis and assessment called the 'Balanced Risk Map'. A definite advantage of this method is its receptiveness to changes resulting from the specific line of enterprise or the market on which it operates or to which an innovative technology is to be introduced. These specific features can be included among the particle risks by adding them to the appropriate scorecards. The principle of analysing the 5 scorecards remains the same. If, during the first or subsequent analyses, one or more additional particle risks are added to any of the scorecards, then each time during analysis and assessment this additional risk must be parametrized. This is very important since the analysis ends with a numeric assessment of risk. If during weekly, monthly or quarterly monitoring, this risk rating changes dramatically e.g. by more than 2 points, it is necessary to introduce changes to the scenario being realized. Thus even an assessment rating of 1 (coded green on the complete risk map) which indicates very low to medium particle risk impact and very low to high probability of occurring, but where the particle risks are unimportant and can be overlooked, can lead to unnecessary anxiety during risk monitoring. In the authors' opinion the Balanced Risk Map is a readily available method, which means that mapping risk and assessing risk levels can be performed by workers at every level of an enterprise's organization.

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Acknowledgements
This publication is part of the project: "Scientists for the Mazowsze economy" co-financed by the European Union under the European Social Fund:
http://www.bioenergiadlaregionu.eu/pl/naukowcy-dla-gospodarki-mazowsza/

Table 1. Particle risks divided into scorecards

SCORECARD 1	SCORECARD 2	SCORECARD 3	SCORECARD 4	SCORECARD 5
Financial risk	**Internal processes risk**	**Customer risk**	**Development and growth risk**	**Stakeholder risk**
Financial result (WACC[1], CAPM[2])	Technology	Structure	Development	Ownership decision
Profitability	Human Resources	Competition	Growth	Local social climate
Taxes	Processes	Marketing		Regulations and administrative requirements
External investment financing	Organization			

Source: own study

Table 2. Particle risk assessment based on the normal distribution of historical events

30-40%	very low/ very big	low/ very big	very high/very big	very high/very big	very high/very big	high/ very big	low/ very big	very low/ very big
24-30%	very low/ big	low/ big	very high/ big	very high/ big	very high/ big	high/ big	low/ big	very low/ big
14-24%	very low/ medium	low/ medium	very high/ medium	Very high/ medium	very high/ medium	high/ medium	low/ medium	very low/ medium
5-14%	very low / small	low / small	very high/ small	very high/ small	very high/ small	high/ small	low / small	very low / small
0-5%	very low / very small	low / very small	very high/ very small	very high/ very small	very high/ very small	high/ very small	low / very small	very low / very small
	>3 σ	$\leq 3\sigma$	$\leq 2\sigma$	$\leq \sigma$	$\leq \sigma$	$\leq 2\sigma$	$\leq 3\sigma$	>3 σ

σ=2 σ=2

Source: own study

[1] WACC (Weighted Average Cost of Capital) is the medium weighted cost of equity capital and cost of debt. This indicator depends on the structure and cost of capital. The weightings are the share of equity capital and debt in the capital serving to finance a business.

[2] CAPM (Capital Asset Pricing Model) is a model of estimating capital assets, also called the capital market equilibrium model. It is a method of estimating the cost of equity capital, and is used mainly to calculate the cost of business capital recorded on the stock exchange.

Table 3. Scorecard 5 Stakeholder influence risk

Risk	**Symbol.**	**Impact**	**Probability**	**Positive-negative risk**
Ownership decision	RI1	Very big.	Very high	Negative
Experience of inhabitants from ecological investments realized earlier	RI2	Big	High	Positive/Negative
Relational capital of a given community	RI3	Big	Medium	Positive/Negative
Presence of local organizations and media	RI4	Big	High	Positive/Negative
Way in which public administration functions	RI5	Big	Low	Positive/Negative
General trends in demographic processes (ageing population, exchange of inhabitants – e.g. departure of middle class, unemployment, depopulation etc.)	RI6	Big	Medium	Positive/Negative
The possibility of integrating the investment with community identity	RI7	Big	Medium	Positive
Regulations and administrative requirements	RI8	Big	High	Positive

Source: own study

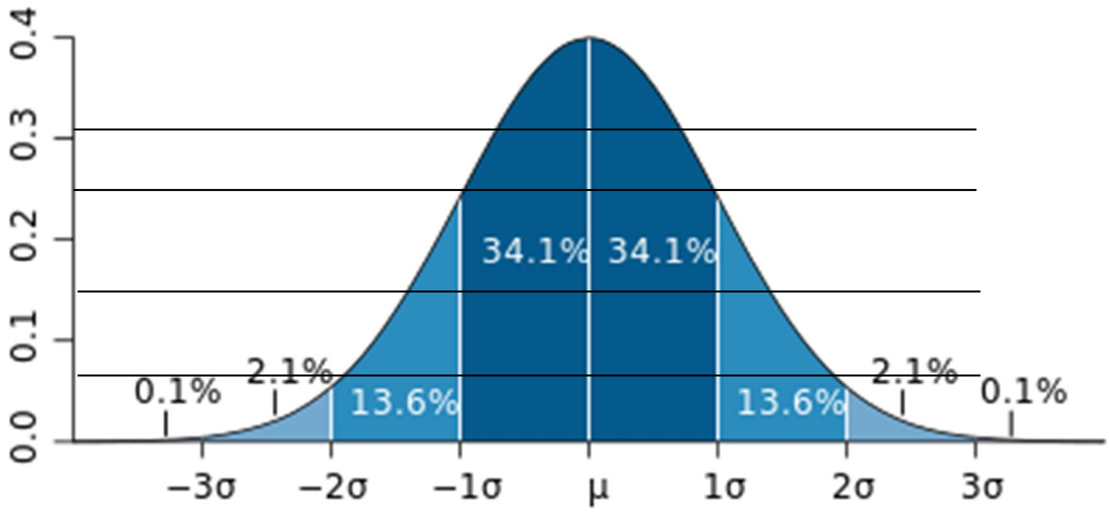

Figure1 Normal distribution illustrating the three-sigma rule
Source: www.wikipedia.org

