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Risk, Risk Perception, Risk Management – a Review of the Literature

SUMMARY: Risks have become an integral part of our society. In this context, the aim of this paper is to provide a summary of the findings of risk research conducted in different fields of study and to trace the effect of these findings on risk management practices. The basic approaches to risk presented in this paper show that the notions of probability employed in studying processes in any area of life belong in the province of epistemology rather than ontology. Therefore, subjectivity cannot be completely excluded from risk management. This inherent subjectivity influences willingness to take risks as well as decision-making and risk evaluation. If we conceive of risks as mass phenomena, we have a number of objective (quantitative) methods at our disposal to estimate their probability and effect. However, the significance of subjective (qualitative) professional judgment increases as the volume of available data decreases. Regardless of the risk analysis method used, it is a basic principle that the costs of risk management should not be higher than the risk itself which in turn determines also the scope of the risk analysis to be carried out.

KEYWORDS: risk, uncertainty, decision-making

JEL CODES: D81, G32

Risks have become an integral part of our society. They are present in our homes, lifestyles, finances and hobbies as well as in the long-term sustainability of our environment. Risk taking is inherent to our lives, while it also drives innovation and development. This is supported by the fact that risk research is a priority for many fields of study. This paper aims to provide an overview of the means and methods we have at our disposal to manage risks, and the factors that may influence us in doing so. As a first step, a summary is given of the attempts at construing the concept of risk. Already at this point, it will become apparent that our relationship to risk is influenced by a number of subjective factors. The next chapter provides a detailed description of

the factors determining our risk attitudes and risk perceptions. The final chapter addresses the general process of risk management in the light of its preceding findings.

RISK IN MODERN TIMES

“The concept of risk is as old as mankind” (Garraci 2013, p. 1), yet arguably the role of risk became significantly more prominent in late modernity. *Bernstein* (1998) goes as far as to say that the mastery of risk defines the boundary between modern times and the past. This is a sound argument even though the further we look back in time, the greater the exposure of (pre)modern societies to hazards (Dessewffy 2002). The seeming contradiction is resolved by a distinction between the con-

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cepts of risk and hazard, as described in detail in later sections of this paper: in most walks of life, traditional societies were not faced with risks but hazards, which were duly explained by unforeseeable Fate, Providence or Will of God (Dessewffy 2002), risk being mostly confined in those times to the realms of gambling and adventures. Providing the foundations for modernisation, scientific and technological development eliminated the hazards and risks posed by nature, while giving rise to new ones (Lányi 2011). Obviously, the level of development in this regard varies by culture and society. The lower the level of modernisation in a society, the more risks and hazards are presented by nature. That is, societies increasingly face technological risks as they develop; however, as a result of globalisation, the risks of more developed societies may also impact other (possibly less developed) societies: in the course of human history, personal risks have evolved into global ones.

Ulrich Beck captures this argument by saying that “*the social production of wealth is systematically accompanied by the social production of risks*” (Beck 1986/2003, p. 25). As a result, the problems of resource distribution are outweighed by the risks stemming from the production, identification and distribution of risks produced by means of science and technology. He calls this risk society, which replaces industrial society when the hazards created by social decisions go beyond the boundaries of insurability (Beck 1998), i.e. protection is no longer provided by private insurers. Consequently, Beck maintains that private insurers keep the gates of risk society.¹ This is confirmed by recent disasters caused by technology. Perrow (1987) inferred both theoretically and empirically that absolute security is non-existent in the field of high-risk technologies; as such technologies no longer involve linear processes, complex interactions will inevitably lead to systemic accidents (cit-

ed in Szíjártó, 1998). And the latter cannot be prevented through an ever growing number of security measures, because they merely add to the complexity of systems (Szíjártó, 1998). Beck further argues that tragedies are also attributable to the fragmentation of liabilities, because in the context of global risks, it is mostly impossible to establish personal liability (Dessewffy 2002). Evolving during the development of capitalism, the institution of limited liability may also encourage disproportionate risk-taking, which in turn may be intensified by the softened budgetary constraints of enterprises (Kornai, 2014).

A reference at this point is appropriate to Renn’s (1998) unique risk typology. Risks are classified on the basis of the way they are perceived in everyday life. For illustration purposes, Renn attached mythological labels to the types, which otherwise show convincing similarities across cultures:²

DAMOCLES’ SWORD: an artificial (technological) risk source;

Pandora’s box: slow killers contingent on publicly disclosed information rather than experience (e.g. artificial ingredients in food or water). Unlike the risks of earlier periods that were mostly perceivable physically as well, these so-called civilisation risks of our times are invisible. Another difference is that today, the majority of such risks stem from overproduction as opposed to the shortage of supplies in earlier times (Beck 1986/2003, p. 29);

ATHENA’S SCALE: captured by cost-benefit calculation, confined to monetary gains and losses;

HERCULES’ IMAGE: voluntary avocational thrills (such as extreme sports, looking for challenges).

Dessewffy (2002) added the following two types to the above list:

TROJAN HORSE: risks inherent in the use of novelties and unknown instruments (the consequences of which are unknown);

HELEN'S ABDUCTION: risks to existence (e.g. to wealth).

The reader should not be misled by these images of personal life. It is easy to find examples of such risks from numerous areas of life. For example, *Hercules* is the driving force behind the excitement of undertaking, i.e. indirectly the operation of the economy.

THE CONCEPT OF RISK

For further inquiry, it is essential to take a closer look at the concept of risk. According to Renn (1992), a prerequisite for the existence of risk is uncertainty, i.e. that future is not predetermined but is dependent on present human activities. Bernstein (1998) argues for the non-existence of absolute certainty, claiming that one can never be certain of anything, since the mass of available information is either inaccurate or incomplete. Consequently, uncertainty is a necessary and constant element of life. In his brief review of Bernstein (1998), *Adams* (1997) refers to virtual risks as a synonym of uncertainties. Such risks are mostly the products of our imagination (e.g. the possibility of an extraterrestrial attack), the probability of which therefore cannot be estimated. *Klinke* and *Renn* (2002) also attempted to decompose uncertainty, and identified four components in the process.³ An evaluation of the components ultimately influences risk perception itself; however, as they are often strongly correlated, it is sufficient to examine only one of them. In *Knight* (1921/1964), risk is defined as measurable uncertainty, and the term 'uncertainty' itself is only used in the opposite case. In other words, risk is probable uncertainty, and consequently one of its descriptive features is the probability of occurrence.⁴ Following *Renn's* (1992) argument, the second descriptive feature of risk is a future state of reality,

i.e. the outcome of risk. The third descriptive feature is the probability of occurrence and the method of aggregating the outcomes (*Renn* 1998)⁵, the result of which is the magnitude of risk. The following sections describe four approaches, each with a different interpretation of these three factors.

