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Risk Culture - a descriptive model

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Risk Culture

A descriptive model

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ABSTRACT

The term risk culture means how people in organisations understand risk. Risk culture influences all risk management related aspects. The term risk culture is relatively new. No comprehensive descriptive model of risk culture can be found in the literature. To understand risk culture better a descriptive model is needed.

This thesis aims to answer the following research questions: How risk culture can be described, how different culture types can be classified, and what risk management methods are feasible for different culture types? The focus of the thesis is on operative risks in the energy sector.

In this thesis a comprehensive descriptive risk culture model is presented. In the first half of the thesis the most important theories of individual and organisational aspects of risk and related topics are reviewed. The model takes into account the most important aspects of risk management. The model consists of four layers: individual perception of risk, organisational culture, decision making and risk culture.

To improve applicability of the model a typology of risk culture types is developed. Using four dimensions in total sixteen different culture types are identified. A questionnaire was used to help defining the dimensions. The different culture types are presented in order to highlight differences between risk cultures.

General characteristics and applicability of different risk management methods are reviewed. For each risk culture type the most applicable risk management methods are proposed. Risk management method review is used to demonstrate potential uses of the risk culture model.

Keywords

Risk, Risk management, Risk culture, Perception of risk, Organizational culture, Decision making

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ABSTRAKTI

Riskikulttuuri kuvaa sitä, miten organisaatioiden jäsenet ymmärtävät riskin. Riskikulttuuri vaikuttaa kaikkeen riskeihin liittyviin osa-alueisiin. Termi on suhteellisen uusi: kirjallisuudesta ei löydy kattavaa deskriptiivistä mallia. Deskriptiivinen malli on tarpeen, jotta riskikulttuuria voidaan ymmärtää paremmin.

Tämä työ pyrkii vastaamaan seuraaviin kysymyksiin: miten riskikulttuuri voidaan määritellä, miten eri riskikulttuurityypit voidaan luokitella ja mitkä riskienhallintamenetelmät soveltuvat eri riskikulttuurityypeille? Työn painopiste on energiasektorin operatiivisissa riskeissä.

Tässä työssä esitetään kattava deskriptiivinen malli riskikulttuurille. Työn ensimmäisessä puoliskossa käydään läpi tärkeimmät riskienhallintaan liittyvät teoriat yksilön ja organisaation näkökulmista. Työssä esitettävä malli ottaa huomioon tärkeimmät osa-alueet. Malli koostuu neljästä kokonaisuudesta: yksilön suhtautuminen riskiin, organisaatiokulttuuri, päätöksenteko ja riskikulttuuri.

Jotta malli olisi paremmin hyödynnettävissä, eri riskikulttuurityypeille luotiin luokittelu-järjestelmä. Luokittelu tehtiin neljän dimension perusteella. Näin saatiin yhteensä kuusitoista riskikulttuurityyppiä. Dimensioiden määrittämisen tukena käytettiin kyselyä. Eri kulttuuri-tyyppien tavoitteena on korostaa eroja eri riskikulttuurien välillä.

Työssä esitellään eri riskienhallintamenetelmien pääpiirteet. Jokaiselle riskikulttuurityypille esitetään parhaiten soveltuvat menetelmät. Riskienhallintamenetelmien läpikäynnin tavoitteena on demonstroida riskikulttuurimallin potentiaalisia hyödyntämistapoja.

Avainsanat

Riski, Riskienhallinta, Riskikulttuuri, Riskin käsittäminen, Organisaatiokulttuuri, päätöksenteko

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1 INTRODUCTION

Interest on risk management has increased for some time, especially due to current economic turmoil in Europe and the United States. Managing risks has always been inherent part of management but typically these efforts have not been identified or labelled as risk management. Formal risk management has taken root widely only in the recent decades. The changes have often been motivated by high profile disasters, such as the space shuttle Challenger in 1986 or man-made crises such as the collapse of Enron in 2002. As formal risk management has become more common more critique has been voiced about whether implemented risk management methods really work (see e.g. (Hubbard, 2008) or (Lewis, 2012)).

As organisational theorists have pointed out (see e.g. (Schein, 2012)) culture influences all aspects of organisational life. Culture ultimately dictates what structures, methods and procedures can be successful in an organisation. Most organisational culture theories emphasise or at least accept the fact that there is no single best organisational culture. What is good and what is bad depends always on the context.

The term risk culture means how people in organizations see, understand and act related to risks. Much like organizational culture risk culture affects all risk management related aspects and ultimately affects whether risk management structures, methods and procedures will benefit or damage an organization. Risk culture is a relatively new term. Sporadic references appear here and there in the risk management literature but very few texts actually focus on risk culture. The most recent attempt to present risk culture as a full-fledged concept has been made by the institute of risk management (IRM, 2012).

1.1 Purpose of the thesis

This thesis has two main topics: risk culture and risk management methods. A comprehensive, descriptive risk culture model is presented. The model is created in such way that it takes into account all important aspects related to risk management. To improve applicability of the model a typology of risk culture types is developed. Sixteen different culture types are identified. General characteristics and applicability of different risk management methods are studied. For each risk culture type the most applicable risk management methods are proposed. The focus of the thesis is on operative risks in the energy sector. The focus has influenced on what topics have

been deemed important, what dimensions are included in the model, how the typology is constructed and what kind of risk management methods have been considered. For the most parts the model can be applied for other risk types and industries.

This thesis aims to answer the following research questions:

- How risk culture can be described?
- How different culture types can be classified?
- What risk management methods are feasible for different culture types?

1.2 Motivation

Traditionally formal risk management has been limited only for insurance and certain high risk industries such as aviation and nuclear power industries. However there is increasing consensus that other areas would benefit from organised risk management and structured risk management methods. There are huge potential benefits that can be gained by better risk management.

Risk culture is a rather recently coined concept similar to the concepts of organisational culture and safety culture. There are very few academic studies or even managerial texts related to the concept of risk culture. Risk culture has a major impact on what perspectives and methodologies will be successful in an organisation. If there is need for improved risk management (more efficient, more effective, and better aligned with strategy) it is important to understand what kind of risk cultures there are in the organisation. Otherwise improvement efforts may be misaligned, worthless or even harmful.

There are wide variation of risk management methods ranging from very “soft” and qualitative to complex and heavy mathematical models. Applicability and effectiveness of methods and tools for each organisation depend on characteristics of each organisation. Risk culture of an organisation has influence on whether certain methods will be effective or efficient.

1.3 Methods

The risk culture model is based on literature study, discussions with experts and personal experience. The starting point of the model is that the risk culture depends on individual aspects and organisational aspects. In the literature study the most important theories of the both areas are discussed. The risk culture model is composition of the most important aspects of these two

dimensions. The final 3+1 level model emphasises the areas that are seen to be the most significant and which cover the field of risk culture extensively enough. The structure of the model is kept simple in order to ensure its applicability in real organisational settings.

In order to help the use the model in organisations a typology of risk cultures was created. 31 persons were asked to answer to 30 statements-pairs about risk related issues. 10 statement-pairs were selected for further analysis. This data was used to create four dimensions of risk culture by using factor analysis. The created dimensions are interpreted to describe four independent areas where companies may differ. Using the four dimensions sixteen different risk culture types can be identified.

In order to demonstrate potential uses of the model and the typology applicability of risk management methods are reviewed. First the commonly used and several more rarely used methods are reviewed. The purpose of the review is to present general characteristics of the methods and not to go into details. Applicability of risk management methods is based on literary review and personal judgement.

1.4 Structure

The remaining of the thesis is structured in the following way: Chapter 2 describes topics related to individual perception of risk and chapter 3 discusses organisational aspects. The risk culture model is presented in the chapter 4. The literary review of risk management methods is in the chapter 5. The risk culture model and the risk management methods are tied together in the chapter 6. Conclusions and areas for further studies are discussed in the chapter 7.

2 PERCEPTION OF RISK

This chapter reviews the most important areas related to individual perception of risk. The chapter focuses on the questions: "how people understand risk?" and "how perception of risk influences decision making". The chapter is structured as follows: The chapter 2.1 presents different ways the term risk can be defined and understood. In chapters 2.2 and 2.3 two influential theories, cultural theory of risk and psychometric paradigm are presented. Chapter 2.4 reviews several heuristics and biases that affect risk perception.

2.1 What is risk?

The first and the most profound question in risk management is: “what is risk?” How the term risk is defined and how it is understood has a profound impact on how risk can and will be managed. In order to successfully manage risks one must understand what is being managed. Unfortunately risk can be defined in many and often conflicting ways. It is possible and even likely that risk is defined in different ways by different groups within an organization, especially if there is no formally stated and commonly accepted definition. The most common ways to see risks are presented below.

In the chapter 2.1.1 two opposing basic views or philosophies are discussed. The chapters 2.1.2 and 2.1.3 list everyday definitions as well as several more formal ones. Finally the chapter 2.1.4 lists some additional definitions typically used by certain groups or in certain contexts.

2.1.1 Objective vs. subjective risk

There are two fundamentally different ways to see the concept of risk: objective and subjective view. The objective view states that "*an accurate and reasonably complete characterization of a risk can be made by stating (only) objective facts about physical world*". In the objective view probabilities are based on statistics or similar figures. The values that are used as input to risk management and the figures that are obtained as results can be seen as objective truth. Risks are as real as physical objects. Many mathematical methods are based on the concept of objective risk.

The subjective view claims that all statements about risks are subjective and that "*an accurate and reasonably complete characterization of a risk does not refer to any objective facts about*

physical world". From the subjective perspective risks are social constructs and estimates concerning their probabilities and impacts are always subjective and dependent on the context and assessing persons. Risks are not real as such but means to state uncertainties. (Hansson, 2010)

2.1.2 Everyday definition

Everyday definition of risk is the way risk is understood in the common, everyday language. This is the way the term is risk is used and understood if no other definition is explicitly stated or implied by the context. The everyday definition influences all risk management and risk communications.

For the English term "risk" the following definitions given: "The possibility of loss, injury, disadvantage, or destruction", "someone or something that creates or suggests hazard or adverse change". (Webster's Third New International Dictionary of the English Language, 1993) and "A situation involving exposure to danger", "The possibility that something unpleasant or unwelcome will happen" (The New Oxford Dictionary of English, 1998)

In Finnish the everyday definition of risk is very similar: "Threat or danger of loss" (Nykysuomen sanakirja, 1992) (unofficial translation)

In a recent linguistic analysis it was concluded that the word risk is used commonly to represent negative consequences. The word risk is also connected to rational and goal-directed actions. (Boholm, 2012).

The everyday definition includes only negative consequences. Everyday definition is important because it is that way the term risk is commonly understood. The more the risk management is meant to done by other than risk specialists the more the definition is likely to have effect on the way risks are seen, discussed and managed.

2.1.3 Descriptions used in the literature

There are several formal descriptions of the term risk. These terms aim to unambiguous enough to be used to support risk management. While the most formal definitions share same elements there are also some clear differences. Below are listed some descriptions from the literature. The list is of course far from being exhaustive:

- "Effect of uncertainty on objectives. Note that an effect may be positive, negative, or a deviation from the expected. Also, risk is often described by an event, a change in circumstances or a consequence". ISO Guide 73, Risk management: vocabulary, quoted in (Hopkin, 2010, p. 12).
- "Risk can be defined as the combination of the probability of an event and its consequences […] In all types of undertaking, there is the potential for events and consequences that constitute opportunities for benefit (upside) or threats to success (downside)." (IRM, 2002)
- "Uncertainty of outcome, whether positive opportunity or negative thereat, of actions and events. It is the combination of likelihood and impact, including perceived importance" (HM Treasury, 2004)
- "Risk is the possibility of an event occurring that will have an impact on the achievement of objectives. Risk is measured in terms of impact and likelihood." (IIA, 2013)
- "Risk […] is Exposure to a proposition of which one is uncertain" (Holton, 2004)
- "Event with the ability to impact (inhibit, enhance or cause doubt about) the mission, strategy, projects, routine operations, objectives, core processes, key dependencies and/or the delivery of stakeholder expectations" (Hopkin, 2010, p. 12)
- "The probability and magnitude of a loss, disaster, or other undesirable event" (Hubbard 2008, p. 8)
- "Risk is a permanent loss of capital" (Lewis, 2012, p. 1)

As can be seen there are significant differences between the definitions: some focus on the cause some on the effect. Some of the definitions are conflicting with the everyday use of the term (e.g. the ones including positive effects). The differences may have significant impact on how risks are understood by different groups in the organization and whether and what kind of misunderstandings there may be when risks are communicated between different groups and at different levels of hierarchy. From the risk management purposes it is important that it is known what definition of risk is used.

There are two common ways to describe risks in way which is aligned with the definitions given above. The first way is to treat risks as scalars and the second way is to treat them as vector parameters. These ways are briefly discussed below.

2.1.3.1 Risk as a scalar

Risk can be defined as a single number (scalar) typically calculated by using probability and impact of a risk event. (Zio, 2007, p. 4) One event may include several potential outcomes and thus several probabilities and impact values. The most straightforward way to calculate value of risk is to calculate a probability-weighted average of impacts of each potential outcome. This way is risk neutral as it weights all impacts in the same way. If needed, risk perception can be included into the calculation by weighing different impacts with different weights (e.g. over-emphasising large losses). The risk is defined as the outcome of such calculation whatever the method of calculation.

2.1.3.2 Risk as a vector

Risk can be defined also as a set of parameters, typically probability and impact of a risk event. (Hubbard, 2009, pp. 91-92) The calculation method and other technicalities may be similar to the previous definition but the difference is that in this definition risk is defined as a set of parameters (e.g. impact and probability). Calculation of the value of risk is already analysing a risk whereas in the previous definition calculation is part of the definition.

The difference between the two ways reflect differences between how models are interpreted and how much it is believed that risks and risk calculation require case-by-case analysis.

2.1.4 Other definitions

The definitions stated in the two previous sections are in still at very general level. Especially specialist groups are prone to define risk in a more narrow and detailed way that best fits to the focus of the specialists. Disadvantage of these definitions is that they may be too narrow to be used outside certain specialist area and thus several definitions of risk are needed to cover all risks of an organization. Having several, sometimes even conflicting, definitions of risk is an obvious source of risks itself. Below are listed several common ways to define risk in a more detailed way.

2.1.4.1 Risk as pure uncertainty

An early and famous definition was made by Frank Knight in 1921. He defined risk as uncertainty that can be measured in contrast to immeasurable uncertainty that he defined as uncertainty. This definition of risk does not take consequences of the uncertain event into account in any way. Thus this definition is one-dimensional measure of (measurable) uncertainty.

(Knight, 1921, ch. I.I.26) This definition is still sometimes used in e.g. economics and decision making literature.

2.1.4.2 Risk as volatility

Many trading related specialists treat and understand risk as synonymous to volatility. This has roots in the Modern Portfolio Theory (Markowitz, 1952). The original theory does not explicitly equate risk and volatility but in application of the theory the terms have become mutually replaceable. E.g. (Fabozzi et al., 2011, p. 52) states that standard deviation and variance are used as measure for risk.

This definition of risk can also be seen as one-dimensional as it has only one parameter: variance (or standard deviation). However the definition captures both uncertainty and magnitude dimensions as variance is related to value of underlying assets.

2.1.4.3 Risk as variation

Risk can be defined as variation from planned values or deviation from target. This view is used e.g. in project risk management. (Hopkin, 2010, pp. 13-14) This definition is related to the definition of risk as volatility but the view risk as variation view is more general and flexible as variation may relate to many kinds of targets and deviation from target may be always bad or it may have both upside and downside.

2.1.4.4 Risk as opportunity

Risk is sometimes defined as opportunity. One way is to define that a positive risk means that "something good may happen". Most of the definitions stated in the previous chapter include possibility that risk is actually an opportunity without any downside.

