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Understanding Uncertainty and Risk in Management

ABSTRACT

Objective: The purpose of this text is to identify approaches to defining and subsequently reviewing the definitions of uncertainty and risk as interdisciplinary terms which are of key importance in modern management.

Methodology: The work is theoretical. The main method used in the research process was the analysis of scientific literature. A one-dimensional logical classification method was also used, in order to categorize approaches to defining uncertainty and risk, satisfying the exhaustive and mutually exclusive criteria in the selection of categories of approaches.

Findings: The main results of the work are: 1) identification of approaches to defining uncertainty and risk, 2) interdisciplinary review of definitions of uncertainty and risk indicating the criteria to distinguish between the two, and 3) determination of the meaning of the terms uncertainty and risk in modern management.

Value Added: Considering the approaches to defining uncertainty and risk taken from many fields and disciplines of science, this text is a compendium of theoretical knowledge for the proper understanding and meaning of these concepts in management.

Recommendations: The research findings can have implications for both management theory as well as the practice of organization management.

Key words: uncertainty, risk, management, risk management

JEL codes: D81, G32

Introduction

Uncertainty and risk are the subject of research in many fields and disciplines of science, which is why they have become interdisciplinary terms that determine the process of effective management (Tchankova, 2002).

The interdisciplinary nature of management sciences justifies a pluralistic approach to the perception of risk (Jedynak, 2017) as one of the key areas of activity for business entities. Therefore, uncertainty and risk in the context of management should be analyzed in multiple dimensions. The interdisciplinary nature of management sciences allows us to understand them as the cumulated value of all areas of the organization's activities in which numerous disciplines intertwine (Czakoń & Komańda, 2011; van Baalen & Karsten, 2012).

In order to properly understand uncertainty and risk in the field of management, it is necessary to familiarize oneself with the definition-based approaches in various areas of science, as they determine the formation of their significance in contemporary management of organizations.

The purpose of this study is to identify approaches to defining and subsequently reviewing the definitions of uncertainty and risk as interdisciplinary terms which are of key importance in modern management.

Approaches to defining uncertainty

Defining uncertainty as a broader concept that is the source (cause) of risk (Jedynek & Szydło, 1997) is the first step to properly defining risk. An overview of the most important definitions of uncertainty is presented in Table 1.

Table 1. Review of the definition of uncertainty

AUTHOR	DEFINITION OF UNCERTAINTY
Schumpeter (1934)	Cognitive limitations (ontological uncertainty) and insufficient knowledge (epistemological uncertainty) in the decision making processes related to the market
von Hayek (1945)	Incompleteness of information in the decision-making process (knowledge dispersion).
Freeston et al. (1994)	Possibility of a potentially harmful event.
Smithson (1999)	Metacognitive awareness of ignorance as to the source of knowledge about a given phenomenon.
van der Heijden (2000)	The possibility of an event occurring by means of a cause and effect chain of reasoning, characterized by the inability to estimate the probability of its occurrence.
Krickx (2000)	Lack of full information on future events.
Dugas et al. (2001)	Possibility of a negative event.
Holton (2004)	Events about which it is not possible to obtain reliable data and it is not possible to estimate the probability of their occurrence.
Carleton et al. (2010)	Possibility of negative events that cannot be predicted.
Carbonara and Caiazza (2010)	A situation where decision makers have limited knowledge to be able to accurately describe the results of future events.
Spiegelhalter (2017)	The inevitable unpredictability of the future resulting from unpredictable factors expressed by classical probabilities.

Source: own study.

Analyzing the definitions of uncertainty presented in Table 1, four categories of approaches to defining them can be identified:

- due to reasons (Smithson, 1999; Krickx, 2000; Carbonara & Caizza, 2010),
- due to the ability / inability to assess probability (van der Heijden, 2000; Holton, 2004; Spiegelhalter, 2017),

- due to its role in the decision-making process (Schumpeter, 1934; von Hayek, 1945),
- due to anticipated consequences (Freeston et al., 1994; Dugas et al., 2001; Carleton et al., 2010).