Technical approaches

Technical approaches are the simplest attempts at capturing the nature of risk: they assume the basic unit of risk to be the average expected probability of events that have a negative, undesirable effect on humans and their environment. In this case, risks and effects are objectively measurable, and the magnitude of risk can be determined by applying probability weights to the negative effects. This approach is primarily characteristic of actuarial, healthcare, environmental and probabilistic⁶ measurement of risk, but also provides the foundations for risk analysis in general. As the key criticism of this approach, reference is commonly made to the absence of an objective understanding of risk and objective risk measurement: the concept of undesirable effect and the parameters of measuring probabilities are dependent on subjective decisions. In most cases, there are also problems with the underlying concept of reality that the future is the continuation of the past; at the same time, this is one of the main criticisms of risk analysis techniques. "We cannot even be 100% certain that the sun will rise tomorrow morning: the ancients who predicted that event were themselves working with a limited sample of the history of the universe" (*Bernstein* 1998). According to technical approaches, the world is predestined, and although the probability and risk of things can be determined, things will inevitably occur. Perfect foresight is attainable. With events of low probability entailing severe consequences,

such an approach is less viable. Another criticism is that compressing the magnitude of risk into a single dimension may be misleading: our evaluation of a low-probability risk with a severe effect may be different from that of a higher-probability risk with a less severe effect. The approaches described in the following attempt to answer these criticisms.

Economic approaches

A common feature of all approaches in the field of social sciences is that they contemplate the causality of risks through processes of society. Economic approaches are still the closest to technical ones. The difference is that undesired effect is replaced by subjective utility. One unit of utility expresses satisfaction or dissatisfaction with a particular event. The advantage is that not only negative effects are measurable, and thus so-called pure risks are replaced by complex (speculative) risks: in addition to negative effects, the possibility of profit (positive utility) also comes into play (Pálinkás 2011). The measure of risk in this case is the expected utility of events. The application of such an approach enables the classification of outputs, making it possible to “retain benefits to the greatest possible extent while mitigating risk through the most efficient allocation of available resources, i.e. to maximise the utility of society” (Zoltayné 2002, p. 458). However, it is impossible to determine the utility of society, since individual utilities cannot be aggregated due to differences in subjective scales and ethical problems. The judgment of probabilities remains technical and objective in nature.

In the early 20th century, new ideas were formed about the concept of uncertainty (Bernstein 1998; Bélyácz 2011). *Keynes* ruled out the possibility of determining objective pure probability. In his book *A Treatise on*

Probability, published in 1921, he demonstrates that although the objective probability of a future event exists, it cannot be determined due to human ignorance, leaving us with mere (subjective) estimations in this regard. That is, our estimation of probability will reflect the degrees of our belief in the future. Thereby the theories of Keynes and his followers moved along sharply different paths from Jevonsian⁷ views (Bernstein 1998).

Psychological approaches

In comparison to the economic perspective, psychological approaches attach greater relevance to subjective judgment. They do so in three ways (Renn 1992): first, they attempt to explain why individuals do not base their risk judgments based on probabilities and expected values. Second, studies identified biases in the evaluation of probability information, and therefore of risks, even where decisions are based on quantified values. Third, but not least, risk perception is greatly influenced by context. This often leads to inconsistencies in decisions. Arguably, in addition to effects, their probabilities and the method of their aggregation are also considered subjective in psychological approaches. Rather than absolute probabilities, the result is a *subjective expected value* based on perceived probability (Renn 1992). A brief account of the findings of research concerning risk attitude and risk perception is given in the following chapter.

The focus on personal, subjective risk perception at the same time constitutes a disadvantage of the school. Similarly to economic approaches, it is difficult to aggregate personal preferences, while the evaluation of social effects is also absent from individual decisions.

Sociological and anthropological approaches

As opposed to psychological approaches, sociological perspectives focus on social interactions in the context of risks. Common to the many sociological approaches is the fact that *“people do not see the world through ‘virgin’ eyes but filtered through social and cultural meanings, which are conveyed by primary sources such as family, friends, superiors and colleagues”* (Dietz – Frey – Rosa 1993; cited in Zoltayné 2002). In such approaches, the definition of undesirable events, the perception of uncertainty and even reality are socially constructed. In their research, *Douglas and Wildavsky* (1982) found individuals’ reactions to be reflected in their social position and opportunities to exert power, based on which they may belong either to the centre or the periphery.

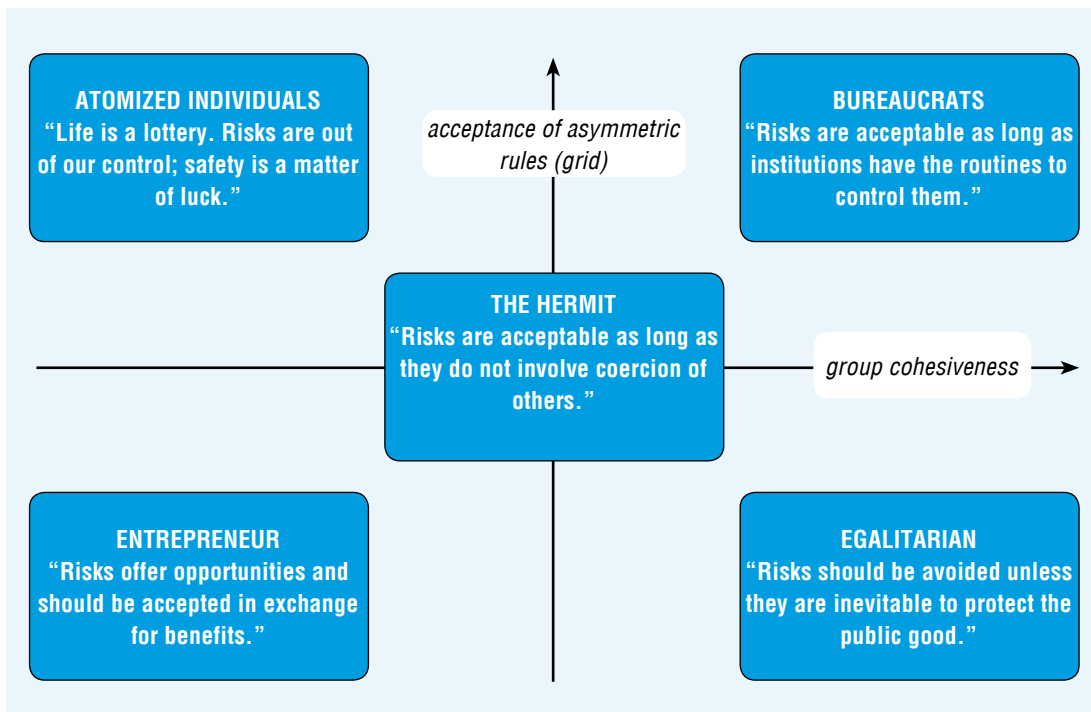
While the former show a preference for individualistic and hierarchical values, the latter are more characterised by sectarian culture, pessimistic vision, defencelessness and greater vulnerability to risks. Based on group cohesiveness and the acceptance of asymmetric rules (grid), Renn (1992) lists five basic cultural prototypes, which co-exist in human societies (See Chart 1).