Another way to define risk as opportunity is to define it as means to gain additional benefits. (ibid, pp. 13-14) However, this definition is maybe more a way to say that to gain additional benefits one must accept more risk (with potential downside) than actually a definition of risk.

2.2 Cultural theory of risk

The previous chapter discussed different technical definitions of risk. The chapters 2.2-2.4 discuss the different ways the people understand and perceive magnitude and importance of

different risks. As will be seen there can be significant differences even if people agree about the basic principles and share the same definition of risk.

The classical economic theories such as expected utility theory and the prospect theory assume that all people try to act rationally, even though this rationality may be violated unknowingly. Even more importantly it is assumed that behaviour of all people is more or less similar and preferences that people choose rise from within. The Cultural Theory proposes that many preferences that people make are due to culture the people choose to or are forced to live within. (Wildavsky, 1987)

Cultural Theory of risk is based on the work of Mary Douglas and Aaron Wildavksy. It was comprehensively described in their influential book Risk and Culture (Douglas and Wildavsky, 1982) although the theory was based on their earlier work. The main claims of the theory are (Mamadouh, 1999):

- everything people do is culturally biased,
- it is possible to distinguish a limited number of cultural types,
- cultural types are universal.

Further work on the theory includes several additional propositions: social relations and cultural bias must be mutually supportive (compatibility condition), there are only five possible culture types (impossibility theorem) and that each of the five culture types needs to be present in any society at any time (requisite variety condition). The culture types are resistant to change and anything that does not fit expectations are explained away (theory of surprise).

The total number of possible cultures has been debated. Some academics see that there are only four types while others include also the fifth, autonomous type. This discussion is somewhat academic as the two dimensions and four or five types is also matter is simplicity and usability of the theory (Douglas, 1997).

2.2.1 The cultural typology: grid and group dimensions

The Cultural Theory describes cultures using two dimensions: group and grid. In fact the theory was initially called grid-group theory (and it is still sometimes referred by this name).

The group dimension represents incorporation and the strength of perception of membership to a group. The group dimension can be described using five subdimensions: proximity of members to each other, transitivity of relations, intra-group interaction, share of activities with other members and easiness of joining of non-members. (Gross, 1995, pp. 73-79)

The grid dimension represents regulation, structure and hierarchy in a group. The grid dimension can be described with four subdimensions of specialisation of the members, asymmetry in role exchange, entitlement (how certain roles are reserved to certain types people) and accountability in interactions. (ibid., pp. 79-82)

The subdimensions described by Gross were meant to be quantitatively measured but in fact this has proven to be difficult. There are also several other ways describe grid and group dimension and in many studies only certain aspects of the dimensions are used.

2.2.2 Culture types

Cultural types describe three distinct levels: interpersonal relations, cultural biases and behaviour strategies. Grid and Group dimensions create five different cultural types: four in each quadrant of a grid-group map and fifth in the middle (Mamadouh, 1997):

- Individualist, low grid, low group type: People are free act like they wish, boundaries are open for negotiation. Environment is competitive and fairness means equal opportunity.
- Fatalist, high grid, low group: there are binding prescriptions and weak group incorporation. Individuals feel that life is organised in such way that it is out of their control. Fairness is not relevant question as much is explained by fate.
- Hierarchic, high grid, high group: There are strong boundaries, strong division of labour and hierarchies. The collective is valued over individuals. Tradition and order are supported. Fairness means equality before the law
- Egalitarian, low grid, high group: Strong group boundaries but few regulations. Minimal internal role differentiation. Shared opposition to the outside world. Fairness is equality of result.
- Autonomous, mid grid, mid group (some studies do not recognise this as a distinct group): Removed from coercive and manipulative relations. Individual is not controlled by or controlling others.

Many alternative labels have been proposed in addition to the ones presented above. The original theory used only labels A, B, C and D. The labels such as individualist (A), fatalist (B), hierarchic (C) and egalitarian (D) are later addition. (Mamadouh, 1999)

2.2.3 Myths of nature

The Cultural theory has a connection to the ways how people understand and perceive nature. These ways, called as the myths of nature, define nature as profoundly different ways. The four basic ways can be connected to the four culture types: (Douglas, 1992, p. 263)

- Nature is benign: Nature is robust and it can withstand significant disturbances and still return to equilibrium. This view is related to the individualist culture type.
- Nature is capricious: Nature is unpredictable and one can't learn from experience. This view is related to the fatalist culture type.
- Nature is perverse/tolerant: Nature can withstand changes within some limits but pushing beyond those limits will cause a disaster. This view is related to the hierarchic culture type.
- Nature is ephemeral: nature is fragile and all changes are bad. This view is related to the egalitarian culture type.

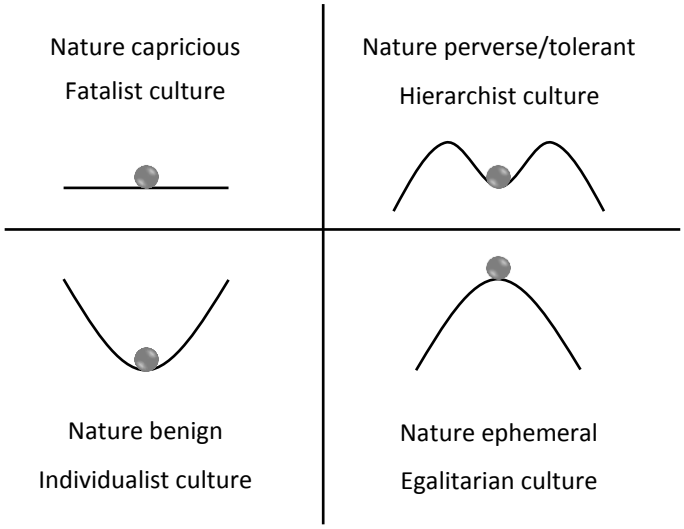

Figure 1. Myths of nature and related culture types. (Steg, Sievers, 2000)

The fifth culture type, autonomous, is related to a view that all four other (contradictory) views are true at the same time. (Mamadouh, 1997) A common way to illustrate the myths of nature

and how related cultures perceive their environment is a ball (current situation) in a slope (environment) as shown in the Figure 1.

The myths of nature have often extended to explain how people perceive their surroundings and environment in other than purely natural terms (e.g. business environment). The Cultural Theory helps to understand why in some discussions people may hold opposite opinions which they are not willing to change or expose them to discussion. Without Cultural Theory this behaviour would seem irrational. (Douglas, 1997)

2.2.4 Culture types and risk perception

The basic assumptions behind each culture type and the way members of culture understand environment have a profound impact on how people understand and manage risks:

- Individualistic cultures see risks as possibilities. Risk taking is needed and those who are willing to take risks will be successful over time.
- Fatalist cultures assume that future is unpredictable. Assessing and managing risks is essentially waste of time as one can't predict what the future will hold.
- Hierarchist cultures assume that future can be predicted and managed at least within certain limits. Risks should be actively managed and excessive risk taking should be avoided
- Egalitarian cultures see that all risks threaten current delicate equilibrium. Thus risk is implicitly bad and all risks should be avoided as much as possible.

The attitude towards risks and motivation for risk management can vary immensely depending on the culture type. In an organisation different cultures may prevail in different levels and in different units. This means that finding a common understand and common language about risk may be difficult and requires sensitivity to cultural aspects. (Underwood, Ingram, 2010)

2.3 Psychometric paradigm

Another perspective to perception of risk is provided by the psychometric paradigm. It is a "framework that assumes risk is subjectively defined by individuals who may be influenced by a wide array of psychological, social, institutional and cultural factors". (Slovic, 2000, p. xxiii) It is based on the work of Paul Slovic, Sarah Lichtenstein and Baruch Fischhoff. It has many connections with the prospect theory and cultural theory.

The psychometric paradigm implies that perception of risk is dependent on whether the risky issue is seen mostly beneficial or harmful, whether the risk is well known and whether it can be controlled. In further studies impact of media and publicity has been included in the theory (Flynn et al., 2001).

2.3.1 Perceived risk and perceived benefit

In the early studies related to the psychometric paradigm it was discovered that perception on risk is dependent on whether the risky issue was seen to be mostly beneficial or mostly harmful. If an issue is associated mostly with its benefits it is perceived to be less risky than an issue that is associated mostly with its harmful effects. The psychometric paradigm assumes that heuristics described in the chapter 2.4 have significant role in how people perceive risks, probabilities and related consequences.

The same applies to the accepted risk level: with issues seen to be mostly beneficial higher risk levels were accepted. However it was found that with most risks the risk level was perceived to be above acceptable level. It was concluded that individuals and society as whole do not have a single level of acceptable risk. Instead the level of acceptability depends of several factors. Different groups (e.g. experts vs. laypeople) also perceive risks in different ways and thus may have different understanding of the acceptable level of risk. It is also unlikely that these differences are removed merely by providing evidence. (Fischhoff et al., 2000)

2.3.2 Dread and unknown risks

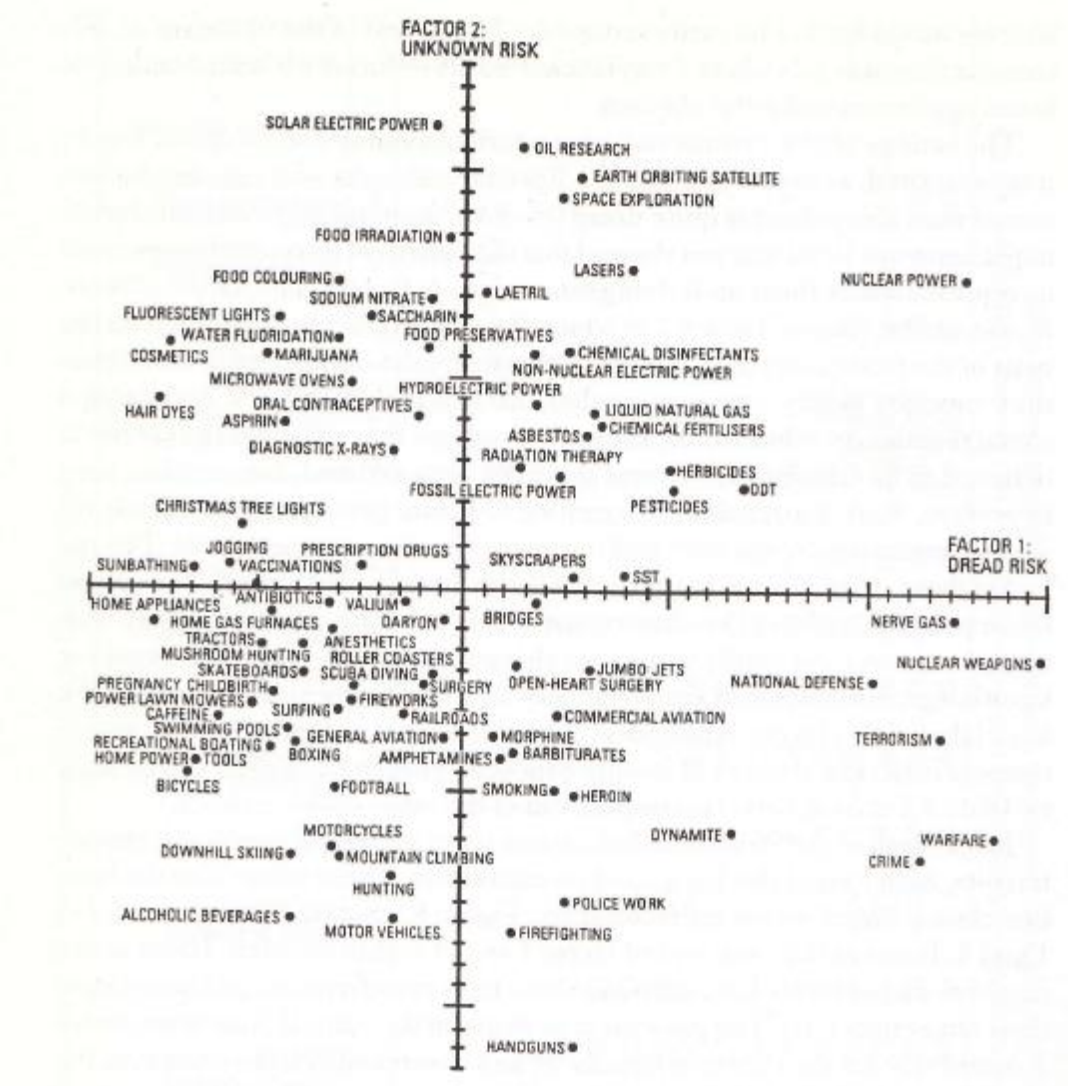

Figure 2. Dread and unknown dimensions of risk. (Slovic et al., 2000a, p. 142)

The psychometric paradigm states that the way the risks are perceived can be described with a two-dimensional model. The dimensions are:

- Dread – how much a risk evokes dread or anxiety, can the risk be controlled, whether the risk is perceived to have catastrophic results etc.
- Unknown – the degree the risk is perceived to be unknown, unobservable, new or unknown to science.

Especially the dread dimension is correlated with people's perception about magnitude of the risk. Risks that are high in the Dread dimension are typically seen to be at unacceptable levels and people are more willing to accept strict limitations to reduce the risks. Classifying risks by using these dimensions may help to understand why certain issues such as nuclear power, genetic engineering etc. raise very strong and persistent opposition which can be seen to be disproportional to actual risk level. (Slovic et al., 2000a)

2.3.3 The social amplification of risk

Some risks are more in public focus that would be assumed by their actual (historical) significance. This has significant impact on how companies and governmental organisations make decisions and may lead to inefficient or even harmful decisions. The risks that are in the upper right-hand corner in Figure 2 (i.e. both unknown and dreaded) are most likely to be subjected to disproportional focus.

The theory of social amplification uses an analogy of electromagnetic signal processing. Risk information can be assumed to be a signal and it is processed in a similar way that electromagnetic signals (e.g. video signals) are processes in physical systems. The risk 'signal' is created by scientists, companies, public agencies, news media, opinion leaders etc. These same actors will also receive and transmit other signals onwards. As a 'signal' is received it undergoes amplification process including the following steps: filtering (i.e. only some parts of the message are taken into further processing), decoding, processing the information, attaching social values, interpreting and validating, formulating behavioural intentions and engaging actions. The actions may cause secondary impacts which may spread over to other parties and distant locations (ripple effect). These actions may be significant and they may have positive or negative implications to actual risk level.

The factors that affect the extent and character of the social amplification are the volume of the information, the degree that the information is disputed, the extent that it is dramatized and the symbolic connotations. Each of these factors helps to increase the gap between the actual and perceived risk levels. (Kaspersson et al., 2000)

2.3.4 Stigma

Stigma and stigmatization refer to an entity (person, company, place, technology etc.) that is identified with a certain negative attribute leading to widespread devaluation, negative labelling

and equating the entity with the label. (Flynn et al., 2001, pp. 1-8) Risk-related stigma is usually related to fear, danger and uncertainty. The process of social amplification of risk has a major impact on creation of a stigma. A stigma may be seen as an extreme case of having a gap between actual and perceived risk. (ibid., pp. 9-27)

The result of stigmatisation is that people that would otherwise conduct a stigmatised action will not conduct it due to the stigma. In practice this may realise in multitude of ways. The social and economic impacts of stigmatisation may be dramatic and persist a long time. Removing a stigma requires people to adjust or change their perceptions and behaviour that produce the stigma. This task may prove to be quite challenging to the stigmatised entities. (ibid., pp. 361-368)

2.4 Heuristics and biases

Heuristics are cognitive shortcuts that help people to reduce complex tasks to simpler judgmental operations. In many cases heuristic can be useful. However, especially situation involving estimation of probabilities heuristics may lead to seriously flawed estimates (Slovic et al., 2000b). Biases are underlying assumptions that push assessments into certain direction. In general biases are not useful.