Analyzing various definitions of uncertainty on a formal basis, it can be concluded that the vast majority of them, in terms of structure, can be qualified to the definitions of induction inequality (partial), i.e. those that explain the general concept (in this case – of uncertainty) by means of a list of comparable but differently formulated meaning. The consequence of this form of definitions is its incompleteness, which is expressed in the inability to exhaust all the designats of terms obtained in the definition review. Most often, uncertainty is identified with events of an unpredictable nature with negative consequences. However, the emergence of contextual comprehension, e.g. in relation to decision making processes or available resources of knowledge (Schumpeter, 1934; von Hayek, 1945; Smithson, 1999) results in the inability to clearly understand uncertainty. In turn, taking into account the functions, definitions of uncertainty can be included in the projecting, regulating, thereby determining the importance for the future. The visible consequence of such a function of the definition of uncertainty is, inter alia, their use in the process of defining risk as a narrower concept of a more real nature.

Approaches to defining risk

There is an unusually large variety of definitions of risk in the scientific literature which derives from the number and diversity of scientific disciplines (Spekman & Davis, 2004; Elahi, 2013). In the context of management, in addition to numerous conceptual attempts to define risk, they are more detailed in the area of individual sub-disciplines of management sciences, e.g. in quality management, financial management or strategic management (Kaczmarek, 2006).

The terminology of risk is also established at the level of standardized norms in various disciplines, e.g. on the basis of the risk management standard – ISO 31000 and quality management standard – ISO 9001 (Jedynek, 2011). Due to its multidimensional, interdisciplinary nature, the concept of risk can be defined as universal, which can be used not only in science, but above all, in all aspects of economic activities: economics, politics, social sciences (Śliwiński, 2002).

Risk is often defined in relation to the uncertainty analyzed earlier, constituting its specification and particularization. Table 2 presents a chronological overview of risk definitions.

Table 2. Review of the definition of risk

AUTHOR	DEFINITION OF RISK
Raiffa & Luce (1957)	One of the conditions for making managerial decisions that require the ability to determine the probability of anticipated effects of decisions.
Markowitz (1959)	Variation of return on investment in the capital market.
Zieleniewski & Szczypiorski (1963)	The possibility of failure, in particular the occurrence of independent events, which cannot be predicted and which cannot be fully prevented, and which may take away the characteristics of effectiveness, profitability and economy by reducing utility or increasing outlays.
Denenberg (1964)	Uncertainty of loss treated as a mainly psychological phenomenon relevant to people's relationships and experiences.
The Commission on Insurance Terminology of the American Risk and Insurance Association (1966)	Uncertainty as to the outcome of an event when two or more possibilities exist. This is measurable uncertainty as to whether the intended purpose of the action will be achieved
Lawrence (1976)	The measure of probability and the weight of undesired consequences
Pasieczny (1981)	A situation where at least one of the elements that make it up is not known, but the probability of its occurrence is known.
Wilson & Crouch (1982)	The product of the probability of occurrence and the severity of the event's consequences.
Holscher (1987)	Risk of failure to achieve intended profit due to incomplete information.
Gardner & Mills (1988)	Deviation from the expected level of income.

Kreim (1988)	Situation where, in conditions of incomplete information, decisions are taken that are not optimal from the point of view of the desired objective.
Sierpińska & Jachna (1993)	Danger of failure to achieve the intended goals or of incurring loss.
Sankey Jr (1992)	Uncertainty related to future events or to results of decisions made.
Gruszka & Zawadzka (1992)	Threat of failure to achieve the desired objective.
Uyemura & Deventer (1993)	Volatility of net cash flow streams generated in a given undertaking, measured by standard deviation.
Marsh (1995)	A situation in which there is a probability of achieving better or worse results than expected, assuming that the distribution of the probability of deviations of these results from their expected value is also known.
Kumamoto & Henley (1996)	A combination of: outcome, probability, significance, cause and effect scenario, and population affected.
Buschgen (1997)	Possibility of deviation of the actual result of the decision taken from the planned results.
Kendall (1998)	Possibility of suffering injury or loss.
Rosa (1998)	A situation or event in which material or human value is at risk and the outcome of which is uncertain.
Johanning (1999)	Uncertainty about the deviation of the results obtained from those planned.
Marshall (2001)	The possibility of events or adverse trends causing future losses or fluctuations in future income levels.
Knechel (2002)	The probability that the results of the process will not meet expectations.
Damodran (2002)	Danger threatening the success of actions taken.
Buła (2003)	Threat of incurring a quantifiable loss.
Doerig (2003)	Uncertainty about achieving future results.
Campbell (2005)	Expected damages resulting from the occurrence of an event.
Stabryła (2006)	The degree of variability or uncertainty in achieving the intended economic result or organizational effect.
Regda (2007)	Uncertainty regarding the occurrence of a loss.
Aven & Renn (2009)	Uncertainty and severity of events and their consequences in relation to values.
ISO Guide 73 (2009), Risk Management – Vocabulary	The degree of uncertainty associated with achieving the organization's goals.