In anthropological approaches, the evaluation of uncertainty and therefore risk-taking is also influenced by cultural background in addition to social effects. In this context, *Braunné* (2011) reviews the research of *Hofstede* (1984), where the four cultural dimensions identified⁸ incorporate the social factors determining risk perception as referred to in Renn (1992):

- ① social inequalities, attitude to authority, power distance (Chart 1 grid);

Chart 1

ATTITUDE OF VARIOUS CULTURAL PROTOTYPES TO RISK



Source: Own editing based on Renn (1992)

- ② individualism vs. collectivism (Chart 1 group cohesion);
- ③ masculinity vs. femininity;
- ④ methods of managing uncertainty: strong vs. weak uncertainty avoidance.

Based on Hofstede's research, attitudes to uncertainty, and consequently judgments of risk, can be assumed to vary by culture. Szíjártó (1998) argues that due to the countless and therefore inappreciable uncertainties in the world around us, every culture develops its own set of priorities, which determine the possible sources of concern. The profile of a country is therefore determined by the factors of uncertainty which it considers to be causes of fear and anxiety, or, on the contrary, to be acceptable risks.

One of the great merits of sociological and anthropological approaches is that they place emphasis on values and beliefs while abandoning approaches based on individual utility and interests (Renn 1992). The 'price' of this, however, is that such approaches are excessively simplifying and model-like.

We have described the main approaches based on the judgment of effects and occurrences, i.e. the 'admission' of objective and subjective elements. For that reason, the approaches are illustrated according to the presence of subjective elements (*See Chart 2*).

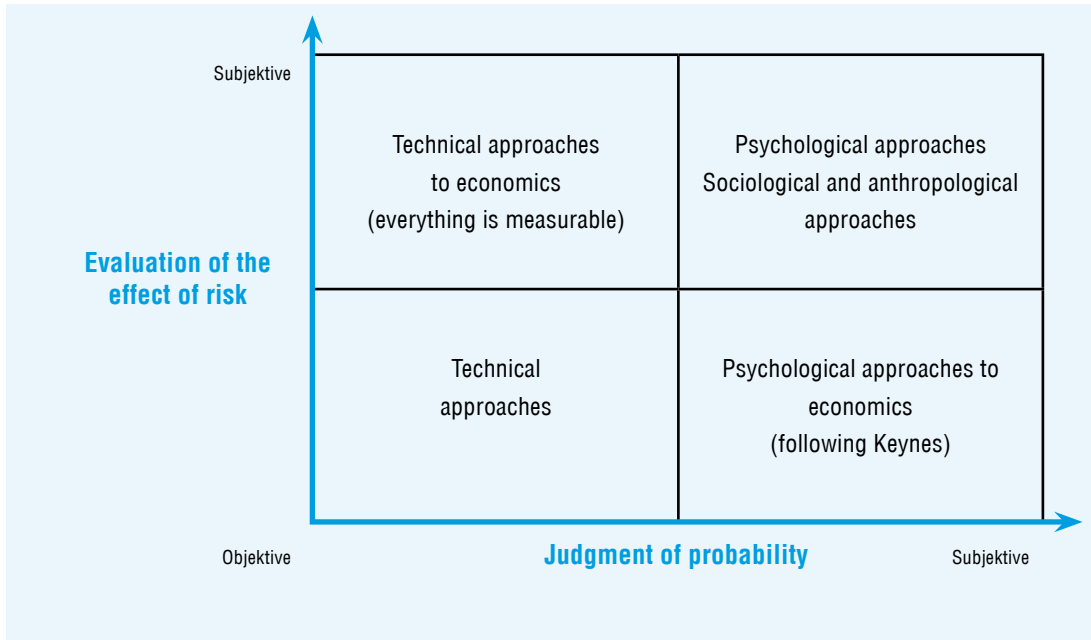
Following this argument, we may agree with the idea proposed by Bélyácz (2011): it has been scientifically demonstrated that the notions of probability employed in studying processes in any area of life belong in the province of epistemology rather than ontology, which raises the question whether, for the purposes of our inquiry, it is objective or subjective probability that is better suited for the management of risks. Nevertheless, what can be pointed out is that objective probability theory is difficult to apply to unique and surprising¹⁰ events. As regards subjective probability, problems arise with measurement and

aggregation. This calls for a comprehensive theory capable of integrating technical analysis with individual, social and cultural effects which (also) shape public experience relating to risk (Kasperson et al. 1998).

In interpreting the concept of risk, we have systematically avoided reference to a related concept that is often used synonymously: we have yet to clarify the differences between risk and hazard. The Concise Explanatory Dictionary of Hungarian defines *risk as the possibility of hazard or loss involved in a particular action* (Braunné 2011), i.e. construes risk as a function of hazard. By contrast, Bonß (1998) proposes that each of the two concepts denotes a separate type of uncertainty: while 'hazard type' uncertainties exist independently of the actor, 'risk type' uncertainties are created by the possibility of action. In other words, hazard is circumstance, but risks arise in situations of decision-making. The decision-making implications of risks result in another important difference: while our decisions involve liability, the existence of hazards is 'not attributable'. This also means that uncertainty can only be considered as a risk if consequences are attributable to the decision-maker. Indeed, it often happens that the risk voluntarily and responsibly undertaken by one individual is an inevitable hazard to another. Bonß cites the example that driving on the motorway against the traffic is a risk that is also a hazard to others (Bonß 1998). According to Luhmann (1990), therefore, the distinction between risk and hazard is of principal significance, as there will always be active agents and passive sufferers who are only affected by actions but are not involved in the process of decision-making, which gives rise to the antagonism of decision-makers and those affected by their decisions (cited in Bonß 1998).