Heuristics and biases cause many of the deviations from purely rational decision making and other effect described in the chapters 2.2 and 2.3. In the following chapter are listed several of the most common heuristics and biases.

2.4.1 Representativeness

When people assess probabilities they make several cognitive shortcuts based on the perceived representativeness of the available information. They ignore underlying base-rate probabilities, misjudge importance of sample size, and expect random event to look "random".

2.4.1.1 Ignoring base-rate probabilities

Probabilities of outcomes are assessed by degree they representative of a certain group regardless of underlying base-rate probabilities. People turn the question "given conditions A, what is the probability of B" in their head in to a question "given B what is the probability that conditions A are true".

As an example people overestimate the probability that a shy, quiet and helpful person is a librarian. These characteristics are connected to (stereotypical) librarian and thus probability is estimated to be relatively high. The more important probability that any given person is a librarian (which is relatively small) is not regarded. (Tversky and Kahneman, 1974)

2.4.1.2 Sample size

People are not able to take sample sizes into account when assessing probabilities. E.g. in an empirical study participant gave similar probabilities to whether an average height of a sample of randomly selected men was over 6 feet regardless of the sample size even though the probability is highly dependent on the group size.

When given a small sample people will give too much weight on the representativeness of the sample. They don't take the sample size into account in assessing probabilities and may see a small sample with intuitively stronger message as a better indicator as a large sample. (Tversky and Kahneman, 1974)

2.4.1.3 Random events

Random events are assumed to generate random sequences. Thus e.g. 10 heads in a row in a coin flip is seen much more unlikely than any individual random sequence even though all individual sequences are equally likely. In addition chance is seen as a self-correcting process: tails perceived to be more likely than heads if previous 10 coin flips have provided heads. When asked to generate random sequences of heads and tails people create too little sequences of several heads or tails in a row compared to a sequence created by an actual random process. (Tversky and Kahneman, 1974)

2.4.2 Availability

Ease of bringing some events, issues or people to mind affect how people assess probabilities. This may help in some instances as more frequent events are recalled better and faster than less frequent events. Thus they are correctly estimated to be more likely. However, other issues than frequency may also affect the ease of recalling. These effects may cause systematic biases in probability assessments.

2.4.2.1 Retrievability

If some topics are easy to retrieve their probability will be overestimated. Factors that affect retrievability include: how well the assessing person knows the topic, how salient memories the assessor has regarding an issue (e.g. experiencing something personally leaves much more salient memories than just reading about it), and how recently related issues have been encountered. Known topics, salient memories and recent issues all increase overestimation of probability.

A bias due effectiveness of search is a related phenomenon to retrievability. The methods people use to search and recall topics affect their assessment of probabilities. If people have effective mental search methods to recall some topics (e.g. words starting with a certain letter) their probability will be overestimated compared to topics that don't have effective search methods. (Tversky and Kahneman, 1974)

2.4.2.2 Imaginability

In some situation people assess probabilities and frequencies by generating several instances of a situation and base their estimates on the ease that they can construct instances. This may lead to significant biases as the way people construct instances may not correlate with the actual number of instances. (Tversky and Kahneman, 1974)

2.4.2.3 Illusory correlation

People create illusory correlations between issues based on the strength of associative bonds between the issues. Thus issues that are associated are seen to occur together. If the associative bonds are strong, strong correlations may be perceived even if available information would imply the opposite. (Tversky and Kahneman, 1974)

2.4.3 Anchoring

If situations where people are given (in purpose or accidentally) a starting point for their estimate, their estimate will be relatively close to that starting point, i.e. they are mentally anchored to the starting point. The anchoring point is not necessarily given but assessors may also create it in the process of assessing.

People will adjust their assessment based on the ways they think the assessed situation is similar or different compared to the anchor point. However this adjustment is typically insufficient and

incomplete. Even if the anchoring point is completely irrelevant for the assessment it will effect on the estimates. Anchoring acts as a heuristic ways (non-perceived mental shortcut) as well as systematic ways (use of anchor point is acknowledged). (Blankenship et al, 2008)

Anchoring affects also on how people assess probabilities of series of similar random events. People anchor their estimate around the probabilities related to a single event and adjust their estimates inadequately. This leads to systematic bias in probability estimates. (Tversky and Kahneman, 1974)

2.4.4 Contamination

Mental contamination is the process where judgement, decision or behaviour is affected in an unwanted way by unconscious or uncontrollable mental processes. The person may or may not be aware of the causes of the unwanted processes but is unable to exclude them. Examples of mental contamination include e.g. how attractive people are perceived more positively than unattractive people and how advertising affects consumer behaviour.

Mental contamination includes such phenomena as: automatic social categorisation, tendency to initially believe any propositions, halo effect (confusing liking and objective judgement), and inability to discount privileged information.

Effects of mental contamination are especially strong if it is not recognised. But even if one recognises mental contamination and takes steps to avoid or correct its effects it is possible that a person will be affected. (Wilson and Brekke, 1994)

2.4.5 Overconfidence

People are typically very confident about their judgements. In reality judgements can be widely off the mark even if person making judgement has strong confidence on it. In other words people don’t know how little they know. A typical way how overconfidence is seen is the way how confidence intervals are estimated. Experts are as prone to over confidence as laypeople. (Slovic, 2000, pp. 109-110) Overconfidence may have great impact on risk management especially if risk management methods require estimation of confidence intervals or other similar ranges.

2.4.6 Planning fallacy

People systematically underestimate the time and effort in their undertakings and overestimate probabilities of success. When people assess themselves they tend to focus too much on plan and

plan-related future scenarios. They systematically deny the relevance of past experience and past failures. The effect is similar regardless people estimate their prospects in their private life or in their work.

When people assess other people the bias is turned upside down. People tend to focus too much on the issues that could impede the plan. Estimates of other people are thus systematically biases in the negative direction. (Buehler et al., 1995)

2.4.7 Affect heuristic

Affect heuristic is strongly related to the psychometric paradigm described in the chapter 2.3. People rely on affection when they judge risks and benefits. There is an inverse relationship between individuals' perception on risks and benefits.

People do not judge risks and benefits individually but base their judgements on a common source, positive and negative images and feelings towards the issue at hand. People judge issues that they perceive beneficial to be less risky than issues that they see less beneficial. It also follows that if people change their perception on risk regarding a certain issue they also change their perception on related benefits to other direction and vice versa. (Finucane et al, 2000)

2.5 Implications for the risk culture model

Individual perception of risk is one of the main themes in the risk culture model. The presented areas have major roles in the model presented in this thesis. At the most general level the risk management efforts are dependent how people understand the concept of risk (chapter 2.1). How risk is understood, how it is communicated and how it appears in formal texts and everyday discussions are all part of risk culture. A group that sees risk as variation and potentially good or bad thing will act differently that a group that sees risk as a hazard and threat.

Chapters 2.2 and 2.3 describe two different theories about how people see risks and why smart and rational people may still disagree strongly about risk-related issues. The theories remind about limitations of rationality. They propose that there are several different ways to see risks (i.e. risk culture types) and that they can and do co-exist in any larger group.

Chapter 2.4 present different perspective to the limitations of human rationality. Depending on the organisational culture, structures and processes organisations can be more or less susceptible and more or less aware about the potential effects and distortions.

3 ORGANISATIONAL ASPECTS

Risk management is usually an organisational effort. This chapter focuses on organisational aspects that have influence on risk management and are important from the risk culture perspective. The presented areas are overlapping but perspectives are different. In the chapter 3.1 organisation culture is discussed at length. Four well known theories are presented in the chapters 3.1.1-3.1.4. Organisational culture metaphors are discussed in chapter 3.1.5. The chapter 0 focuses on decision making.

3.1 Organisational culture

Numerous books have been written about organisational culture, cultural differences and ways to manage and change culture. There is little doubt that cultural aspects have significant impact on work, performance and ultimate success or failure of organisations. But in many cases the definition of culture is missing or left vary vague. In literature the term culture can be mean more or less anything. One of the basic questions is whether organisational culture is something an organisation *has* or something it *is*. This distinction has profound impact on how culture is seen will the focus be on managing and changing or on understanding culture. In the following chapters four different perspectives and definitions are reviewed. In addition eight metaphors for organisational culture are discussed briefly.

3.1.1 Shared Values and Assumptions

One of the most influential definitions of organisation culture has been presented by Edgar H Schein. He defines culture as: "*a pattern of shared basic assumptions learned by a group as it solves its problems of external adaption and internal integration, which has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems*". (Schein, 2010, p. 18) He proposes that any group with enough shared history enabling developing of shared assumptions will develop a culture. There are no geographical or physical limitations.

3.1.1.1 The three levels of culture

Schein's model of organisational culture is based on three levels (ibid., pp. 23-33):

- The level of Artifacts includes all one can see, hear and feel such as: architecture and physical environment, language and jargon, style, observed behaviour and display of emotions, myths and stories about the organisation, stated values and observable rituals.
- The level of espoused beliefs and values includes ideals, goals, values, ideologies and rationalisations. This level is used as a way to depict culture to others and within the group.
- The level of underlying assumptions include the assumptions that are unconscious and taken-for-granted. This is the deepest level and it determines behaviour, perception, and feelings.

The level of artefacts is easy to observe but difficult to decipher. This level can be seen as manifestation of the two underlying levels. Even if the level of artifacts has some important symbols reflecting the whole culture its actual meaning and importance is difficult to understand if one does understand the underlying values and assumptions. (ibid., pp. 23-25)

The level of espoused beliefs and values concern beliefs about what works and what is good. Solutions, explanations and proposals become espoused beliefs and values as they are tested and perceived to work either via empirical data or social validation. The espoused values and beliefs provide meaning and comfort to the group. The espoused values are conscious and they can be explicitly stated. (ibid., pp. 25-27)

The level of underlying assumptions is about what is taken for granted, what is the truth and what is non-debatable. The basic assumptions are formed by repeatedly implementing certain beliefs and values successfully. The basic assumptions are so strong that it is inconceivable to behave in another way. The basic assumptions, once formed, are extremely difficult to change. People try to explain events in such way that they will be aligned with their basic assumptions even if a clear contradiction exists. (ibid., pp. 27-32)

3.1.1.2 The main dimensions of culture

The main dimensions define the content of culture, i.e. what the basic assumptions and espoused values are about. Schein presents several dimensions that can be divided into two sets. The first set of dimensions consider very profound, even philosophical, areas such as what is reality and how it is defined, what is truth and what passes for information, how time and space are understood and basic assumptions about human nature, human activity and relationships between people.

The second set covers somewhat more mundane perspectives of assumptions about external adaptation and internal integration. The dimension of external adaptation covers topics such as mission, strategy, goals, means and measurement. The dimension of internal integration covers areas of common language, defining group boundaries, distribution of power and status, norms of trust and friendship, allocating rewards and punishment and explaining the unexplainable. (ibid., p. 70)

3.1.1.3 Creating, maintaining and changing culture

Schein proposes that founders and initial leaders of a group have profound effect on forming of culture. Influences that create culture of a group come from three main sources: beliefs, values and assumptions of founders of the group, learning experience of group members as the group evolves, and new beliefs, values and assumptions brought in by new group members. The most important of these sources is beliefs and values of the founders. (ibid., pp. 219-233)

After the culture has been formed there are several mechanisms that embed the culture into the organisation. These focus on what leaders focus and pay attention to, how they react to different situations, how and to whom rewards and status are given and how resources are allocated. The effects depend on the actual behaviour and they may send a different message than leaders are intending. Mechanisms such as organisational structure, rites, physical design and formal statements work only as a reinforcement. (ibid., pp. 236-258)

After culture has been established it becomes increasingly difficult to change or manage it. Changing a mature culture is typically painful process to members of a group and the change is resisted. Often radical change affecting the underlying assumptions needs to be initiated by a dramatic event or crisis. A change requires process of unfreezing, changing and freezing of the culture. A change is nevertheless possible and it can be managed. (ibid., pp. 274-296)

3.1.2 Software of the mind

Geert Hofstede's theory of cultural dimensions is based on his extensive work with international companies, especially with IBM. His theory of culture is strongly focused on national and ethnic cultures. Organisational culture is just a one of the areas that the theory can be used.

3.1.2.1 Values and Practices

One of the main themes of the theory is that large part of the way people act and behave is due to mental patterns of thinking, feeling and acting (i.e. mental programs or software of the mind). For a large part they are formed in the early childhood but they are developed also afterwards. Hofstede proposes that there are three levels of the mental software: basic human nature, culture, and personality. He defines culture as "*the collective programming of the mind that distinguishes the members of one group or category of people from others*". Culture is always collective and learned phenomena. (Hofstede, 2010, pp. 3-6)

Culture is presented as four layers or "skins of an onion": symbols, heroes, rituals and values. Symbols are words, objects etc. that carry a meaning that is important only to those who share a culture. Symbols are easily created, copied and lost. They form the most superficial layer of culture. Heroes are persons that have characteristics highly prized in the culture. Rituals are collective actions that are considered socially essential and thus carried for their own sake. Symbols, heroes and rituals are visible to outsider via practices. However their cultural meaning is not visible and lies in how these practices are interpreted by insiders. In the core of culture are values. They are tendencies to prefer something over something else. Values deal with paired concepts such as good versus evil or unnatural versus natural. Values are learned mostly within early childhood after learning is more and more focused on practices. (ibid., pp. 7-10)

3.1.2.2 Dimensions of national cultures

The initial theory presented four dimensions of culture that can be measured relative to other cultures. In later work two additional dimensions were added. The dimensions are:

- Power distance presents equality or inequality within a culture and describes how evenly power, authority and status are spread between individuals, how limited or strong dependence of subordinates on bosses there is. It is based on the value system of the less powerful members rather that more powerful members of culture. (ibid., pp. 60-62)
- Collectivism/Individualism represents how strong ties there are between individuals, how people are supposed to look after themselves and their family and what kind of loyalty is expected from group (e.g. family) members. (ibid., pp. 94-99)
- Femininity/Masculinity refers to traditional social gender roles: masculinity is about assertiveness, competitiveness, achievement and toughness. Femininity is about care, nurture, co-operation and security. (ibid., pp. 137-144)

- Uncertainty avoidance is about how uncertainty, risk and ambiguity are understood, handled and tolerated. Uncertainty in this context is a personal feeling creating discomfort and anxiety. Many of these feelings are cultural (i.e. learned). (ibid., pp. 188-195)
- Long term/short term orientation is related to values oriented either towards future (such as include perseverance or thrift) or to the past or present (such as respect for tradition or fulfilling social obligations). This dimension was seen to be directly related to economic growth. This dimension was not part of the initial theory. (ibid., pp. 236-239)
- Indulgence/Self-restraint is related to the concept of subjective wellbeing (or happiness). It measures whether members of culture feel that gratification of natural human desires should be restrained and regulated or gratification should be free and related to enjoying life and having fun. This dimension was not part of the initial theory. (ibid., pp. 280-286)

3.1.2.3 National culture versus organisational culture

The software of mind theory has been studied and applied in organisational context. There are certain aspects that are different in organisational and national context. National cultures are acquired during early childhood and in lesser extent later in life and they contain most of the basic values. Organisational cultures are acquired when entering an organisation, when basic values are already in place. They consist mainly practices are therefore more superficial.