Urbanowska-Sojkin (2013)	A factor, the assessment and minimization of which, is a key condition for the effectiveness of strategic management.
ISO 31000 (2018) Risk Management-Guidelines	Effect (expressed as a deviation from the expected state) of uncertainty on objectives (which may have different aspects and categories and may be used at different levels of management).

Source: own study.

As can be seen from the review of the risk definitions made in Table 2, the method of defining this concept has changed over the years, from a narrow approach, focusing on the probability of negative events, to a broad approach analyzing the real consequences of risk materialization (Aven, 2012). In addition, in many cases, the concept of risk is treated the in the same way as the concept of uncertainty or a strong interdependence between the two can be observed. Approaches to defining risk can be divided into 6 categories:

- due to the cause, source (Pasieczny, 1981; Holscher, 1987; Kreim, 1988; Rosa, 1998),
- due to the ability/ inability to achieve the planned objectives (The Commission on Insurance Terminology of the American Risk and Insurance Association 1966; Gruszka & Zawadzka, 1992; Sierpińska & Jachna, 1993; Johanning, 1999; Knechel, 2002; Damodran, 2002; Doerig, 2003; Stabryła, 2006; ISO Guide 73, 2009; ISO 31000, 2018),
- due to its role in the decision-making process (Raiffa & Luce, 1957; Sinkey Jr, 1992; Buschgen, 1997; Urbanowska-Sojkin, 2013),
- due to the expected results and outcomes (Zieleniewski & Szczypiorski, 1963; Denenberg, 1964; Lawrence, 1976; Wilson & Crouch, 1982; Kumamoto & Henley, 1996; Gardner & Mills, 1998; Kendall, 1998; Marshall, 2001; Cambell, 2005; Buła, 2003; Regda, 2007; Aven & Renn, 2009),
- due to the possibility of estimating (Markowitz 1959; Uyemura & Deventer, 1993; Marsh, 1995).

In most cases, definitions of risk, like uncertainties, are induction inequality definitions that do not exhaust the catalog of possible ways of their understanding (thus they show the feature of incompleteness). On the contrary, they become the basis for refinement by other authors. Such examples are the

definitions of Knight (1921) and Keynes (1921) clarified e.g. by Snowdon et al. (1998). In the catalog of definitions of risk, one can also find a few examples of classical equality definitions, which clearly lay out the meaning of the concept (limited possibility of various interpretations). These are suggestions of e.g. Lawrence (1976), Wilson & Crouch (1982), where the definition is presented in the form of an unambiguous mathematical formula. Taking into account the function of definitions, the ways of understanding risk, as presented, can be included in the projecting, regulatoring. However, one can also find an example of a reporting definition whose task is to standardize existing ways of understanding a given concept for a given group. The definitions of risk contained in international standards, e.g. ISO Guide 73 (2009) may be an example of this. Here the definition of risk has been unified on the basis of its common understanding in the environment of the organization, the consequence of which is a precise and specific understanding of it in the environment of entities implementing the ISO 31000 standard.

Criteria to distinguish between uncertainty and risk

Despite the strong dependencies existing at the level of defining risk and uncertainty, examples can be identified where they are defined as separate concepts that should not be used synonymously. Definitions of uncertainty and risk formulated by the same authors can be found in the scientific literature (Table 3).