This also means that undertaking risk is accompanied by freedom (Beck 1998), which is

CLASSIFICATION OF APPROACHES BASED ON THE SUBJECTIVITY OF JUDGMENTS ON RISK EFFECTS AND THE PROBABILITY OF OCCURRENCE⁹



Source: own editing

in accordance with the once novel view expressed by Keynes that “*uncertainty makes us free*” (Bernstein 1998). If we keep calculating probability for its own sake, we will remain passive sufferers, whereas if we undertake risk, we create a decision-making situation and become active agents. Using the previous example to illustrate this point: on the motorway and generally in traffic, there is a hazard that other motorists will not adhere to the rules of the traffic code. However, motorists undertake this risk when they sit into their cars and participate in traffic. As a result of the decision, hazard is transformed into risk, which can be managed with the appropriate techniques (purchase of safer cars, development of driving skills, choice of safer roads, etc.). This also paved the way for game theory, a popular school of economics in the second half of the 20th century, one of the principal premises of which is that the true source of uncertainty is

our ignorance of others’ intentions (strategies) (Bernstein 1998). In our case, this is what motorists intend to do; for example, whether they plan to enter the motorway against the traffic. If we knew, we could make the ideal decision from our point of view. Consequently, whether an individual undertakes risk or becomes risk averse depends on his perspective of risk, his subjective judgment, and risk attitude.

Our observations on risk up to this point are summarised in *Chart 3*. The section of uncertainty and measurability indicates Knight’s interpretation of risk (streaked area). If we assume the decision-making situation to be a prerequisite for the existence of risk, Knight’s risk can only be interpreted as a hazard (chance). On the contrary, we only consider risk to exist in a decision-making situation, which is a prerequisite for active risk management.¹¹ For that reason, in this paper the concept of risk

includes all phenomena which require a decision-making situation and are surrounded by uncertainty, but their probability and effects can be measured and estimated.

RISK ATTITUDE AND RISK PERCEPTION

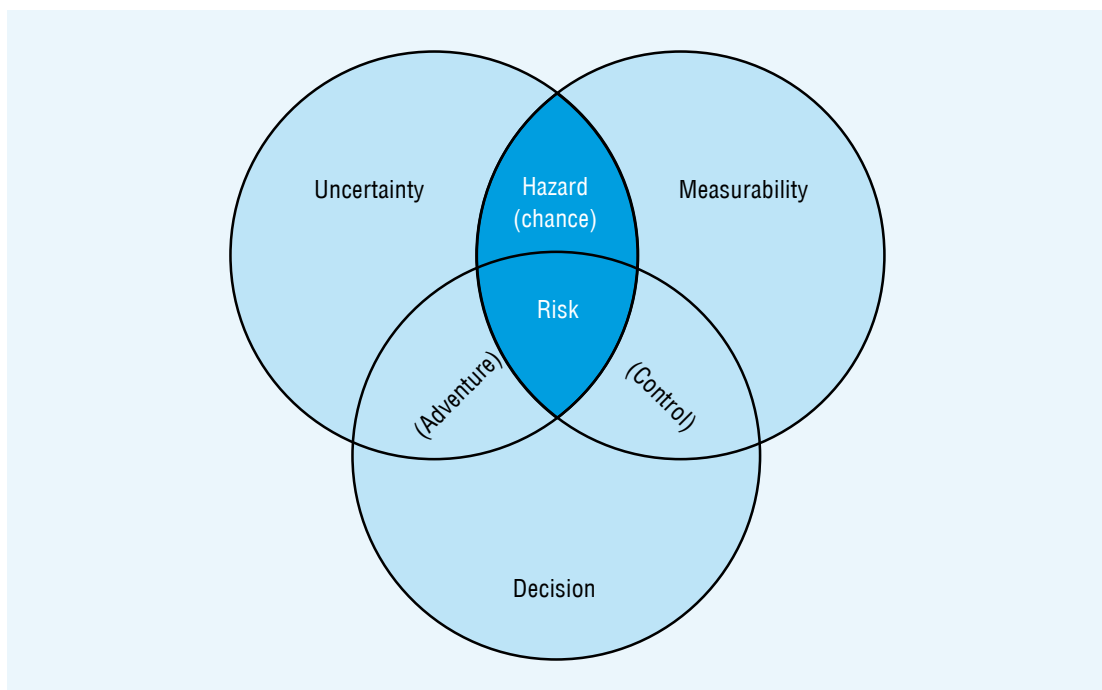
The approach to risks is fundamentally determined by risk attitude, i.e. the decision-maker's inclination for risk taking that stems from his personality. The idea underlying the decision theory approach is that such an inclination can be determined "by matching various lotteries describing arrangements that involve risk and simulate virtual situations against events of certainty, then drawing up decision-makers' utility function based on their choices" (Ulbert – Csanaky 2004, p. 2). However, Ulbert – Csanaky (2004) mention

positive illusions that influence an individual's approach to risks. One example is that most people consider themselves superior to others, i.e. "they hold unrealistically positive views on their selves," which leads to overconfidence. The illusion of control is created when the individual believes to be capable of influencing random events. Additionally, unrealistic optimism can also be observed when people believe that negative events tend to happen to others rather than themselves.

In addition to the above "traps" of self-evaluation, the individual's subjective perception of the situation will also influence his decisions. According to Simon (1955), perfect rationality does not exist, i.e. there is no-one who will exclusively aim to maximise his personal utility when all the relevant information is at his disposal (homo oeconomicus). This is due partly to the lack of perfect information, and partly to decision-makers' limited cogni-

Chart 3

THE RELATIONSHIP OF UNCERTAINTY, MEASURABILITY AND DECISION-MAKING SITUATIONS¹²



Source: own editing

tive capacities preventing information processing. For this reason, decision-makers use mental operations called heuristics, and “often simplify the problem, and rely on subjective feelings, biases and rules of thumb rather than a rational analysis of the situation” (Hámori 2003, p. 780). In the course of their empirical studies, Kahneman and Tversky (1974) identified three such heuristics.

▶ According to the availability heuristic and in particular under biases due to retrievability, in their risk perceptions individuals systematically overestimate unusual, extraordinary, spectacular and previously experienced events. Additionally, the apparent frequency of an event depends on how readily it is retrieved from memory. At first, it would seem logical that more frequent events are more easily retrieved, but Kahneman and Tversky point out that shocking events and those with a higher impact are perceived to be more frequent (e.g. murders as opposed to thefts).

▶ Representativeness means that our risk perceptions are more influenced by recent or current events than by those occurring years earlier, and that our perceptions and decisions are insensitive to statistical sample size.

▶ Adjustment and anchoring constitute the third heuristic discussed by the authors. According to this heuristic, our momentary risk perception is greatly influenced by random external effects.