Hofstede states in the core of organisational culture are not values but shared perceptions of daily practices. Values run deeper and they are not largely affected by belonging to an organisation. This conflicts with management consultant literature which focuses on values of founders and leaders of organisations. The focus of Hofstede is on the ordinary members whose (supposed) task is to carry organisational culture. He states that in effect values of the founders and leaders become shared practices of the ordinary members. (ibid., pp. 346-348)

The values have important role in selecting new members into an organisation. Alignment in values of the people in an organisation is due to hiring process as organisations tend to hire people who represent values of the organisation. The socialisation process after hiring is about learning practices. (ibid., p. 349)

3.1.2.4 Dimensions in organisational cultures

Hofstede concludes that the dimensions used to measure culture on the national level are not appropriate for measuring organisational cultures within same national culture. Instead six other dimensions should be used. These dimensions differ from national dimensions in such way that they are more focused on practices than underlying values. Each of dimensions is neutral and there are no good or bad sides in any of the dimensions. The six dimensions are:

- Process oriented/results oriented. Process oriented cultures perceive that they avoid risk, spend only limited effort in their tasks and see that every day is the same. Result oriented cultures perceive that they are comfortable with unfamiliar, spend maximal effort and see that every day is different. (ibid., pp. 355-356)
- Employee oriented/job oriented. In employee oriented cultures people feel that organisation is interested about employee welfare while in job oriented cultures people feel that employee in interested only in the work. (ibid., p. 356)
- Parochial/professional. In parochial cultures employees identify themselves mostly with the organisation. In professional cultures they identify themselves mostly with their job. (ibid., p. 356-357)
- Open system/closed system. In open cultures people feel that the organisation and its people are welcoming newcomers and outsiders. Only a very short time and effort is needed to fit in. In closed cultures people feel that organisation is closed and secretive. Only selected people will fit it. (ibid., p. 357)
- Loose control/tight control. In cultures of loose control costs are not seen as an important issue, meeting times are flexible and people joke about their job and company. In cultures of tight control people are highly cost-conscious, punctual and jokes about job or company are rare. (ibid., p. 357-358)
- Normative/pragmatic. Normative cultures emphasise following organisational procedures and having high standards on business ethics and honesty. Pragmatic cultures are market driven, emphasise customer needs and have pragmatic attitude towards business ethics (ibid., p. 358)

Based on these six dimensions Hofstede identified three broad subcultures: professional, administrative and customer interface subcultures. The groups are clearly distinct are there are several culture gaps between the subcultures. (ibid., pp. 364-366)

3.1.2.5 Managing organisational culture

Hofstede states that managing and changing organisational culture requires joint action of two parties: power holders and experts. He emphasises that it is important to understand culture(s) of an organisation from all levels not only from the top management perspective. However, managed culture change must be lead from the top. It can't be delegated.

Changing culture calls for drastic measures: structural changes such as closing departments and moving people, process changes such as changing business processes, controls, automation or communication practices, and personnel changes such as hiring and new policies. Changing culture calls for persistence. The changes should be monitored during the process of change. Hofstede concludes that cultural change can be only somewhat manageable. (ibid., pp. 371-376)

3.1.3 Culture reflecting business environment

Terrence Deal and Allen Kennedy proposed a model that states that the type of an organisational culture depends on the business environment the company is operating. They proposed a simple typology of cultures based on the degree of risk in company's activities and the speed of feedback from the markets. (Deal and Kennedy, 1982, p. 107) Benefits of a strong culture were an elemental part of the initial model. (ibid., pp. 15-16) This view has been restated in their further work related to the model although with some reservations (Deal and Kennedy, 1999, pp. 24-25).

Deal and Kennedy use an dictionary definition of organisational culture: *culture is "the integrated pattern of human behaviour that includes thought, speech, action, and artifacts and depends on man's capacity for learning and transmitting knowledge to succeeding generations*." (Deal and Kennedy, 1982, p. 4).

Culture is based on four levels: values, heroes, rites and rituals, and cultural network. Values are the basic concepts and beliefs that define success and establish standard for achievement. Heroes are people that personify values and provide tangible role models for employees to follow. Rites and rituals are systematic routines of everyday life. They show what kind of behaviour is expected. Cultural network is informal communication network that carries values and myths and stories about heroes. It is essential for getting things done in an organisation. (ibid., pp. 13-15)

3.1.3.1 Risk and feedback – four culture types

Deal and Kennedy present a simple typology that is based on two dimensions: how much risk is associated with the activities of a company and speed of feedback that the company and its employees receive from the markets. Using these two dimensions they present four cultural types.

The tough-guy, macho culture represents culture where individuals take high risks and get quick feedback whether they are right or wrong. This culture type is associated to quick decisions and ability to stomach high risks: culture is typical in industries where successful risk taking may create fortunes almost overnight: e.g. venture capital, entertainment, and professional sports. Focus is excessively on the short-term performance at the expense of long term development and learning. The culture extremely competitive and it creates stars which may last only a short time. (ibid., pp. 108-113)

Work hard/play hard is related to low risk environments where people get quick feedback. This culture type is associated to industries where action is essential and focus is on customer needs: e.g. sales and manufacturing. Success of members of work hard/play hard culture is measured in volume. Focus on volume is a strength but also a weakness as volume may come at the expense of quality. Initially this type of culture was strongly connected to aspect of fun and commitment. (ibid., pp.113-116) In their further work Deal and Kennedy observe that focus has moved away from the play hard aspect and more towards the work hard aspect. (Deal and Kennedy, 1999, p. 15).

Bet-your-company cultures are associated with high risk and slow feedback. Companies need to make high stakes commitments that will prove to be right or wrong only long time afterwards. Sometimes the high stakes may mean betting the whole company. This culture is typical in industries where high upfront commitments are required to bring uncertain benefits in the future: e.g. oil drilling and aerospace manufacturing. These cultures are characterised by deliberateness and planning. Expertise and experience is valued. They focus mostly on the long term. (Deal and Kennedy, 1982, pp. 116-119). In their further work Deal and Kennedy observe the long-term vision of bet-your-company cultures has eroded since the early 1980s (Deal and Kennedy, 1999, p. 15).

The last type is the low risk and low feedback type: the process culture. This culture is related to large institutions and regulations. Typical areas include banks, insurance, utilities, pharmaceutics

and governmental organisations. People take little risk but receive little or no feedback on effectiveness or impact of their actions. This focus is more on internal efficiency and procedures. (Deal and Kennedy, 1982, pp. 119-123)

3.1.3.2 Management of culture

Deal and Kennedy propose that managers have important role in supporting and shaping culture. They make a distinction between symbolic managers that manage culture and value conflicts and rational managers that focus only on technical issues such as efficiency and costs. Symbolic managers lead cultures from outside: they live with the culture taking into account its characteristics but if necessary they can step outside. Good symbolic managers lead and shape culture not by forcing or fixing problems themselves but by letting the members of culture to find a solution. (ibid., pp. 141-155)

3.1.3.3 Cultural change

Deal and Kennedy state that cultural change is made by leaders. They recognise that stronger the culture harder it is to change and that leaders usually underestimate effort needed for change. An actual need for change can come either from outside or inside of a company. Successful cultural change requires at least the following: change process must be led by a hero, an outside threat must be recognised, transition rituals must have an important role in the change, new values and behaviour must be trained, outside "shamans" must be used, there must be tangible symbols of the new direction, and job security must be offered. (ibid., pp. 157-176)

3.1.4 The culture and effectiveness model

Daniel Denison has presented a framework for organisation that ties organisational aspects and effectiveness together. The model is based on four basic concepts that are both overlapping and at some parts even conflicting. His model is less comprehensive than the models of Hofstede and Schein as his focus is mostly on the effectiveness. Denison defines organisational culture as "*underlying values, beliefs and principles that serve as a foundation for an organization's management system as well as the set of management practices and behaviors that both exemplify and reinforce those basic principles*". (Denison, 1990, p. 2) He also adopts a definition that is based on the definition of Schein (among others) that describes organisational culture with four levels: artifacts, perspectives, values and assumptions. (ibid., pp. 32-33) The framework is presented in Figure 3.

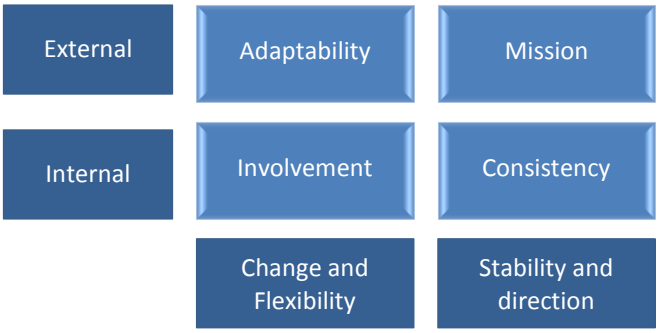

Figure 3. The culture and effectiveness model. (Denison, 1990, p.15)

3.1.4.1 Involvement

Involvement means such participation that creates sense of ownership and responsibility. Sense of ownership implies stronger commitment to organisation. (ibid., p. 7) The concept of involvement addresses internal dynamics of an organisation and it is seen to help in change and provide flexibility. (ibid., p. 14-15) Denison proposes that there are two kinds of involvement: spontaneous and informal kind and more formalised and planned kind. Both kinds seem to have positive connection to effectiveness. (ibid., p. 179-180)

3.1.4.2 Consistency

The consistency is related to having shared system of beliefs, values and symbols widely understood by the members of culture. High consistency is related to the concept of strong culture that was much used and praised by the early organisational culture texts. It is proposed that high consistency has positive connection to effectiveness. But this holds only if the shared values and beliefs are aligned with actual practices of an organisation. If there is a conflict between these the high consistency is more likely to be a burden (ibid., pp. 8-10) The concept of consistency addresses internal dynamics of an organisation and it is seen to provide stability and direction. (ibid., p. 14-15) There are several different kinds of consistency: conformity between ideology and practices, consistency in the system of control, consistent bureaucracy and conformity in style and appearance (ibid., pp. 180-182)

3.1.4.3 Mission

The concept of mission means shared definition of the function and purpose of the organisation. The mission provides purpose and meaning, a clear direction and goals to an organisation and its

members. It convinces individuals that success is more likely. The concept of mission addresses external dynamics of an organisation and it is seen to provide stability and direction. (ibid., p. 13-15) If the mission of an organisation is questioned it may lead to a crisis. (ibid., p. 184)

3.1.4.4 Adaptability

Adaptability has three aspects: ability to respond to external pressures, ability to respond to changes in internal demands and ability to restructure processes and behaviours that enable an organisation to adapt to changes external and internal demands. (ibid., p. 12) The concept of adaptability addresses external dynamics of an organisation and it is seen to help in change and provide flexibility. (ibid., p. 14-15)

3.1.4.5 Effectiveness

Denison states that the four dimensions can be seen as causes that lead to the effect that is effectiveness. Effectiveness can be viewed from three different perspectives: fulfilling stakeholder needs, reaching one's goals, and effectiveness of a decision making process. (ibid., pp. 35-37) Effectiveness is correlated with performing well in all of the four dimensions of the framework. (ibid., p. 176)

3.1.4.6 Cultural change

Denison argues that cultural changes are responses to changes in the business environment. Change happened only if belief for the need to change becomes widely accepted in the company. Cultural change can't be dictated and usually it requires changes in top management. Existing cultures have huge inertia and attempts to manage controlled cultural changes will fail. However, cultures have significant capacity to change if long enough period of time is observed. (ibid., pp. 189-190)

3.1.5 Organisational culture as a metaphor

Mats Alvesson (2002) describes eight different metaphors for organisational culture. In general metaphors can be seen as illustrative devices or as ways how people relate to reality. Thus metaphors of organisational culture are not only ways how people describe organisations but also ways how people understand and explain organisational life. The eight metaphors are briefly discussed in the following sections.

3.1.5.1 Culture as exchange-regulator

Culture is explained as a control mechanism. Culture helps the participants to act in complex exchange situations by reducing risk of opportunistic behaviour without explicit control mechanisms. Culture acts as an implicit control mechanism providing participants with memory which helps to evaluate what is perceived as fair reward and what is deemed to be in the best interests of the participants. Culture has specific and positive function. (Alvesson, 2002, p. 31)

3.1.5.2 Culture as compass

As a compass culture is able to direct an organisation towards a right direction. The value system of an organisation provides guidance for goals, policies and strategies. Right values act similar to a correctly functioning compass: they guide a company towards the direction it wants to go. Wrong values act like a defective compass: they guide towards a wrong direction. (ibid., p. 32)

3.1.5.3 Culture as social glue

In this metaphor culture provides the informal and non-structural means, namely shared values, beliefs and norms, that keep organisations integrated and help to control them. Culture helps to achieve harmony and consensus and to avoid fragmentation and conflict. Culture is either seen as something that ensures that consensus is gained naturally over time or it is a tool for management to actively create cohesion and loyalty. (ibid., pp. 32-33)

3.1.5.4 Culture as sacred cow

The sacred cow metaphor focuses on the deeper level of underlying values and assumptions that make up the core of culture. These values or assumptions are “sacred” in a sense that members of a culture are deeply committed to them, they are taken for granted and they are nearly impossible to change. This metaphor emphasises limits of rationality and stability of the cultural core. (ibid., p. 33)

3.1.5.5 Culture as affect-regulator

This view stresses the way how culture controls emotions of employees. Corporate socio-affective bonds are seen as a core dimension of organisational life. Culture is seen as a control device for emotions of members of an organisation. Culture can be an explicit tool for management to set rules for expressing emotions. (ibid., pp. 33-34)

3.1.5.6 Culture as disorder

Culture can also be seen to create disorder, confusion and lack of clarity. This view is contradictory to most other views that equate culture as order or see it as a way to create order. This view emphasises non-systematic, fluid and contradictory character of culture. (ibid., p. 34)

3.1.5.7 Culture as blinders

The blinder metaphor argues that culture works as subconscious level. The culture works as blinders and forces its members to see the world from certain perspective leading to blind spots. Culture may also protect leaders from values and opinions that would challenge their worldview. This means also that leaders and managers are not able hear alternative ideas to current consensus. (ibid., p. 35)

3.1.5.8 Culture as world-closure

This metaphor assumes that culture makes certain questions or topics to be non-negotiable, natural and impossible to change. This is achieved by tradition or other impersonal forces or by influence of leaders or other powerful actors. Thus culture creates a selective and biased worldview. This metaphor assumes that top management is somehow removed or above organisational culture. (ibid., pp. 35-36)

3.1.6 Overview and comparison

The four models for organisational culture are compared in this section. The main aspects the four models are summarised in the tables on pages 43-44. These aspects are deemed to be important especially from the risk culture perspective.

Table 1. Definition of culture and cultural levels.

	Definition of culture	Cultural levels
Schein	Pattern of shared assumptions ad values	Assumptions Values and beliefs Artifacts
Hofstede	Collective programming that distinguishes one group from another	Values Rituals Heroes Symbols
Deal and Kennedy	The integrated pattern of human behaviour	Values Heroes Rites and rituals Cultural network
Denison	Underlying values, beliefs and principles and set of management practices and behaviours	Assumptions Values Perspectives Artifacts

Table 2. Cultural dimensions.

	Cultural levels	
Schein	Reality and truth Time Space Human nature External adaptation Internal integration	
Hofstede	**National culture:** Power distance Collectivism/Individualism Femininity/Masculinity Uncertainty avoidance Long/short term orientation Indulgence/Self-restraint	**Organisational culture:** Process/results oriented Employee/job oriented Parochial/professional Open/closed system Loose/tight control Normative/pragmatic
Deal and Kennedy	Risk related to operations Feedback from the marketplace	
Denison	Involvement Consistency Adaptability Mission	

Table 3. Creation of culture and cultural change.

	Creation of culture	Cultural change
Schein	Creation of a new culture is based on: 1) Beliefs, values and assumptions of founders of the group 2) Learning experience of group members as the group evolves and new beliefs 3) Values and assumptions brought in by new group members.	Changing culture is typically painful process. Often a dramatic event or crisis is required. A change requires process of unfreezing, changing and freezing of the culture.
Hofstede	Values are acquired mostly during the early childhood. Organisational cultures consist mostly practices that reflect values of founders and leaders.	Changing culture requires structural changes, process changes and personnel changes. Changing culture calls for persistence. Cultural change is only somewhat manageable
Deal and Kennedy	Creation of culture is not discussed.	Cultural change is initiated and managed by the top management. Change must be led by a corporate hero.
Denison	Creation of culture is not discussed.	Change requires changes in external demands. Managed controlled change is not likely to be successful. Organisations' capacity to change is huge.