Table 3. Distinction of definitions of uncertainty and risk

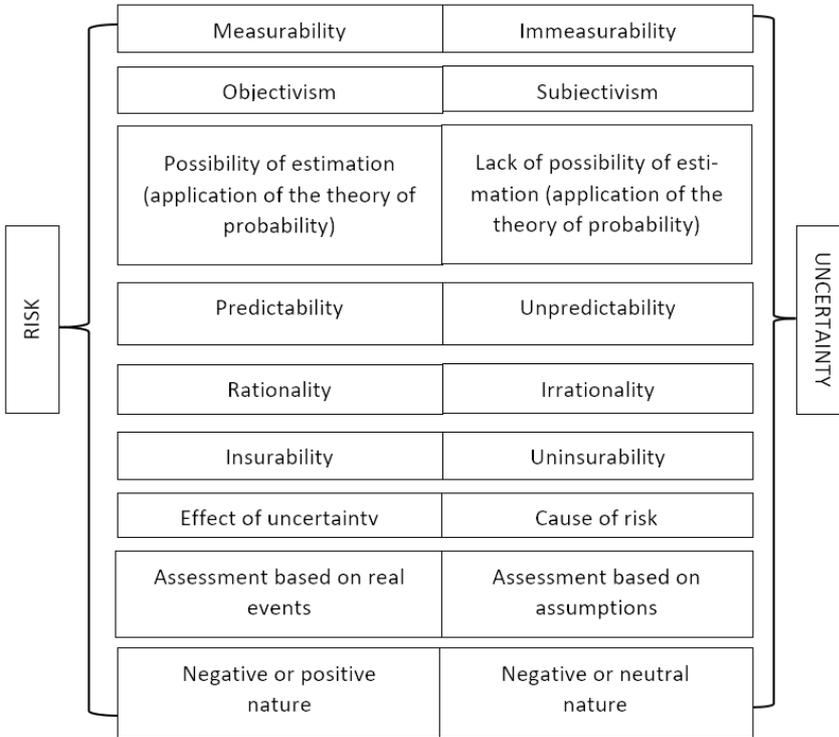
DEFINITION OF RISK	AUTHOR	DEFINITION OF UNCERTAINTY
Objectified uncertainty as to the occurrence of an undesirable event (degree of uncertainty as to the occurrence of a loss, which, however, does not translate into a certain level of probability of its occurrence)	Willett (1901)	Subjective feeling of undesirable significance

Uncertainty expressed in a measurable / tangible manner, related to adverse events (risk of loss)	Knight (1921)	Immeasurable / intangible qualitative events, often with positive consequences (profit uncertainty)
The possibility of occurrence of events subject to predictable probability, which can be presented in the form of a mathematical formula	Keynes (1921)	The possibility of occurrence of events the probability of which cannot be precisely determined
Combination of speculation measured by probability, current situation in the real world	Pfeffer (1956)	Combination of speculation measured by belief, state of mind
A case that can be researched using the theory of probability	Lange (1967)	A case that cannot be researched using the theory of probability
One dimension of uncertainty (subjective uncertainty)	Arrow (1971)	Irrational state of the world
Opportunity or threat to the decision maker under conditions of uncertainty	Jędralska (1992)	The consequence of the complexity of socio-economic phenomena and the resulting difficulties in estimating the likelihood of their occurrence in the future
Frequent, dynamic phenomenon (associated with human activities), of a negative or positive nature (profits or losses)	Jedynek & Szydło (1997)	Source of risk, common, complicated (difficult to measure) phenomenon of negative or neutral nature
The characteristic feature of a situation the probability of which is known, can be quantified (measurable) and is insurable, exhaustive and closed	Snowdon et al. (1998)	A situation, the probability of which cannot be quantified (not measurable), is uninsurable and open to potentially unexpected events
Measurable and objective uncertainty (potential variability of the event, inability to accurately predict the effects of any actions)	Williams et al. (2002)	The immeasurable aspect of subjective risk
Result of uncertainty (uncertainty affecting the well-being of stakeholders)	Bodie & Merton (2003)	Essential but not adequate condition for risk (cause of risk)

Source: own study.

Based on the above considerations and taking into consideration the variety of relationships between uncertainty and risk, it can be concluded that they are disjoint concepts. However, on the basis of numerous common elements (Pablo, 1999) they are largely dependent on each other. The differences can be determined by a number of criteria, which are presented in Figure 1.

Figure 1. Criteria to distinguish between the concepts of risk and uncertainty



Source: own study.

The last differentiation criterion presented in Figure 1 (negative, neutral or positive results of the materialization of risk / uncertainty) is associated with the emergence of the concept of negative and positive risk. The perception of risk from the point of view of a negative concept, equates risk with the risk of suffering loss or damage. On the other hand, the positive concept treats risk as an opportunity and the prospect of obtaining additional benefits (Mittal & Ross Jr., 1998; Zinn, 2017), among others in the form of a chance for qualitative and quantitative development (Teczke, 1996).