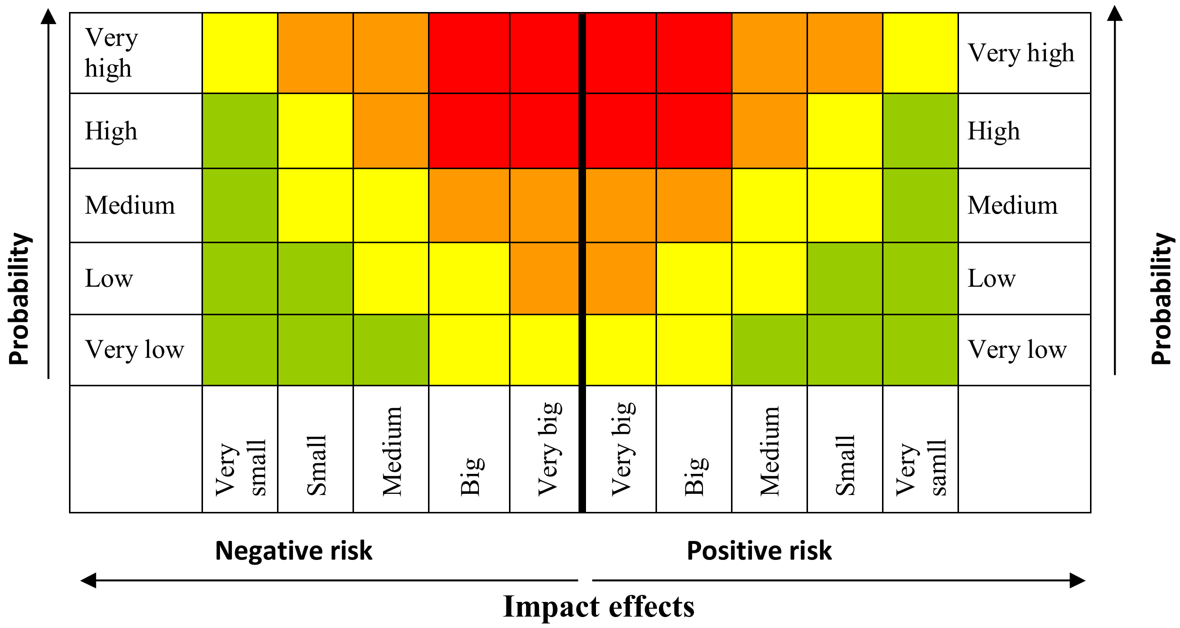

Figure 2. Complete risk map
Source: J. Podlewski, *Zarządzanie ryzykiem RYZYKONOMIA*, www.ryzykonomia.pl

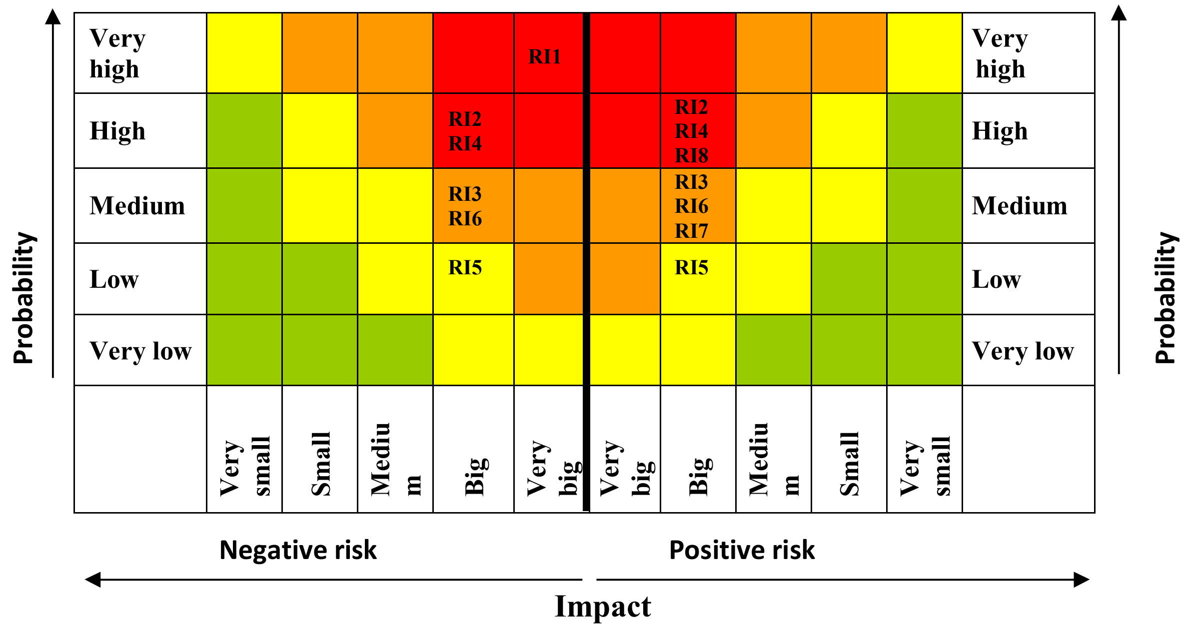

Figure 3. The complete risk map from Scorecard 5 Stakeholder influence risk
Source: own study