Table 4. How culture is related to management and risk.

	Relationship to management	Relationship to risk
Schein	Leaders create, manage and change culture.	Basic assumptions and beliefs define how risk is understood and ultimately managed.
Hofstede	Culture is seen and evaluated mostly from the perspective of ordinary members of a group.	The dimension of uncertainty avoidance has clear connection to how risks are understood. The dimension open/closed system correlates with uncertainty avoidance dimension.
Deal and Kennedy	Managers lead and shape culture from outside. They are not part of the culture but external observators.	Risk is inherent part of the model. One of the two main dimensions in the cultural typology is risk related to operations.
Denison	Right culture is important for organisational efficiency. Controlled change can't be managed.	Risk is not explicitly referred. All of the dimensions relate to the way risks are understood and managed.

3.2 Decision making

Decision making refers to the process of identifying and analysing potential choices and as well as to selection of choices that are pursued. Decision making produces (more or less) identifiable outcomes. Many decisions are made unconsciously but especially in organisational settings decisions conscious and at least some are formal. The following chapters focus on more conscious and formal decisions. Decision making is cognitive, emotional and social process. All of these aspects influence the decision making process and actual decisions. Decision making processes and methods are influenced by the organisational culture.

Decision making can be explained in multitude of ways. The way decision making is described and understood influences how decision making is seen and what kind of role formal decision making has.

3.2.1 Decision making as a process

Decision making can be seen as an identifiable process or as an activity. The traditional way to describe decision making (going back to Plato and Aristotle) is to state it as purely cognitive and identifiable process. All decisions can be reduced to logical and consistent choices. It is assumed that different options can be identified and that decisions are discrete events. This view describes decision making ultimately as an individual process. Even though this view criticised to be psychologically unrealistic it is used in many decision support tools and methods. (Cook et al., 2007, pp. 3-4).

The traditional way to describe decision making is to compare it to gambling. The decision situations are formulated to involve bets and payoffs that have some objective or subjective probability. A decision maker estimates expected payoff of each potential decision-chain and acts accordingly. This is common approach in decision making textbooks (e.g. Baird, 1989, Ríos, 1994, Raynard et al., 1997). This was also the approach that e.g. Kahneman and Tversky (1979) assumed in their seminal work regarding loss aversion.

To understand real life decision making complex models are needed. Real life decision makers are not always rational (chapters 2.2-2.4) and they may have hidden agendas. Understanding and accepting human "non-linearity" is vital for effective and efficient decision making.

3.2.2 Decision making as an activity

More complex and realistic view is to see decision making as an activity. This view assumes that decisions are not necessary discrete events but something that happen along the way. It is also assumed that choices may not be very distinctive or easy to distinguish and even if they are it is often not possible to assess all possible options. Thus decision making is seen as activity that produces decisions but it is not easy to determine when actual decisions are made. This view focuses more on the way how decisions are made instead of what is being done. (Cook et al., 2007, pp. 5-11). Several decision-making-as-an-activity theories are discussed below.

The recognition-primed decision theory proposes that a decision maker seeks to connect a decision with previous decisions and experiences. The decision maker tries to recognise similarities between the current situation and previous situations and to use a solution that was has been successful in the past. He or she performs mental simulations about how well the previous solutions might work. The solution is modified iteratively until it is satisfactory. Thus the decision maker does not copy old solutions but uses them as a starting point. (Beach and Connolly, 1994, pp. 138-141)

The narrative theories suggest that a decision maker makes a mental model about the situation at hand and potential outcomes. Models can be described as scenarios or stories. They are plausible alternatives for future from the perspective of the decision maker. The alternatives and thus the outcome of the decision depend strongly on the perspective of the decision maker. (ibid., pp. 142-144)

Incremental theories suggest that decision making process can be either a series of small experiments or a large one-off decision. In incremental situations decision making and decision implementation are intertwined to a single continuous process. Feedback has significant role in incremental decision making and goals and assumptions may change during the process. (ibid., pp. 151-153)

Moral and ethical theories propose that morals, beliefs and values of decision makers have great impact on decisions. Thus there can't be a purely rational decision maker. The decision maker takes three aspects into account when making decisions: 1) utilitarian aspects, 2) social aspects based on the norms of the society, and 3) deontological aspects based on the beliefs and values of the decision maker. (ibid., pp. 154-155)

The image theory assumes that decision makers use three categories of knowledge (images) to make decisions: 1) knowledge about beliefs and values, 2) knowledge about desirable future, and 3) knowledge about plans to reach desirable future. The decision maker uses the knowledge either to decide whether he or she should adopt new goals or plans (adoption decisions) or to assess whether his or her actions are effective to achieve the goals (progress decisions). (ibid., pp. 160-169)

3.2.3 Decision making in groups

In many organisational settings decisions are made in groups. Group decision making makes thing more complicated as in most situations people making a decision do not have the same information available. This means that everybody has slightly different perception of the decision. Most organisational decisions are ill defined and all options are not clear for everybody. In addition organisational decisions are affected by internal politics, power struggles and personal aspirations of each participant. Thus organisational decision making processes can be very complex. (ibid., p. 124)

There are two basic group decision making situations: non-cooperative and cooperative situations. In the non-cooperative situation the group members are competing and there may be disputes and conflicts between them. In the cooperative situations members of group seek to achieve a common goal. (Lu et al., pp. 39-42) From the risk management perspective the cooperative situations are more common even though the both situations can be relevant.

A single decision maker can base his or her decision on rules or algorithms. A group decision is always more complex. Even in cooperative situations group decision making involves conflict of interests and different opinions. Group decisions are typically made based on simple methods, such as authority (leader decides), majority rule, ranking rules and consensus. (ibid. pp. 46-48)

It is not obvious that groups make better (or worse) decisions than individuals. The group decisions have potential to be better than individual decisions but there are many pitfalls that can reduce the quality of group decisions. Many groups are designed to be satisficing entities (i.e. seeking good enough solutions instead of optimal). Groups tend to favour cohesion: more extreme (i.e. far from group mean) views tend get less attention than views that are closer to mean. (Kerr and Tindale, 2004)

Information that is not shared by most of the groups is not weighted as much as information that is widely shared. This may lead to too early and suboptimal decisions based on information that is shared by most of the group. Having shared information increases a group member's influence in a group: having much shared information increases likelihood of one's less shared opinions to be accepted. (ibid.)

Some studies have shown that group decisions are more inconsistent and varying than individual decisions. This is seen especially is groups participants are allowed to discuss to find common decision. The research suggests that groups function better when the members share the same ideas about the task of the group and roles of its members. (ibid.)

Models of organisational decision making

Below six different decision making models presented by Langley et al. (1995) are reviewed. The first three are simpler models while the last three are more refined and realistic. The six models cover the whole spectrum from fully rationalistic to complete anarchy.

3.2.3.1 Sequential model

The sequential model represents the traditional model of decision making as a well ordered, sequential process. In the first step of the process information is organised in to provide a diagnosis of the issue at hand. In the second step alternate choices for the decision are developed. Finally in the last step the best alternative is selected. It is assumed that the process proceed steadily, like a machine. (ibid.)

3.2.3.2 Anarchial model

The anarchial model represents the opposite to the sequential model. This model assumes that decisions appear tangentially from a metaphorical vortex without no clear structure or process. The best known metaphor the anarchical model is a garbage can: in an organisation problems and solutions are disconnected and problems, solutions and decisions are mixed like in a garbage can. (ibid.)

3.2.3.3 Iterative model

The iterative model is somewhere between the two extremes. The basis of decisions making is seen to be generally sequential but dynamic factors such as organisational politics or environmental effects are taken into account. Decision makers make effort to keep decision

making sequential but dynamic pressures push decision making into new tracks. Depending on the magnitude of dynamic effects decision making may seem sequential, anarchic or something in between. (ibid.)

3.2.3.4 Convergent model

The first three models assume that decisions happen in a given point of time. The convergent model does not make this assumption but assumes that decision making follows a trajectory. Decisions are not made in a single point or even in a stepwise manner. Instead, decision making is a process where decision makers converge toward the selected choice over time. A formal decision, if such is made, is often only an artificial construct. (ibid.)

3.2.3.5 Insightful model

The insightful model builds on the convergent model. It is assumed that decisions follow trajectories over time instead of being discrete events. However the influence of individuals is emphasised in the form of insights, inspiration and memory. This implies that while the decision making process is convergent it does not converge steadily. There can be stepwise progress caused by insights. (ibid.)

3.2.3.6 Interwoven model

The intewoven model of decision making sees decision making as a network of issues with complex linkages. These linkages may be sequential (e.g. one decision leads to another), lateral (e.g. competing resources) or precursive (e.g. one decision influences choices related to another decision). The decision making process is seen as a stream where several issues float constantly changing. The network assumption differs from traditional decision making models which typically assume that decisions are made in isolation. (ibid.)

3.2.4 Decision making and risk

Risk is has important role in most decisions. Associated risks influence desirability of each potential choice. The term risk has typically negative connotations even though risk is elemental part of decision making. More than actual risks decision making is influenced by perception of risks (chapter 2). In general decision making attempts to improve level of certainty. (Cook et al., 2007, 78-89)

The context and focus of a decision process affects how different risks are perceived. Perception of different risks depends on whether they are focused or not, how well they fit in the perceived past and present reality, and how convincingly they can be described. Also hopes and goals related to decision choices influence how risks are assessed. Hard facts such as statistical evidence may have relatively small role in decisions (Teigen and Brun, 1997)

Formal risk management and formal decision making have a strong connection. Failure to take risks into account leads more likely to suboptimal decisions. Risk management is more or less pointless unless it is not used decision making. Most decisions have uncertainties and risky aspects even if they not always acknowledged. Therefore to understand risk management it is necessary to understand decision making. This chapter discusses some of the most important aspects of decision making. Heuristics, phenomena strongly connected to decision making are discussed in the chapter 2.4.

3.2.5 Psychological aspects of decision making

3.2.5.1 Framing

Framing means setting observed events and issues into a context that has meaning to an observer. Same situation can be seen in many different ways. The selected perspective, or frame, has impact on how the situation is interpreted and perceived. Thus framing of a decision may have a profound impact on the outcome of the decision

If an existing frame is challenged people are quick to adjust or replace their frames. In social situations (such as most organisational decisions) people seek to understand the frames of other people. People with shared experience tend to frame situations in similar way. (Beach and Connolly pp. 15-29)

3.2.5.2 Involvement

Importance of a decision and motivation of a decision maker influence how strongly he or she is involved in decision making. Level of involvement affects decision making. All involvement are not similar. Instead three different types of involvement have been identified: value-relevant involvement, impression-relevant involvement, and outcome-relevant involvement. These are related, respectively, to whether the decision represents values important to the decision maker, it is perceived important to participate into the decision, and whether the outcome is important to the decision maker.

Different types of involvement drive different behaviour: e.g. value-relevant involvement leads to seeking of choices that support one's values whereas impression-relevant involvement leads to selection of choices that are known to be perceived positively. Outcome-relevant involvement supports objective assessment of choices whereas the two other types are connected to more subjective positions. (Verplanken and Svenson, 1997)

3.2.5.3 Compatibility

Compatibility refers to similarity and compatibility of input and output of decision situation. People act differently if input and output are compatible compared to a situation when they are not. Compatibility influences also on heuristics and biases that people use (chapter 2.4). Two different effects influence how people structure decisions: task effects relate to issues such as general structure of the decision, used parameters, time constraints etc. whereas context effects relate to issues such as content of the decision.

Structure of a decision and how different items are understood as inputs and outputs influence how decisions are made. Compatibility of input and output influences on what kind of decision strategy is chosen. The selected strategy has impact on evaluation of potential choices, actual decision and judgment of the outcome. (Selart, 1997)

3.2.5.4 Emotions

Decision making is not purely logical and rational process. Emotions have strong influence on how people approach decisions and what is outcome of decision process. This chapter has strong connection to the psychometric paradigm discussed in the chapter 2.3.

Mood can have a marked effect on how decisions are made. Even slightly positive mood can have substantial positive effect on creativity and ability to perform complex tasks. Positive mood makes people also more loss aversive. (Beach and Connolly, 1994, pp. 99-100) When people are in positive mood they are more likely to rely on their gut feeling and to use simplifying heuristics. Negative mood may cause decision makers to stick more to formal methods and procedures. (Elsbach and Barr, 1999)

Regret and disappointment are the most studied emotions in decision making. People feel regret both when a decision turns out badly but also before anything has happened as they know that something bad may happen. People shape their decisions to avoid regret. The magnitude of regret that people feel is strongly dependent on whether they have taken active steps to achieve a

state that produces a loss (e.g. buying a share) or have been inactive (e.g. keeping a share that has been owned for a long time). Whether it is action or inaction that causes larger regret (when comparing similar losses) depends on the situation. Less regret is experienced if a losing decision was seen to be justifiable. (Beach and Connolly, 1994, pp. 101-102)

3.3 Implications for the risk culture model

The organisational aspects discussed in the previous chapter all shape risk culture. Organisational culture (chapter 3.1) influences more or less everything that is done in an organisation. It can be debated whether risk culture is part of organisational culture or organisational culture is part of risk culture. Organisational culture is without doubt broader concept than risk culture. However it can be argued that only part of organisational culture influences risk management. Thus the latter perspective is adopted in the model in this thesis and organisational culture is seen as something that influences risk culture.

Decisions define ultimately whether risk management and especially operative risk management is successful. If operative risk management does not lead to right decisions is can't be successful no matter how sophisticated and accurate it is. Thus it is important how decisions are made and who makes them (chapter 0). Whether decision making processes are collective or authoritative or analytic or fast have very different risk management implications. Decision making is deemed to be such an important aspect in risk culture that is emphasised in the risk culture model by its own layer (Figure 7).

4 RISK CULTURE MODEL

The main goals of this thesis are to define the concept of risk culture, to propose a model of risk culture that helps to understand the concept, and use the model in development of risk management practices. A model or theory can be formative (i.e. telling how things should be done) or descriptive (i.e. telling how things are done). Both perspectives can be useful for academic and management purposes.

The IRM model that acted as one of the main motivators for this thesis is clearly a formative model. Its aim is to define a good risk culture and to describe how organisations should act to improve their risk management. In this work a descriptive model is presented. A descriptive model will help to understand to understand the complex and multidimensional concepts of risk and culture. A descriptive model will also help to study implications of one of the main propositions of this thesis: there is no single best risk culture.

4.1 IRM model

Institute of Risk Management has published a formative model which defines risk culture, describes ways to measure it and states eight areas that are important for a good risk culture. It seeks to "*provide advice to organisations wanting greater understanding of their own risk cultures and to give them some practical tools that they can then use to drive change*." (IRM, 2012, p. 3). It is one of the first attempts to describe this extensive and important concept in a single model. Risk culture is defined as an organisation's or group's approach to risk. This approach both influences and is influenced by methods and techniques used to manage risks. (ibid., p. 17).

The IRM model presents risk culture as five connected layers of a onion-like system. The four inner layers are: personal predisposition to risk, personal ethics, behaviours and organisational culture. The four inner layers influence the fifth layer, risk culture. The model is displayed in the Figure 4. (ibid., p. 17) The first three layers are more connected to an individual and the last two layers are related to organisations.