According to the prospect theory developed by the authors (Kahneman – Tversky 1979), the process of decision-making leads up to satisfaction rather than the achievement of the optimum, i.e. it focuses on relative gains and losses and not on absolute values. They also found that decision-makers were risk averse in the event of gains and risk takers in the event of losses. This also explains anomalies of decision-making such as commitment to objects already possessed, or insistence on or an over-estimation of the *status quo* (“deviation from

the status quo is definitely judged by individuals to be of risk” – Hámori 2003, p. 789). As a result, rather than reconsidering similar or identical decision-making situations, the same decisions are made. This leads us to the authors’ farthest-reaching discovery of the framing effect (Tversky – Kahneman 1986). They found that risk perception is influenced by the way the decision-making problem is formulated and information is communicated (e.g. whether the effects of an event are formulated positively or negatively).

Renn (2004) describes additional factors. In his view, their significance lies in their capability of explaining why it is sources judged by objective risk analysis to be of low risk that cause the greatest concern in the public (*social amplification*): this is why people judge much-debated sources of risk such as the use of atomic energy more negatively and risks arising from leisure activities (such as smoking) more positively (*social attenuation*) (Kasperon et al. 1988). He lists the following factors as particularly relevant:

- familiarity with the risk source; sensory perception of danger;
- voluntary acceptance of the risk; ability to personally control the degree of risk;
- impression of fair distribution of benefit and risk; undesired impact on future generations; congruence between benefactors and risk-bearers;
- impression of reversibility of the risk impact;
- reliability of information sources; clarity of information on risk;
- trust in state-operated risk control and risk management.

Studies on risk perception also point to the fact that the vast majority of the public perceive risk differently than experts do (Douglas 1998). Research on psychometrics by Slovic et al. (1984) found that the risk perception of so-called laymen is based on two aspects: the

dreadfulness and familiarity of the risk, confirming the relevance of these two phenomena to the above list. Additionally, laymen's risk attitudes are characterised by both wisdom and error. Occasionally, laymen lack information about risk but their basic conceptualisation of the phenomenon concerned is much richer than that of experts, and reflects legitimate concerns that are usually omitted from expert risk assessments (Slovic 1987, p. 466, cited in Ulbert – Csanaky 2004). Research by Kahneman and Tversky also advanced our understanding of laymen's thinking, risk perception and decisions.

Hámori (2003) provides a detailed overview of the criticisms of this research. One of the most important criticisms is that the experiments conducted usually describe a single, punctual act of decision-making, while real decisions rely on previous experience and learning processes to a greater extent. Indeed, the experiment by List (2003) quoted in his paper demonstrates that the behaviour of trained experts is “*much closer to the rational choice corresponding to the predictions of neoclassical theory*” (p. 796) than that of the “man in the street” without any professional experience. Ulbert and Csanaky (2004) also find that decision-making experience may profoundly influence the level of development in risk perception. However, this also means that rationality is the result of a learning (market selection) process rather than an inherent feature.

This has a very important consequence: experienced risk analysts are legitimately expected to carry out expert risk analysis based on a sophisticated methodology, i.e. to ensure to the greatest possible extent that the distorting effects related to risk perception are eliminated from systems of risk analysis.¹³ The following chapters therefore place special emphasis on showing the extent to which risk management involves subjective elements.

STEPS OF RISK MANAGEMENT

Historical experience shows that there is no simple and universal recipe for risk management (Klinke – Renn 2002). This paper aims to present the widely used, general methodology of risk management and to understand the lessons learned, in the hope that the methodology can be adapted and applied to the management of any type of risk.

Risk management includes all activities that enable the probability of risk occurring or its effect to be eliminated or reduced to an acceptable level (Pálinkás 2011). The risk management presented in this paper consists of 6 main steps (*See Chart 4*).

The first step involves the identification of the relationships affecting the activities of the decision-maker (individual, community, business organisation) concerned. This may be considered as an initial situation assessment, as part of which a review is carried out on the internal and external environments and their characteristics. This is also where the ultimate objective of risk management is to be set (Pálinkás 2011).

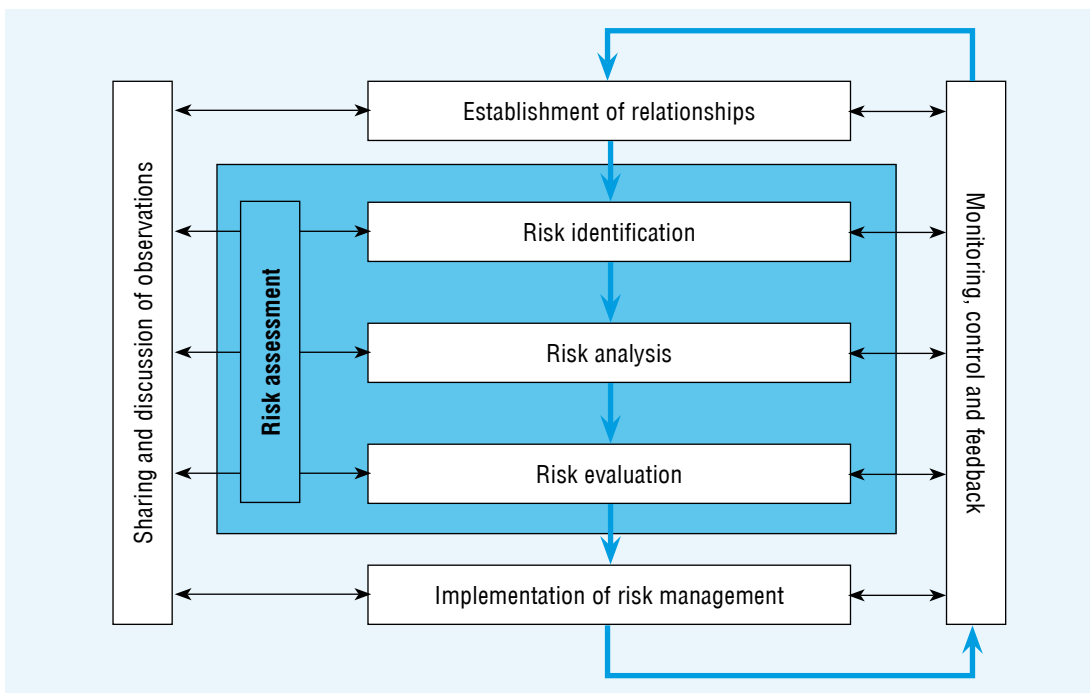
In the second step, the risks must be identified. Every risk comprises three elements:

- ① source (cause);
- ② the problem created; and
- ③ future impact.¹⁴

In the course of risk identification, all risks must be registered even if at the moment of being identified, the probability of occurrence and the effect of a particular risk are judged to be negligible.