The significance of the concepts of uncertainty and risk in modern management

In addition to the need for a purely definitive approach to understanding the role of uncertainty and risk in management sciences, one should also consider the role of perception of potentially risky activities in shaping organizational objectives and attitudes of managers. The perception of risk can significantly affect the process of identifying and achieving the objectives of the internal management process of an organization (Renn, 1998) by:

- enabling the definition of an autonomous, entity-specific way of defining risks and optimizing their management (Sargeant & Jen, 2016),
- adaptation of risk management methods to the information resources at disposal, its credibility, the individual situation of the entity and the scope of anticipated threats (Vasvari, 2015),
- shaping attitudes towards individual categories of risk depending on the severity of threats and motivators of taking risky actions (Ulbert & Csanaky, 2004),
- maintaining a balance between rationality in risk taking and subjectivity (Hámori, 2003),
- individual assessment of sources of risk (their reversibility / irreversibility), assessment of the effects of their materialization and the choice or necessity of compensating them (Kasperson et al., 1988).

Uncertainty and risk are also treated in management as determinants characterizing the conditions for making decisions (Ugur, 2005). Considering the scope and information available to the decision-maker, decision-making conditions can be differentiated into the following: conditions of certainty (the decision-maker has all the information necessary to predict the results of all available alternatives of choice), risk conditions (the decision-maker has information to forecast the effects of available alternatives of choice, but these are uncertain effects with a higher or lower probability of occurrence) or uncertainty conditions (the decision maker most often does not have information enabling him to predict the results of the available options,

and even if they do, it is not possible to estimate the degree of probability of their occurrence. Therefore, the effects of the decision undertaken in these conditions are most often unpredictable) (Tyszka, 2010).

Risk in management is usually analyzed in organizational terms. Thereupon, the risk relates to management at all levels of the hierarchical organization and may affect the functioning of the entity in the short, medium as well as long term. Furthermore, the risk relates to the organization's activities in three dimensions (Bugdol & Jedynak, 2012):

- strategic (risk related to the organization's strategy and organizational objectives),
- tactical (risk related to undertaken ventures, mergers, acquisitions, development of products and services),
- operational (risk related to routine activities).

In turn, uncertainty in relation to management processes is perceived in external and internal categories (depending on the nature of its source) (Johansen et al., 2014; Bombola, 2014). The reasons for identifying such categories of uncertainty are:

- 1) in case of external uncertainty:
 - emergence of new uncertainties resulting from social, cultural, technological, economic and climate changes (Obłój, 2007),
 - the far-reaching process of internationalization of enterprises and economies (Pierścioneck, 2011),
 - changes in the functioning of economies and societies (Raynor, 2008),
 - process changes in management forced by macro-scale events (Montana & Charnov, 2008).
- 2) in case of internal uncertainty:
 - unexpected intra-organizational changes caused by changes in objectives, management assumptions or cultural standards in the organization (Koźmiński & Latusek-Jurczak, 2011),
 - the possibility of disturbing the functional balance of the entity (Simon, 2007),
 - managerial mistakes (Goffee & Jones, 2006).

Conclusion

The deliberations that are the subject of this text have enabled the identification of approaches to the definition of uncertainty and risk on the basis of an interdisciplinary review of definitions of these concepts in the scientific literature. The multitude of definitions of uncertainty and risk that were identified indicates their significance in many areas and disciplines of science. This interdisciplinarity is the core for their understanding both in the theory of management sciences as well as in the practice of managing organizations.

The numerous definitions of uncertainty and risk that were identified have been divided based on one-dimensional logical classification method (Bailey, 1994; Saran, 2014) into categories that satisfying the exhaustive and mutually exclusive criteria thus creating approaches to defining them. On this basis, four approaches to defining uncertainty (due to: causes, possibility/impossibility to assess probability, role in the decision-making process, anticipated consequences) and five approaches to defining risk (due to: cause/source, possibility/impossibility to achieve the assumed objectives, role in the decision making process, expected outcomes/results, possibilities of estimation). Therefore, specific approaches differ from each other in the ways of understanding and the possibilities of interpreting the meaning of the concepts of uncertainty and risk.

On the basis of the various definitions of uncertainty and risk that were identified, a catalog of criteria distinguishing them was also developed, due to the need to prevent blurring of the boundaries between the ways of understanding these two dependent, but separate concepts.

It should be emphasized that the way of understanding uncertainty and risk (determined by definitions, sector specificity, scale of the entity's operations, strategy and even individual characteristics of the managerial staff) depends on the effectiveness of operations and results (Subramaniam et al., 2011), and sometimes even survival in a globalized economic environment and high



competitiveness (Dannreuther & Lekhi, 2000). The undoubted effect of the multitude of ways of understanding these concepts are various strategies and methods to prevent the negative effects of their materialization.

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