Figure 4. IRM risk culture framework. (IRM, 2012, p.17)

The main theories that are behind the IRM model of risk culture are Cultural theory of risk (discussed in the chapter 2.2), Double S model by Goffee and Jones and work-value model by Gilles Spony. The double-S model describes an organisation as a collective based on two dimensions: sociability and solidarity. The solidarity dimension is related to common tasks, shared goals and mutual benefits. The sociability dimension is related to high people focus and how well people get on together. Based on these two dimensions four types of organisations are defined: fragmented, mercenary, networked and communal. (ibid., p. 24) The work-value model is a model that describes cultural aspects both on organisational and individual level. The model is constructed around four dimensions or work-value scales: self-enhancement, individual dynamics, consideration for others, and group dynamics. (Spony, 2003).

The aim of the IRM model is to be very practical and easy to apply. A major part of the model is related to tools and methods that can be used to measure different aspects of risk culture and ways how change culture towards "best practices".

4.1.1 Individual level

The individual level of the IRM model covers three areas: personal predisposition to risk, personal ethics and behaviour. Personal disposition to risk is presented using two dimensions, risk tolerance and how analytical or structured approach one has towards risk. On a practical

level the issue is approached by using a commercial method called Risk Type Compass. The method groups people to nine different risk types. Using the Risk Type Compass one can study personal disposition to risk at individual and group level. (IRM, 2012, pp. 28-31)

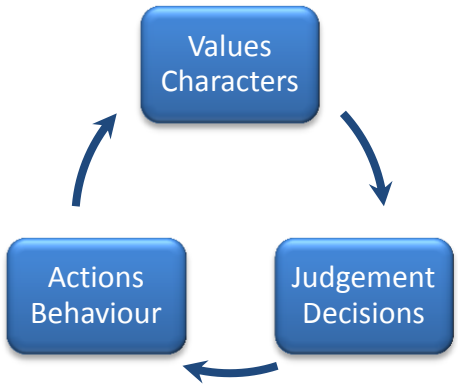

Figure 5. Character, judgement and behaviour flow model. (IRM, 2012, p. 34)

Personal ethics and behaviour are explained using a character, judgement, behaviour flow model shown in Figure 5. The model states that actions and behaviours are derived from judgements. Judgements themselves are determined by individual character, experiences and moral values. These are influenced by actions and behaviour. On practical level the model uses a commercial tool called MoralDNA. It measures how individuals emphasise different values such as courage or wisdom. These values are connected to three different ethics: ethic obedience, ethic of care and ethic of reason. (ibid., pp. 34-38)

4.1.2 Organisational level

The IRM risk culture has two major perspectives of organisational level: double-S, or sociability-solidarity model and concept of cultural cycles. The double-S model divides organisations to four groups depending on their level of sociability and solidarity: fragmented (low on both), mercenary (high solidarity, low sociability), networked (low solidarity, high sociability) and communal (high on both). (ibid., pp. 24) It is stated that from the perspective of risk management performance organisations should seek to move towards higher sociability and solidarity (i.e. towards communal type). (ibid., pp. 18)

The cultural cycles concept proposes that cultural change is connected to three cycles: professional cycle, managerial cycle and culture cycle. Successful cultural change requires that all cycles are understood and taken into account. The professional cycle is related to experience,

education, life opportunities and professions. The managerial cycle is related to ways that the business model is put into practice to fulfil selected strategic choices. The cultural cycle is related to organisational culture and cultural change. (ibid., pp.46-47)

4.1.3 IRM risk culture aspects model

The IRM risk culture aspects model is a model for good risk culture. It has four main themes, each divided into two areas. Each area is connected to either sociability or solidarity dimension of the double-S model. The model is shown in the Figure 6. It is proposed that weakness or misalignment on any of the eight areas may cause problems in risk management.

Figure 6. IRM risk culture aspects model. (IRM, 2012, p.64)

The eight areas are:

- **Risk leadership** is about having a risk vision, defining responsibility and ownership, effective communication and leading by example. Strong risk leadership requires that leaders take risks into account when creating strategy, setting objective and assessing performance of an organisation. (ibid., pp. 65-66)
- **Dealing with bad news** is connected to the way managers want to hear about risks and incidents. Good risk culture requires that reporting bad news and near misses is encouraged and need to communicate risk information is clear for the whole organisation. (ibid., p. 73)

- **Informed risk decisions** means that risk information is used in decision making at all levels. Risk decisions are not separated from other business decisions. Decision makers demand to have risk information to support decision making. (ibid., p. 68)
- **Reward** refers to connection between risk and reward. Good reward system takes risks into account especially with executive compensation. Risks, performance and results are not separated in the reward system. A good reward system help to ensure balanced risk taking within the risk appetite of an organisation. (ibid., pp. 74-76)
- **Accountability** is about knowing who's responsible for risk management guidelines, policies, and practices and management of risks. Strong accountability means that responsibilities are known, communicated and most of all lived by. (ibid., p. 67)
- **Transparency** is about having such risk management tools and methods that can be trusted, and if needed their results can be verified. Output of risk management process is challenged. (ibid., p. 70)
- **Risk resources** means that there are enough people to handle risk management related tasks and that the risk organisation and other risk experts command respect and trust. The risk functions have adequate status and authority. (ibid., p. 67)
- **Risk skills** are related to risk resources. At good level not only risk experts but also managers and other members of an organisation are able to take uncertainty into account in decision making, weigh alternative options and balance risk and reward. (ibid., pp. 79)

4.2 Descriptive model of risk culture

In this thesis a descriptive model for risk culture is presented. Risk culture is defined as *the way risk are understood and perceived in an organisation and how this is reflected in risk management and decision making*. The model is built on the theories presented in the chapters 0 and 3. The basic structure of the model is presented in this chapter. Based on the model a four dimensional typology for risk cultures is presented. The dimensions are discussed in the chapter 4.4 and the different risk culture types in the chapter 4.5.

The main reason why this thesis proposes a descriptive model instead of normative model is that a descriptive model helps to understand underlying aspects better that normative model. No assumptions are made about what is good and what is bad or what kind of culture is superior to other types. These questions are important but they should be asked only after deeper

understanding about risk culture is gained. The ultimate goal of this thesis is the same as it is in the IRM model: to improve risk management.

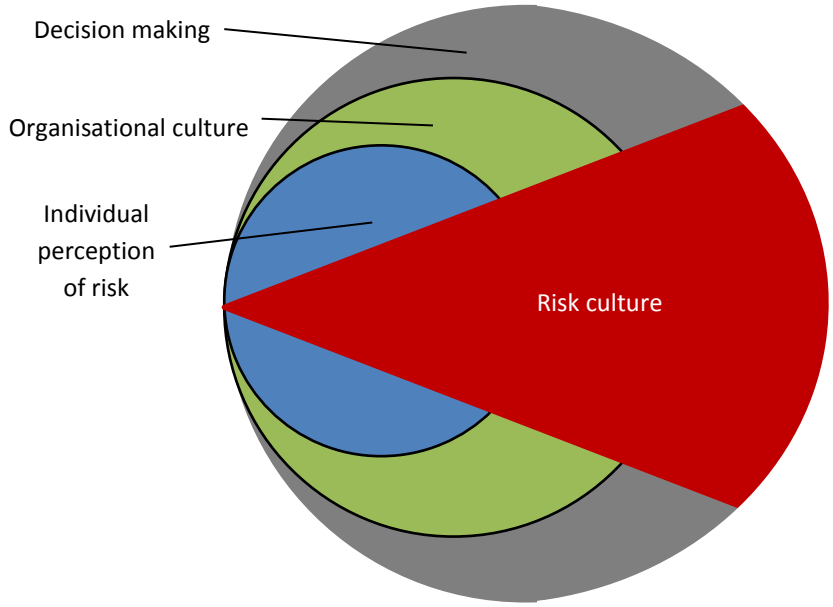

Figure 7. Descriptive model of risk culture.

The descriptive model has four main focus areas:

- Individuals perception of risk
- Organisational culture
- Decision making
- Risk culture

The selection focus areas is based on their importance in literature, on personal experience, and on numerous discussions over years with experts in risk management, finance, safety, engineering, operations, maintenance and project managers. One typical aspect of these discussions have been that even though the discussion have been loaded with risk aspects or been even solely about risks the most people do not perceive them as discussions about risks. This means that many people seem to handle uncertainties and risks at more implicit level.

The selection of individual perception of risk as a focus area is based on its importance in risk and management literature as well as on personal experience. It is clear that people do not think

or talk about risks in a same way. Even the number of different definitions points to this direction. As it shown in the chapter 2 there are influential theories that propose that people see risks in different ways. However it seems that this is commonly ignored either by ignorance or by assuming that given enough objective information everybody would see risks in the same way. It is evident that usually this not the case. Personal experience has shown that differences in risk perception can lead to bitter organisational disputes and misunderstandings. Especially if the differences between risk perception are not acknowledged (as is very often the case).

Organisational culture influences more or less everything that is done in an organisation. It is easy to see that organisations or organisational units that have different cultures (say production and trading) see and handle the same risks in very different ways. Assumptions, values and beliefs all influence how risks are understood and how risk taking is perceived. The levels of artifacts, rituals or practices are connected to the ways risks are actually managed and how they appear in the everyday discussions. The models of Deal and Kennedy and Hofstede mention risk explicitly. Thus it is assumed that organisational culture has major influence on risk culture that it should be identified as a focus area.

One can argue that decision making is part of organisational culture. It is identified as a separate focus area because it has such a large impact on how risks are managed in an organisation. Decision making practices dictate what risks are taken into account, how they are incorporated into decision making, who processes risk information and how risks are shown in the different levels of decision making hierarchy. Raising the decision making as a separate focus area also underlines the fact that almost all decisions deal with uncertainties and risky choices.

The fourth focus area is risk culture. Its meaning is to underline that there are some aspects of risk culture that do not fully fit under any other focus area. These are topics such as risk appetite and internal controls which are very important from risk management perspective and may have profound impact on risk culture.

These four areas cover majority of the aspects related to risk management. The focus areas are defined only for descriptive purposes and whether as issue belongs to one area or another bears no significance. Other that risk culture the focus areas are not risk management specific. They are important also in many other areas of organisational life and management. This is illustrated in Figure 7.

4.2.1 Individuals perception of risk

How individuals perceive risks is significant part of risk culture. People are generally loss aversive (Kahneman and Tversky 1979) but some are more aversive than others. In addition people have different attitudes towards different types of risks. Attitudes of key individuals may have notable impact on attitude of the whole organisation.

People perceive many aspects of risks (e.g. whether risk is known or unknown) in different ways (e.g. Marris et. al, 1997). E.g. experts may perceive certain "dread" risks in completely different way than non-experts. Perception of risks that an organisation faces varies from person to person, from unit to unit and from stakeholder to stakeholder. There can be huge differences between units with completely different mind-sets (e.g. R&D and marketing). The differences are potential source of misunderstandings, conflicts, and misalignment of actions.

Perception of risk is influenced also by social context and surrounding culture. The four basic cultures of the cultural theory (chapter 2.2) see risks and risk management in very different ways. All four culture types are present in all societies. The relative importance of each culture in an organisation has great impact on how risks and risk management are perceived. Different units and groups may have completely different cultures and thus they may understand risk management in very different ways.

Risk management and decision making are affected by many heuristics and biases (chapter 2.4). Quality of risk management and decisions depend on how well people are aware about these distorting effects, how willing they are to accept that everybody (instead of just everybody else) is influenced by them and what actions are taken to avoid and correct the effects.

The theory reviewed in the chapter 2 points several key aspects that are important in the individual perception of risk focus area. At least the following aspects are to be taken into account when assessing risk culture of an organisation:

- How risk is defined in different groups?
- How the perception towards risk is different between different groups?
- Are there risks that belong to some group? I.e. can one group be considered as experts while others be considered as laypeople?
- Is risk seen as something to be followed or as something to be mitigated?

- Are the decision makers and experts aware and willing to take into account the heuristics and biases that distort decision making and risk management?

4.2.2 Organisational culture

Organisational culture influences everything that is done in an organisation. Culture influences how risk is defined and understood. Perception of the leaders of an organisation may have profound effects on what part risks play in the organisation and its strategy.

Power and responsibility and trust are strongly cultural topics that are strongly related to risk management. Decisions about whose responsibility is to identify and assess risks and who use risk information have profound impact on how risks are seen and managed. Distribution of trust and responsibility affect also how risks are owned, how people commit to risk management and how risk or loss aversive people are.

Time perspective is an important factor in organisational culture. How time is perceived and is the focus of an organisation on the immediate or distant future dictates how issues are prioritised. The time focus is also connected to the way how plans are made, updated and interpreted.

Another cultural aspect that is important from risk perspective is communication. Organisational culture dictates how risks appear in organisational language, how they are discussed and how they are communicated internally and externally.

Many risks are connected to change either by being caused by changes or being an impulse for changes. How people in an organisation see change depends on organisational culture. Attitude towards change may increase certain risks and make management of others easier. Both stability and flexibility have their pros and cons from risk management perspective.

The theory reviewed in the chapter 3.1 points several important topics in the organisational culture focus area. At least the following aspects are to be taken into account when assessing risk culture of an organisation:

- How risk is understood in different organisational units? Are the definitions different? Which definition is dominant?
- Who identifies and assesses risks?
- Who uses the risk information?

- What is the time focus of the organisation?
- How risk responsibilities are distributed?
- Who owns risks and how risk ownership is perceived?
- How risks are seen in the language of the organisation and in daily discussions?
- How risks and risk-related information are communicated?
- What is attitude towards change in the organisation?

4.2.3 Decision making

Good risk management requires good decision making. In the end it is the right decisions and actions that make risk management efforts successful. How decisions are made and how risks are taken into account depend on how risks are perceived at the individual and organisational level.

Hierarchy and organisational structure influence on decision making. In some organisations decisions are made at as low level as possible and in some organisations all decisions are made at the top level. Some organisations have clear rules about who can decide what while some are more ambiguous.

The speed and flexibility of decision making vary widely between organisations. Some require very fast and flexible decision making while others prefer analytic, deliberate and structured decision making. A related issue is level of consensus required in decision making. Authoritative decision making process has very different risk implications compared to very consensus seeking process.

Attitude toward risks and risk figures has also direct connection with decision making. In some organisations decisions are made based mostly on best estimates and risk are ignored or used only qualitatively. Other organisations use only ranges or distributions and do not use base case estimates at all.

The theory reviewed in the chapter 0 points several important topics in the decision making focus area. At least the following aspects are to be taken into account when assessing risk culture of an organisation:

- At what level actual decisions are made? At what level formal decisions are made?
- Is speed or completeness preferred in decision making?
- Are the decision making processes flexible or standardised?

- Which one is preferred in decision making: consensus or efficiency?
- How risks are taken into account in decision making?
- Are the risks discussed explicitly in decision making situations?

4.2.4 Risk culture

Risk culture means the collective assumptions about nature of risk and risk management as well as the ways risks are discussed, communicated and managed. Like organisation culture (or any other culture) it is collective phenomenon and every organisation has one even if it not acknowledged.

Risk culture defines how risks are understood and managed in an organisation. There is no universally good type of risk culture. Goodness of risk culture depends on external and internal factors of an organisation or unit. However there are some aspects that can be deemed as universally bad, such as "shoot the messenger" mentality. These aspects are discussed in the IRM report (IRM, 2012, pp.64-81). The descriptive model described in this thesis has broader perspective: there can be very different types of risk cultures that may or may not be good in the eight focus areas described by the IRM framework. However, being good in these areas is not enough. One must also have a successful match between the organisation and the risk culture.

The descriptive model of risk culture is built on the aspects discussed in the chapters 4.2.1, 4.2.2, and 4.2.3. In addition there are several other aspects that are related directly to risk culture, such as risk appetite and internal control.

Risk appetite is the total value that an organisation is willing to put at risk. It is typically different than risk capacity that is the value that an organisation can put at risk. (Hislop, 2012, p. 233) Risk appetite and risk capacity can be used explicitly and actively or in risk management and decision making. However, often they are not clearly defined and exist only hidden in policies, guidelines and managerial judgement.