The third step is risk analysis, as part of which the probability of occurrence and the effect of the risk are assessed. Although *Krekó* (2011) explains the limitations of risk analysis through a banking example subject to the data available, his findings are easily generalised for any area of risk analysis. Quoting a study by *Száz* (2011), he writes that a risk can

THE RISK MANAGEMENT PROCESS



Source: Based on Hornai (2001) and Pálinkás (2011)

be analysed objectively if it can be considered a mass phenomenon. If not, the risk can only be judged subjectively, such as the question whether anyone will drive up against me on the motorway today. However, Krekó (2011) demonstrates that whether or not a particular phenomenon is a mass phenomenon depends on the information available. If we had detailed data on the traffic violations committed on motorways in the past years and decades, we could already talk about a “mass phenomenon”, and produce a more objective analysis.

In his view, if a sufficient number of observations are available on a relatively simple phenomenon that is dependent on people, meaningful relationships can be established by means of data mining¹⁵ – even without any presuppositions. This is the quantitative approach. In this approach, an attempt is made at identifying the probability of occurrence and effect of a specific event by modelling the

characteristics and patterns of past occurrences on a sufficiently large observation database. The results can be validated and tested, but as the future cannot be considered to be the continuation of the past, such models are not time-proof either: their performance must be monitored continuously, which may indicate the need to refine the model or, in the event of a significant change in the business environment, to adopt a new model. Also in the context of banks’ lending decisions, Száz (2011) writes, but I venture to say that this is also a general feature of all our decisions, that “*the faith in historical average statistics defies all previous norms and beliefs*” (p. 342). This will perhaps become even more relevant as we move into the age of big data, where all phenomena are measurable, all data are public and privacy is diminishing.

At the same time, for estimation purposes, “*something is needed to make up the deficiencies*

arising as the quantity of data decrease” (Krekó 2011, p. 373). In other words, the smaller the quantity of the data available on a particular phenomenon, the greater the role of expert estimates, i.e. qualitative risk analysis. Using the example offered by Krekó (2011): retail rating systems are purely statistical, whereas sovereign ratings, although they also rely on quantitative analyses, are “essentially expert methods”. Qualitative risk analysis offers a subjective judgment on the probability of occurrence and its effect. The magnitude of risk is typically obtained as the product of the two, which is commonly represented in a probability-effect matrix (Hornai 2001; Fekete 2009). It appears reasonable that obtaining information and using it to eliminate uncertainty to the greatest possible extent is only a matter of resources, i.e. of cost-benefit analysis (Medvegyev 2011).

The fourth step involves the assessment of risk in light of the acceptable level of risk and the level of protection already achieved (the risk management techniques and controls currently in place). The acceptable level of risk is essentially determined by risk attitude, which is far from being devoid of subjective factors. Accordingly, decision-makers can be risk averse, risk seeking and risk neutral. The relationship of the two factors determines priorities and the appropriate techniques of risk management (see *Chart 5*).

During the implementation of risk management, the aim is essentially to reduce the magnitude of risk (gross risk) to an acceptable level (net risk) rather than to eliminate risk completely (Fekete 2009). A fundamental requirement for the risk management techniques employed is that their cost should be lower than the magnitude of the risk and the extent of reduction (Hornai 2001). This is illustrated in *Chart 6*.

The point of risk aversion is that risk is “reduced” to hazard by the decision-maker’s

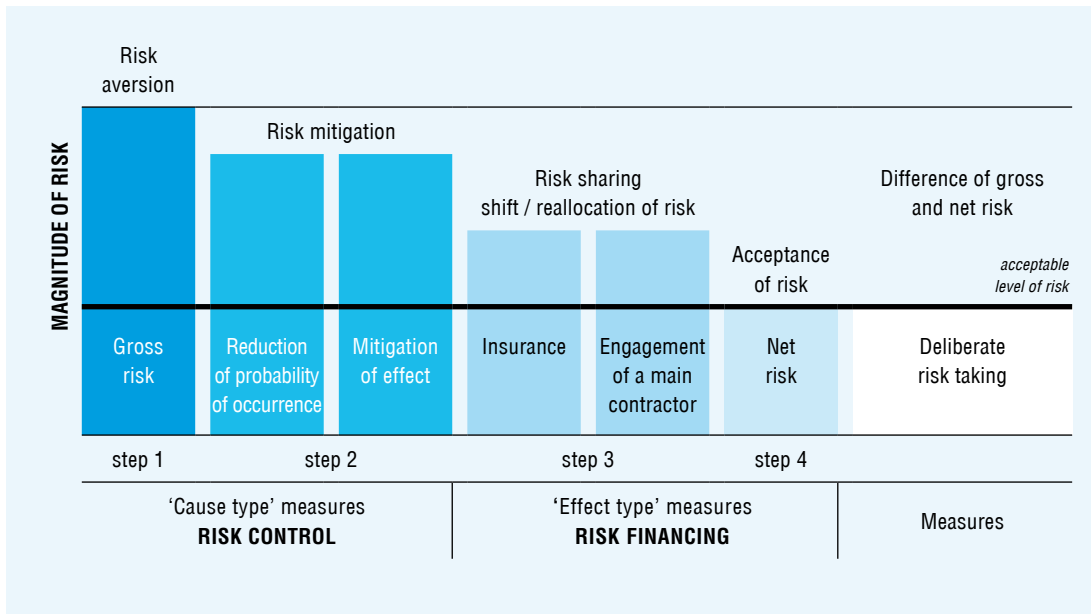
avoidance of certain actions of risk. This in itself is risky because the decision (and consequently liability) may be shifted to other stakeholders (Hornai 2001). In such cases, no risk is undertaken.

Farkas and Szabó (2005) refer to the risk managed in the course of risk mitigation as “retained risk” because the decision-maker uses their own assets to manage risks. This has two basic forms: *pre-loss* focuses on the reduction of the probability of occurrence and assumes effects to be given, while *pro-loss* aims to mitigate the effects of the risk and assumes its occurrence to be certain: leaving the realm of uncertainty, this strategy may provide greater security and control over effects. Taleb (2012) suggests *that in order to make the right decisions, we should focus on their potential consequences (which can be known) rather than on the chances of their occurrence (which cannot be known)*. This provides the foundation for precaution-based strategy (Klinke – Renn 2002), an approach aimed at the acceptance of uncertainty instead of the accumulation of more knowledge and producing more accurate forecasts. Its key words are resilience, vulnerability management, and robust response strategies, which provide more resistance against unexpected events as well.