Risk management is often connected with internal control and risk assurance. Different organisational cultures and decision making structures require different control environments. The role, extent and flexibility of control environment influence on how risk is perceived and how risks are taken into account in decision making.

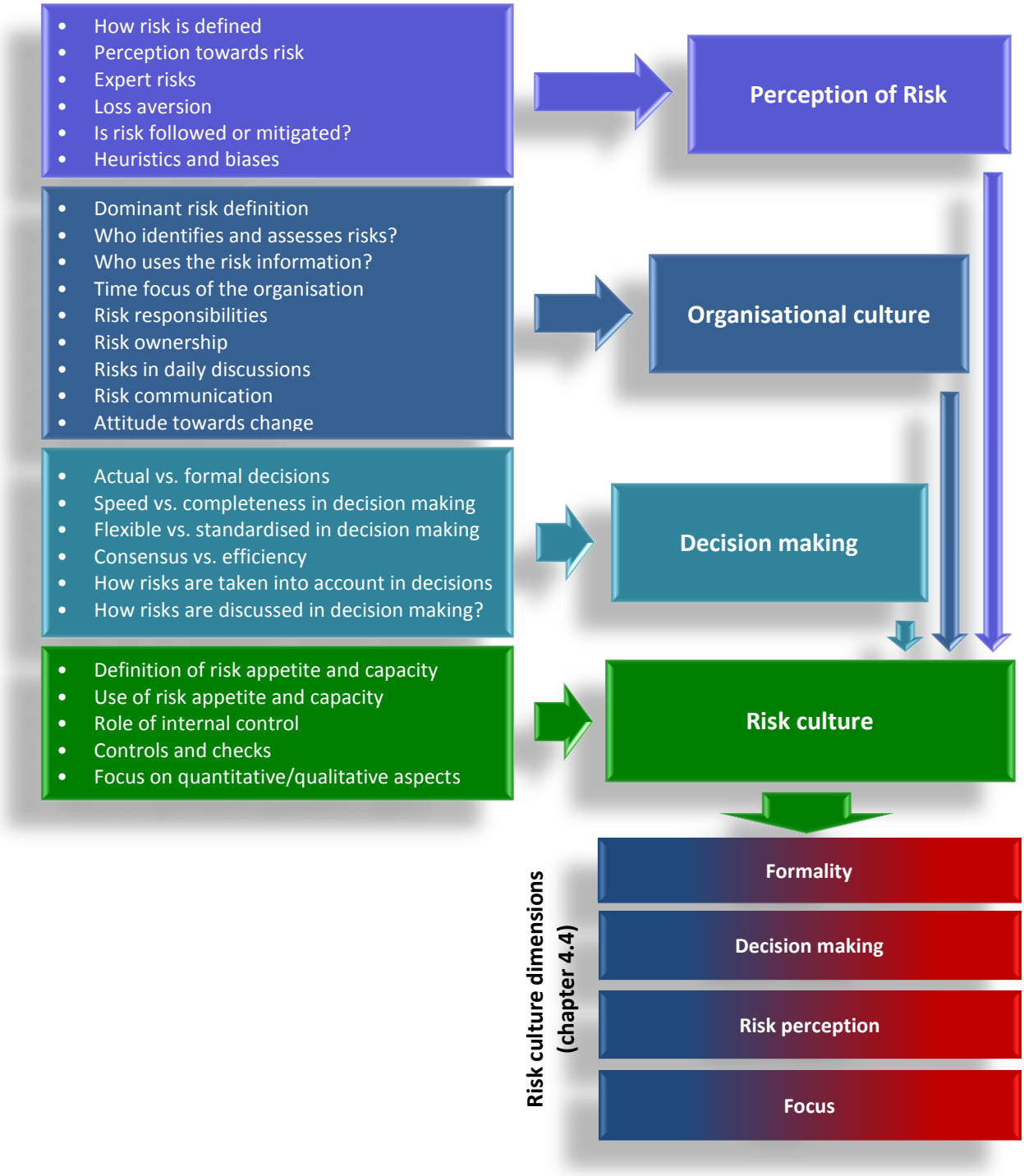

Figure 8. Detailed view of the descriptive model of risk culture.

Risk is multifaceted and complex concept. Even if one focuses only on operative risks there are still many aspects that must be taken into account. One way to classify these aspects is to divide

them to aspects that can be quantified, such as monetary value, production capacity, physical parameters, time or different kinds of indices and qualitative aspects such as motivation, reputation, competence, satisfaction or loyalty. Character of risk management can be very different depending on whether focus is on qualitative aspects, quantitative aspects or both.

The following aspects are to be taken into account when assessing risk culture of an organisation:

- How risk appetite and risk capacity are defined?
- How risk appetite and risk capacity are used in management and decision making?
- What is the role if internal control?
- What kind of controls and checks are used?
- Does risk management focus on quantitative aspects, qualitative aspects or both?

The descriptive risk culture model covers all the aspects mentioned above and in the previous three chapters. The model is presented in detail in the Figure 8.

4.3 Empirical study

To help using the descriptive model in practice a simple typology for different risk cultures was created. The typology is based on dimensions that describe how organisations perceive and handle risk management related areas. The dimensions were constructed in such a way that they fulfil the following criteria:

- The dimensions cover all the important elements of risk culture,
- They are as independent from each other as possible (i.e. are not strongly correlated),
- They are easy to understand,
- They can be measures or assessed,

The dimensions are selected in such way that they cover ranges of selected areas in such way that a culture is in a single point of each dimension. The opposite ends of a dimension are mutually exclusive (e.g. slow and fast).

4.3.1 Questionnaire

An empirical study was conducted to help in identification of the dimensions. The study had two steps. In the first step a questionnaire was presented to number of people in order to gather

information about how different areas of the risk culture model are perceived. In the second step a factor analysis was conducted in order to create a limited number of dimensions that would describe different risk culture types.

The questionnaire had 30 statement pairs. The statement pairs represented two opposite poles of important areas of risk culture. All questions were constructed in such way that the neither of the statements would represent a superior alternative. Phrasing was as neutral as possible and all moral connotations were avoided. The aim of the questionnaire was to cover all the areas presented in the risk culture model and that the collected data would be such that it could be used in constructing descriptive dimensions for the risk culture typology (Figure 8).

The respondents assessed how the statements reflected the assumptions and practices in their teams. The respondents have risk management, engineering, finance and commodity trading backgrounds. All respondents were from a single company but from diverse set of organisational units. All are working closely with some aspect of risk management. In total 35 questionnaires were sent and 31 answers were received. The questionnaire is presented in the appendix 1.

The respondents provided answers to the questions by scoring them with a score from 1 to 5. A score 1 presented strong agreement with first statement of a statement pair and score 5 presented strong agreement with the other. A summary of the results is presented in the appendix 2.

4.3.2 Factor analysis

The second step of the empirical part was a factor analysis in order to identify a small number of factors that could be used to describe different dimensions of risk culture. In factor analysis the number of respondents should at least 3 to 5 times the number of studied parameters. (Fabrigar et al., 1999) As the number of questions (30) was too large compared to the number of responses (31) the whole initial data set was not used in the analysis. Before the factor analysis was conducted the number of questions was reduced to 10. The questions were grouped into three groups:

- Questions that can be represented by other questions,
- Questions that were discarded in order to help to focus the analysis,
- Questions that were selected to be used in the factor analysis

The first group represents cases where it was estimated that two or more questions were covering a same issues. Then only one question was selected to represent the issue. However, the main target was not to study whether there is solid connection or likely causality between two or more variables. Instead the purpose was to reduce the number of variables without reducing too much explanatory power.

The second group has questions that were removed from further analysis even though they were not similar to other questions. They were removed in order to keep the analysis sufficiently simple and focused. The questions covered too many areas to be covered in the limited scope of this thesis. From the perspective of the factor analysis there is no difference between the first and second group. Most of the discarded questions are interesting from the risk perspective and require further research. The main purposes of the selection process was to limit the number of analysed aspects in order to be able to analyse it in meaningful way while keeping the focus in selected areas (individual perception, organisational culture, decision making). The selected set of questions is not more correct than any other possible set of questions. The results of the selection process are shown in the appendix 3.

The remaining 10 questions were analysed with factor analysis. Factor analysis is a way to explain correlation between variables by presenting multiple variables with fewer composite variables or factors. The assumption behind of the factor analysis is that several correlated observable parameters are actually determined by some unobserved latent variable (factor). The data used in factor analysis should be on an interval scale (i.e. difference between 1 and 2 is the same as the difference between 2 and 3). The data obtained from the questionnaire is on an ordinal scale. However, the data is assumed to approximate interval scale and thus factor analysis can be used.

In factor analysis a regression model between predefined number of factors and the variables (in this case scores of individual questions) is solved. The solution provides one potential set of factors. However there are infinite amount of potential sets of factors with each having different weights between parameters and factors. Therefore initial solution is typically rotated in such way that is fulfils some desired criterion. In this case the solution was rotated in such way that each variable was identified with a single factor as much as possible (varimax rotation). The equations related to factor analysis are not presented here. Description of factor analysis in general can be found e.g. in (Cudeck, 2000).

The factor analysis was performed with the Minitab 16 statistical software. The analysis was conducted to several different set of variables and different number of factors. The results are presented in the appendix 4.

4.3.3 Qualitative comparative analysis

An alternative method to analyse data from questionnaire is the qualitative comparative analysis (QCA). The method is especially suited for situations where there are only small amount of data. The simplest form of QCA, using binary data, was used. The QCA method helps to find connections between different parameters using Boolean algebra. The goal of the method is to find combinations of parameter that appear consistently with selected value of the dependent variable. In a nutshell the method studies which combinations of independent binary variables cause the dependent parameter to be either 1. There are also more advanced methods that handle integral scales and continuous data. (Rihoux, 2006) The QCA method was tested in this thesis. In the end it was decided that the method would not be used.

4.4 Dimensions of risk culture

Using the factor analysis four dimensions were chosen to describe risk culture in organisations. Four dimensions is a compromise between being too simple and thus having no descriptive power and being too complex and thus being too difficult or time consuming to use in practice. Some judgement was used in the dimension selection. The dimensions (factors) proposed by the factor analysis are:

- Factor 1, questions 4, 12 and 22 (see appendix 1 and appendix 4)
- Factor 2, questions 1 and 2
- Factor 3, questions 8, 27 and 28
- Factor 4, questions 15 and 29

One question (question 8) was seen to represent better another dimension than implied by the factor analysis results. Thus the dimension 1 represents questions 4, 8, 12 and 22. The selected dimensions were named. The selected dimensions are:

- Formality (represents the questions 1 and 2)
- Decision making (represents the questions 4, 8, 12 and 22)
- Risk perception (represents the questions 15 and 29)

- Focus (represents the questions 27 and 28)

The descriptions of the dimensions shown in the chapters 4.4.1-4.4.4 are built around the related questions. Hoverer, it is assumed that questions represent adequately a larger topic. Thus the descriptions are somewhat more extensive than the mere questions.

It should be noted that this is not the only one way to describe dimensions of risk culture. Depending on the questionnaire and respondents it is possible that completely different set of dimension could be constructed. As stated in the chapter 4.3.3 a fair amount judgement was used to select the 10 variables to be used in the factor analysis. It is obvious that this selection will influence the selected four dimensions as well. However, the four selected dimensions fulfil the criteria presented in the beginning of the chapter 4.3. The dimensions are discussed in detail in the chapters 4.4.1-4.4.4.

4.4.1 Formality

The formality dimension is related to formality or flexibility of management methods and processes. It describes how units are managed, how flexible or rigid processes are, what is the attitude towards adhering to or bending rules, and how much intuition is used compared to predefined rules and procedures. The extreme ends of the dimension are called: formal and flexible. The questions 4, 8, 12 and 22 of the questionnaire represent the formality dimension (see appendix 1). The extreme ends are presented in Table 5.

Table 5. The extreme ends of the formality dimension.

Formal	Flexible
Formal rules and procedures are used extensively in daily operations	People rely on intuition and managerial judgment in daily operations
Risk management relies heavily on rules, algorithms and procedures	risk management is intuition-based
Processes are followed in the same way in all situations	processes are flexible and situations are assessed case-by-case
There are many formal controls and checks	there are only few or no formal controls and checks

4.4.2 Decision making

The decision making dimension is about how decisions are made. It describes how much effort is spent to prepare for decisions, how fast decisions are made, how detailed decisions are, and when decisions are made. The extreme ends of the dimension are called deliberate and dynamic. The

questions 1 and 2 of the questionnaire represent the formality dimension (see appendix 1). The extreme ends are presented in Table 6.

Table 6. The extreme ends of the decision making dimension.

Deliberate	Dynamic
As much information as possible is gathered for decision making	Decisions are made even if there are large uncertainties
Decisions are based on extensive analysis	Decision are based on intuition
Decisions are made when planned	Decisions are made fast

4.4.3 Risk perception

The risk perception dimension is about how risk is understood. It describes whether risk is seen as acceptable or unacceptable part of life and is risk seen as threat or variance. The extreme ends of the dimension are called accepting risk and avoiding risk. The questions 27 and 28 of the questionnaire represent the formality dimension (see appendix 1). The extreme ends are presented Table 7.

Table 7. The extreme ends of the risk perception dimension.

Avoiding risk	Accepting risk
Risk is something that should be avoided	Risk is something that must be accepted as part of daily life,
Risk is seen as threat	Risk is seen as variation
Risk figures are seen to describe actual values	Risk figures are seen to describe order of magnitude

4.4.4 Focus

The focus dimension is about perspective of management and operations. It describes whether business is seen via technical assets (such as power plants) or via people and processes. It also describes whether risk management focuses on technical aspects such as profit or production or on behavioural factors such as motivation, competence or reputation. The extreme ends of the dimensions are called technical focus and behavioural focus. The questions 15 and 29 of the questionnaire represent the formality dimension (see appendix 1). The extreme ends are presented in Table 8.

Table 8. The extreme ends of the focus dimension.

Technical focus	Behavioural focus
Focus of management is on technical factors and	Focus of management is on “soft” parameters

numeric parameters	
Risk management focuses on technical risks	Risk management focuses on human factors (e.g. safety, reputation, competence)

4.5 Typology for risk culture

In this chapter a typology for risk cultures is presented. It is based on the four dimensions presented in the chapter 4.4. This typology, like any other typology, is simplistic and incomplete. The main task of the typology is to help to understand risk culture and to improve operative risk management efforts in the energy sector. Thus it may be incompatible for other purposes and for organisations not in the energy sector. The typology will be as generic as possible in order to not to unnecessarily limit its applicability in future. An overview of the typology is presented in the Table 9.

Each different culture type represents one end of all of the four dimensions. Thus there are sixteen different culture types. All culture dimensions have more stable end (Formal, Deliberate, Avoiding risk, Technical focus) and more fluid end (Flexible, Deliberate, Accepting risk, Behavioural focus). Thus the culture types range from very stable and conservative to very dynamic ones. The model assumes that all sixteen combinations are feasible in certain conditions. The Table 9 is constructed in such way that neighbouring culture types have more in common than types that are far apart. The colour of each culture type indicates overall stability of the culture type. More stable types are blue while more flexible are red.

It should be noted that the factor analysis proposes that the data can be adequately represented by using only four parameters (i.e. dimensions) and thus there can be sixteen different combinations (if only low/high values are used). The data do not imply that the all the combinations exist or are even possible. In this thesis it is assumed that the dimensions are independent of each other and that all potential combinations are possible.

Table 9. Risk culture typology.