Where the decision-maker is not able or willing to undertake the given risk alone, he can share it. One of the most basic ways of doing so is arrangements and contracts between the two parties. The essence of its other form, insurance, “*is the organisation of a risk pool wherein losses are shared between members (the insured), through the establishment of a collective fund (premium payments)*” (Farkas – Szabó 2005, p. 81). However, as soon as the pool is created, moral hazard is posed by any member failing to behave as if they were liable for the damage incurred.¹⁶ This has been pointed out by Nobel Laureate economist *Kenneth Arrow*, who at the same time holds that in an

Chart 5

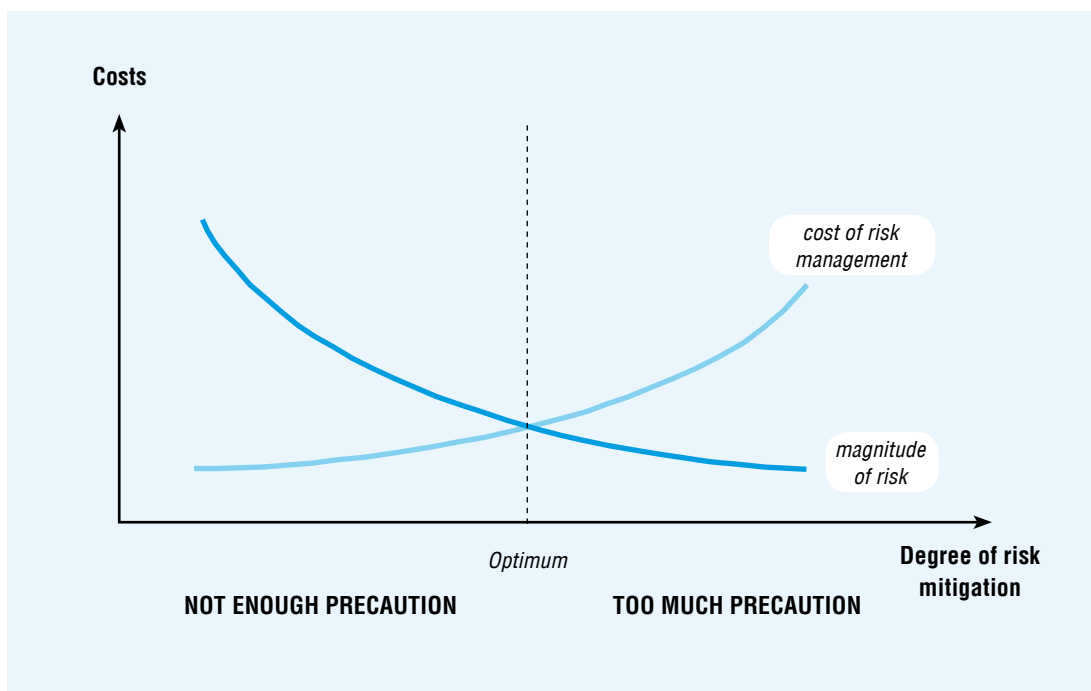
STEPS OF RISK MANAGEMENT IN THE LIGHT OF THE MAGNITUDE AND ACCEPTABLE LEVEL OF RISK



Source: Fekete (2009)

Chart 6

COST OF RISK MANAGEMENT AND MAGNITUDE OF RISK



Source: Own editing based on Fehér (2008) and Klinke – Renn (2002)

ideal world all uncertainty is insurable, which would promote risk taking and therefore economic growth (Bernstein 1998). However, as we noted earlier, Beck (1998) suggests that we are actually heading towards a state in which insurance is not always available, even in cases where previously it was possible.

Where the risk concerned is below a level that is acceptable to the decision-maker, risk may be undertaken without any other risk management measures.

In practice, decision-makers rely on a mix of the techniques described above. For example in lending, in respect of a high-risk debtor, a decision may be adopted that the debtor cannot be granted credit (risk aversion), or if credit is granted (risk taking), it must be against higher interest rates and collateral pledged (reduction of risk through the mitigation of effects), but risk may also be shared through the engagement of credit guarantee companies (insurance).

The last step of risk management is monitoring the implementation of the selected technique, and reviewing it as required. Feedback is particularly important as it enables the risk management system to develop and become more efficient.

In addition to the above six steps, Pálinkás (2011) mentions one further step. He argues that during all of the steps, it is essential that decision-makers keep in touch with stakeholders. While this makes a significant contribution to making the right decisions, it helps to ensure that stakeholders are not passive sufferers but active agents of the decisions, thereby closing the “gap” between decision-makers and stakeholders.

As indicated in Chart 4, the identification, analysis and evaluation of risks are collectively referred to in Pálinkás (2011) as risk assessment. Another feature common to these areas is decision-makers’ subjective risk perceptions permeating the steps of risks management.

Risks are identified by experts in the first place, whereas in risk analysis, although reliance can be made on objective analytical models if a sufficient quantity of data is available, the role of expert methodologies will become more prominent as the number of observations decrease. In turn, the evaluation of risks is dominated by the risk approach and attitude of the decision-maker or, as the case may be, that of management. While the solution allowing these to be filtered may be a broader scope of available information and measurement possibilities, the warning of Bernstein (1998) should be kept in mind:

“The information you have is not the information you want. The information you want is not the information you need. The information you need is not the information you can obtain. The information you can obtain costs more than you want to pay.”

CONCLUSIONS

The aim of this paper was to provide a summary of the findings of risk research conducted in different fields of study and to trace the effect of these findings on risk management practices. It purposefully did not address the risk of specific areas, nor did it provide an overview of the types and forms in which risk can occur in the world. The reason for that is that the limited overview of the literature provided was meant to give a general description of risks and risk management that is readily adapted to any area. Apart from limitations of space, the absence of a comprehensive ‘risk inventory’ is explained by our concern that it would have been impossible to take account of all types of risk from all walks of life, which would inevitably have made such an inventory incomplete.

The main finding of this paper is that in risk management, it is not possible to eliminate subjective elements completely. We agree

with Slovic (2000) in that “*Risk’ does not exist ‘out there,’ independent of our minds and culture, waiting to be measured. Human beings have invented the concept of ‘risk’ to help them understand and cope with the [...] uncertainties of life.*” (Kahneman 2013, p. 164). Accordingly, our risk attitudes and risk perceptions may be influenced by a number of factors – even if we are not aware of such an influence. Additionally, we have seen that in addition to uncertainty and measurability, a further important element of risk is the existence of a decision-making situation, i.e. the ability to “cope with” and undertake risk. However, what constitutes risk for the responsible decision-maker will appear as a hazard to those who are only affected by his decisions; therefore, to ensure that risk management is efficient, it is essential that stakeholders are involved in decision-making.

Risk management includes the fundamental steps of risk identification and analysis. The method of risk analysis will depend on whether the situation at hand is a ‘mass phenomenon’. At the outset, we referred to the fact that game theory approaches uncertainty from an entirely different angle, which is because we are ignorant of others’ intentions. Risk analysis is supposed to predict future events and actions without the knowledge of those intentions. Our study concluded that objective predictability is only dependent on the information available, as the methods of data mining allow high-performance predictive models to be developed. At the same time *Karl Popper* argues that long-term predictions are only possible with systems that are well isolated, constant and repetitive, and expresses his conviction that modern society is not such a system. *Where humans are concerned, prediction is impossible* (Barabási 2010, p. 77). *Barabási* (2010) resolves the contradiction himself by making a distinction between society and everyday activities: as many of our daily activities are repetitive, they can be reli-

ably predicted. As a result, while predictions remain vague at the level of society, they become increasingly self-evident at the level of individuals. *Barabási* (2010) expects that owing to the development of predictive methods, the future will be even less mysterious and unpredictable. Nevertheless, he rejects the premise of the technical approach that the future is the continuation of the past: even if an individual appears to be completely predictable based on past data, they may still make decisions that deviate from previous patterns. However, such ‘bursts’ can be captured by statistical methods; moreover, not all of our decisions are made at random: as regards most of our actions, we are bound by our routines, which is what makes us predictable.¹⁷

Qualitative analysis should be particularly mindful of the effect of subjective factors, and be sceptical of results. We must always ask ourselves what professional arguments there are to support the estimated probability of occurrence and effect, and what could influence our estimations. We must remember *Taleb’s* (2012) warning that the rarer an event, the less we know about its actual role, which calls for caution when construing the results of qualitative risk analysis.

In risk evaluation, a key role is played by risk attitude (i.e. whether the decision-maker is risk averse, risk neutral or risk seeking), which, despite involving factors that can be objectively captured such as assets and income, largely depends on subjective factors that need to be understood as they influence individuals’ attitude to the risk concerned. A key criterion in selecting the appropriate technique is that its resource requirement should not exceed the extent of risk mitigation obtained through its implementation.

Is the method of risk management described above sufficient to avoid surprises? Hardly so according to *Taleb* (2012), who argues that “*in spite of our progress and the growth in knowledge,*

[...] the future will be increasingly less predictable” (p. 29). This is because our lives are dominated by surprises (“black swans” as he calls them). In his view, life is a series of events that have an enormous impact; that is, the decisive moments of our lives are unexpected events rather than predictable ones. These events (such as the appreciation of the Swiss Franc in January 2015) cannot be foreseen. Two points to complement Taleb’s thoughts: on the one hand, the black swans observed in our society are also the results of decisions, which means that they are not unexpected for the decision-makers (for example, the removal of the Franc peg cannot

have been unexpected for Swiss central bankers). However, the consequences of the decisions affected the participants of the economy, who neither expected the outcome, nor were they in a decision-making position. Arguably, for stakeholders black swans thus remain within the realm of uncertainty, and are in fact virtual risks. In my view, this prevents them from being incorporated into risk management, since obviously it is not possible to be prepared for all possible future states of the world and all of the resulting risks. There will always be surprises, which we must keep in mind in daily risk management.

NOTES

- ¹ For example, tornadoes are more easily formed as a result of greenhouse gases, stopping insurers from providing coverage for the risks arising (Beck 1998).
- ² In Renn (2004), predestined risks originating in nature, such as disasters, are presented as a separate type.
- ³ The components are variability, systematic and random measurement errors, indeterminacy, and lack of knowledge.
- ⁴ Whether this is based on a statistical estimate or the findings of previous observations is irrelevant. When there is uncertainty, obviously neither is available. The relationship and different interpretations of risk and uncertainty are discussed in detail by Bélyácz (2010; 2013).
- ⁵ The third concept is also referred to in Renn (1992) as the underlying concept of reality.
- ⁶ In this case, the information relevant to the operation of a complex system is only partially known, and the probability of certain events is only estimated.
- ⁷ English economist William Stanley Jevons was a prominent proponent of quantification. His views are aptly characterised by the following quote: *“[...] pleasure, pain, labour, utility, value, wealth, money, capital, etc. are all notions admitting of quantity; nay, the whole of our actions in industry and trade certainly depend upon comparing quantities of advantage and disadvantage”* (Bernstein 1998, p. 201).
- ⁸ Later the fifth dimension of long- or short-term orientation was added to the model.
- ⁹ As a result of their diverging paths indicated above, economic theories appear in two fields.
- ¹⁰ In his conceptual framework Shackle, one of Keynes’ followers, attaches particular prominence to surprise. He associates every future event with a degree of potential surprise, indicating the magnitude of the surprise the occurrence of each event would bring (Bélyácz 2011). *Taleb’s* (2012) black swan theory focuses directly on surprise and randomness rather than the examination of known and repeating phenomena. In comparison with previous observations, a black swan is a rare but high-impact event, which we try to explain subsequently in various ways in order to make it predictable in the future.

- ¹¹ We will see, however, that risk management does not always involve risk taking.
- ¹² Although decision-making situations related only to uncertainty or measurability are outside the scope of our inquiry, we have attempted to complete these two sections. We believe that the undertaking of a decision-making situation in the face of unknown uncertainty is adventure. Conversely, we suppose the relationship of measurability and decision-making situations to involve control.
- ¹³ According to psychological research (e.g. Kahneman 2013; Slovic et al. 2004), there are two forms of thinking: system 1 works automatically and quickly, with little effort and without deliberate control (such as strolling at a normal pace), whereas system 2 focuses on mental activities requiring effort (such as doing complicated calculations). However, these systems of thinking are often brought into conflict (e.g. we cannot do complicated calculations while strolling). We instinctively rely on system 1 in the course of risk perception, and on system 2 in the course of risk analysis. Thus, a learning process is understood to be the extent to which we can routinely employ the tools of system 2, and are able to become the “grand masters” of the area concerned (in this case, the analysis of risk) (Mérő 2008).
- ¹⁴ The methodology of the European Court of Auditors (ECA 2013) provides detailed guidelines for the correct formulation of risks: for instance due to insufficient recruitment (cause) translators for specific languages are not available (problem), which leads to a significant delay in the publication of official documents (impact).
- ¹⁵ Data mining aims to retrieve information from databases which go beyond the primary purposes of creating the databases (Nagy 2002).
- ¹⁶ This requires information asymmetry, where one of the parties to risk sharing has more or more accurate information.
- ¹⁷ Barabási (2010) also mentions a key moral implication of this. While past data collected about us are protected by countless laws and regulations, the question arises what protects our future. As prediction systems develop, information on our future actions and behaviours, and in relation to that, the protection of this information, is becoming increasingly important.

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