		Flexible		Formal	
		Dynamic	Deliberate	Dynamic	Deliberate
Accepting risk	Behavioural focus	**Start-up** Flexible Dynamic Accepting risk Behavioural focus	**Gambler** Flexible Deliberate Accepting risk Behavioural focus	**Broker** Formal Dynamic Accepting risk Behavioural focus	**Developer** Formal Deliberate Accepting risk Behavioural focus
	Technical focus	**Venture** Flexible Dynamic Accepting risk Technical focus	**Planner** Flexible Deliberate Accepting risk Technical focus	**Project** Formal Dynamic Accepting risk Technical focus	**Strategist** Formal Deliberate Accepting risk Technical focus
Avoiding risk	Behavioural focus	**Consultant** Flexible Dynamic Avoiding risk Behavioural focus	**Trainer** Flexible Deliberate Avoiding risk Behavioural focus	**Committee** Formal Dynamic Avoiding risk Behavioural focus	**Hierarchy** Formal Deliberate Avoiding risk Behavioural focus
	Technical focus	**Expert** Flexible Dynamic Avoiding risk Technical focus	**Optimiser** Flexible Deliberate Avoiding risk Technical focus	**Process** Formal Dynamic Avoiding risk Technical focus	**Machine** Formal Deliberate Avoiding risk Technical focus

All sixteen different culture types are presented below. Each culture type covers different kinds of organisations and groups. The names of culture types are only for illustrative purposes and descriptions are only representative examples. Terms group and organisation are used to cover all kinds of groups of all sizes that can have a common culture.

4.5.1 Start-up type

The start-up culture type is the most agile and flexible culture type. Speed, agility and flexibility are the most important aspects in the ever-changing environment of start-up cultures. Fast pace requires flexible decision making system and informal management methods. Due to continuously changing environment short term focus is preferred. Risk is accepted as a natural

aspect of the fluid environment. Examples of the start-up culture include start-ups and units working with completely new products and markets.

4.5.2 Gambler type

The gambler culture type focuses on fulfilling short term goals by taking calculated risks. The decision making process is guided by procedures and mandates and decisions are analytic. Management is based mostly on intuition and there are few formal controls. Risk is accepted as part of business: risk must be taken in order to achieve results. Focus of management is on human factors and behavioural issues. An example of a gambler culture type is a marketing team in a dynamic market.

4.5.3 Venture type

The Venture culture type focuses on fulfilling plans in a risky and changing environment. Risk is an inherent part of the plan. Decision making is swift and decisions are made even under high uncertainty. Managerial judgement and intuition play major role in decision making. Processes are flexible in order to support fast management and decision making pace. The focus of the group is on the fulfilment of technical or numeric targets. Examples of the venture type are new organisation in new market areas and growth projects.

4.5.4 Consultant type

The consultant culture type is seeking to achieve soft goals in unpredictable setting. Operational environment may be fluid, tasks require untested solutions or operations can't be easily planned beforehand. Thus management methods are flexible and non-constraining. Decisions are made fast and without unnecessary delays. Risk is seen as something that threatens achievement of defined goals and thus risks should be avoided or mitigated. An example of the consultant type is a team providing management consultancy.

4.5.5 Broker type

The broker culture type represents an organisation that operates in dynamic environment but whose operations are governed by guidelines and controls. The dynamic environment requires that risk must be accepted as inherent part of life rather than something that you can remove. Operations focus on human aspects and peculiarities that are borne from working with other people. Examples of a broker type organisation are a stockbroker organisation and a team of sales agents.

4.5.6 Planner type

The planner culture type focuses on long term issues. Decision making is analytic and typically not time constrained. Risk is accepted as part of everyday life as one can't predict future with full certainty. Analysis is important and great care is taken to make the right decisions. Long term plans guide the overall operations. Management is guided by intuition. Daily processes and operations are situation dependent. An example of a planner type organisation is a research and development team.

4.5.7 Developer type

The developer culture type focuses on development that can be measured using soft factors. Management is systematic and guided by procedures and guidelines. There are well defined and detailed processes that help people to act in the most common tasks. Decision making is deliberate and analytic. Focus of the group is future-oriented and thus uncertainty and risk are accepted as inherent part of operations. An example of the developer type is a development project seeking to achieve notable change.

4.5.8 Project type

The project culture represents an organisation that tries to fulfil well defined tasks in turbulent environment. The organisation has clear management methods and structures. There are many controls and checks to follow and ensure performance. However, decision making is fast and flexible to ensure performance in turbulent environment. Risk is seen as natural characteristics of environment and therefore accepted as something that there always is. The focus of the organisation is technical parameters and targets. An example of a project type organisation is a project team of a power plant project.

4.5.9 Trainer type

The trainer culture type has flexible management methods and no or few formal procedures. Decision making is slow and deliberate and risk aversive. This can be e.g. due to nature of decisions, looseness of the group or the way decision making is organised. The main focus of a trainer type group is on the soft factors. Human parameters are used in decision making and discussions instead of hard technical or numeric parameters. Examples of the trainer type include a training department and a voluntary not-for-profit organisation.

4.5.10 Expert type

The expert culture type is driven by problem solving. Important part of problem solving is reduction of measurable uncertainty (even if the members do not see it this way). Risk is seen as something that is blocking or inhibiting achieving targets. Members of the group can be very independent and self-guiding. Thus management and decision making processes are flexible and many ad hoc processes may be used. An example is an engineering department.

4.5.11 Committee type

The committee culture type has stable purpose in stable environment. A committee type organisation has clear guidelines for how it is managed and how decisions are made. Extensive analysis is preferred over rash decisions. The focus of the organisation is on soft and intangible issues. The organisation is conservative and sometimes analysis is seen as the end itself instead of being means to support decision making. An example of a committee type organisation is an advisory board supporting management.

4.5.12 Strategist type

Strategist culture type is systematic, disciplined and formal. Management is rule and procedure guided and many controls and checks are used to ensure that the group is going to right direction. Decision making is hierarchic, deliberate and well controlled. Extensive analysis is preferred over fast decisions. Risks are necessary evil that must be accepted - they are natural part of the business. Focus of the organisation is on the long term planning. Traditional banking organisations are examples of strategist type.

4.5.13 Optimiser type

Optimiser culture type focuses on long term technical targets. Decision making processes are slow and deliberate as decisions are not usually time constrained and they may have long term effects. The long term goals are related to reducing uncertainty and thus risk is understood as something that should be removed. Operations are flexible and there are only few detailed procedures and controls. Examples of the optimising type include units developing established assets and products.

4.5.14 Hierarchy type

The hierarchy culture type is formal, hierarchic and analytic. Management systems and process are characterised by slow and deliberate pace. Formal decisions are made high in a structured hierarchy. Nature of a hierarchy type unit or organisation is conservative and thus risks are seen as problems that should be avoided or removed. The focus of the organisation is in human factors rather than technical aspects. An example of this type is a training department.

4.5.15 Process type

The process culture type represents organisations that focus on ensuring steady state operations of an existing physical or business process. The organisation has formal, well established structures and management methods and many controls and checks. Decision making can be fast and flexible but it is limited to solving everyday problems. Formal structure and steady state focus mean that big change decisions are taken elsewhere. The focus of the organisation is on meeting well defined targets. Risks are seen as disturbances and potential failures to meet targets. Examples of the process type culture are e.g. a unit operating a physical production line or a call centre.

4.5.16 Machine type

The machine culture type is the most stable culture. Good planning and deliberate decision making with extensive analysis are important. Focus is on the technical aspects and on the long term. Operations are managed with large number of measurements, controls and checks. Mandates are systematically defined. Risk is seen as a threat to achieving plan. In an optimal situation there are no risks. An example of the machine culture type is a public authority in an established area.

5 RISK MANAGEMENT METHODS

Table 10. An overview of risk management methods.

Basic methods		
Chapter	**Method type**	**Description**
5.1.1	Intuitive methods	Risks are taken into account intuitively. No system or structure is used.
5.1.2	Simple ranking and scoring methods	Simple scores (e.g. 1 to 5) or labels (low/medium/low) are used to assess and rank risks.
5.1.3	Structured scoring methods	Risks are ranked by scoring different aspects and aggregating scores with a predefined way.
5.1.4	Structured qualitative methods	Risks are identified and assessed using structured methods (e.g. checklists) and guidelines.
5.1.5	Simple quantitative methods	Probability and actual impact are used to assess and rank risks.
5.1.6	Simple statistical methods	Risk are calculated using statistical distributions and Monte Carlo calculation.
Methods supporting decision making		
Chapter	**Method type**	**Description**
5.2.1	Scenarios	Risk levels are assessed qualitatively or quantitatively by defining plausible future scenarios.
5.2.2	Decision trees	Risks are evaluated in connections with decisions. Subsequent decisions and risks are present in tree format.
5.2.3	Real options	Real option perspective is used to assess risks related to different choices in decisions.
5.2.4	Game theory models	Risks of different scenarios are studied using game theory methodology.
Advanced methods		
Chapter	**Method type**	**Description**
5.3.1	Fault trees	Significant events are analysed by studying cause-and-effect chains leading to the event.
5.3.2	Bayesian network methods	Risks are assessed using numerical probabilities and network -like connections between different events.
5.3.3	Simulations	Events, their effects and connections are studied using computer simulations.
5.3.4	Stress testing	Effects of extreme events and tolerance and robustness of systems are studied.
5.3.5	Probabilistic risk analysis (PRA)	Sophisticated system model is used to calculate probability of an unlikely major event.

In this chapter the most common types of risk management methods are reviewed. The purpose of the review is to present sufficient background information for the chapter 6. There are a large number of different methods but most of them fall into the categories presented below. In addition the focus is on the simpler methods as they are more likely to be applied more widely in companies. Advantages and disadvantages presented in the literature are summarised for each

type. The list of methods is not exhaustive. The list covers the range from purely subjective methods (such as purely intuitive methods) to the methods that seek maximum objectivity (such as PRA).

The methods have been divided into three groups: basic methods, methods supporting decision making, and advanced methods. The basic methods are simple methods that can be used in many situations with relatively little effort. The methods supporting decision making are used especially in connection with formal decisions but they can be used in other contexts as well. The advanced methods are structured and more complex. They typically focus on certain areas. The advanced methods have typically more limited scope that the other methods.

Many of the methods described below can be used together. There is also some overlapping between the types. The method types are summarised in the Table 10.

5.1 Basic methods

5.1.1 Intuitive methods

In its simplest form risk assessment is purely an intuitive process. Risks are taken into account in decision making either implicitly or explicitly. All kinds of rules and heuristics can be used to take risks into account. No effort is being made or no system exists for assessing, comparing or ranking risks. These methods are used all the time at all levels and all kinds of decisions.

Risks are part of decision making even if they are not acknowledged. Risks are communicated via statements related to gut feeling such as “I have bad/good feeling about this” or via statements that explicitly mention risks, uncertainty, and corrective actions: “It can’t be done, it’s too risky”, “Outcome is certain” or “we must do A to ensure that B does not fail”.

Intuitive methods are naturally very fast and require very little additional effort. They can be applied to all kinds of decisions with all kinds of risks. The major drawbacks are that efficiency is tied to limited mental capacity and the ability to understand complex systems and related interconnections. Intuitive methods are also very susceptible to heuristics and biases discussed in the chapter 2.4.

5.1.2 Simple ranking and scoring methods

The simplest structured method is to assess risks using scores. The main dimensions of risks are defined and scores are given for each dimension and for each risk. Typical dimensions are

probability and impact although it is possible to use different dimensions or only a single dimension such as severity. The scores are typically given in a 1-2-3-4-5, low/medium/high or similar scale. The scores may be pure scores or they may have some qualitative (such as “very high impact with significant consequences”) or quantitative explanations (such us “impact over 10 M€”). The scored risks are typically presented in a risk matrix such as one presented in Figure 9. (Hargreaves, 2010, pp. 224-226)

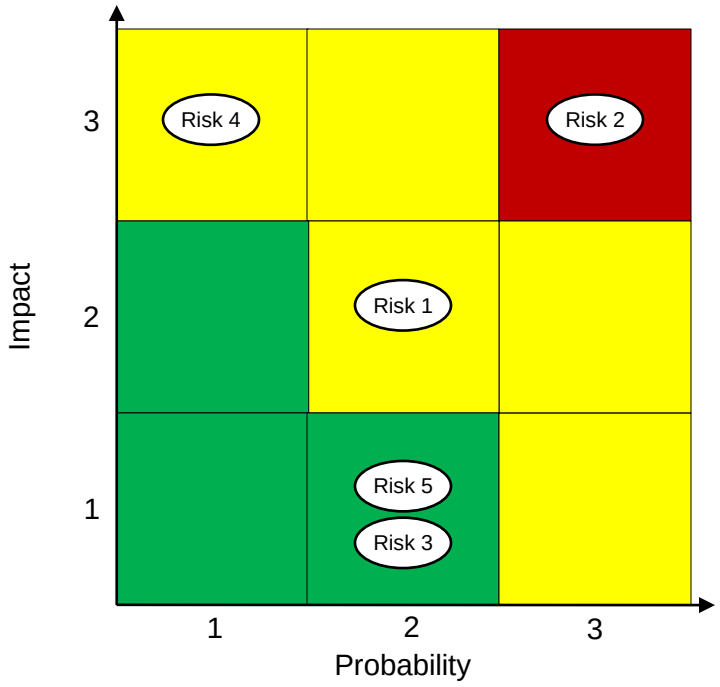

Figure 9. A typical risk matrix using a scoring system.

Scored risks can be ranked in several ways. The most common ways include summing individual scores, multiplying individual scores or using a risk matrix to illustrate which risks are acceptable and which are not. Figure 9 displays a common method of using traffic light colours to indicate severity of each risk.

Simple scoring methods are straightforward and easy to use. They are extremely widespread and presented in many textbooks, e.g. (Hargreaves, 2010, pp. 224-226) and (Kendrick, 2009, pp. 158-163) and risk management standards (IRM, 2002), (Moeller, 2007 pp. 73-76).

5.1.3 Structured scoring methods

Structured scoring methods take a step further from the simplest methods. Structured methods split risks into several parameters which are assessed individually. Total risk values are calculated from individual components using predefined formulas. Scoring may be explicit or it may be hidden in the structure (if a specific software is used). Scoring systems are relatively simple and straightforward to use but depending on the methodology they may require some time and effort. They can help to take more aspects into account than the simple scoring methods. Structured methods are typically used to rank risks.

Failure mode and effect analysis (FMEA) is one of the most used scoring methods. It is widely used in many industries such as aerospace, automotive and power generation. The method provides a systematic way to identify failure modes in a system or process and to evaluate effects of those modes. It helps to assess what can go wrong in any given part of a system or process and what are the consequences for the whole system. In FMEA each failure mode is evaluated by giving scores to severity of effects, likelihood or frequency and detectability. The risks are ranked by multiplying the three scores. Action planning and follow-up are integral parts of the method. FMEA helps to cover all important risk of a system, focus on root causes, to understand relative importance of each failure mode and to prioritise and focus actions to manage risks. (Haapanen and Helminen, 2002)

5.1.4 Structured qualitative methods

Structured qualitative methods can be used to identify risks and relationships in a systematic manner. They range from simple "What if?" analysis to very time consuming techniques. They provide only qualitative results and thus they do not provide absolute values, relative differences or ranks of risks. Structured systems are relatively easy and straightforward to use but they can be time consuming. (HSL, 2000)

Hazard and operability study (HAZOP) is a widely used structured method. It is used mainly for safety assessment of industrial processes. HAZOP is applicable to well defined systems that can be split into manageable sections. HAZOP requires an experienced team. The team goes through the system under review section by section. For each section potential failure mechanisms and consequences are identified. Guidewords and technical parameters are combined to provide systematic output. Brainstorming and checklists are used to ensure that risk are covered in the required extent. (Schlechter, 1995)

5.1.5 Simple quantitative methods

The simple quantitative risk methods are similar to simple scoring methods but they seek to evaluate risks using a continuous scale instead of a discrete risk score scale. The simplest method is to evaluate probability and impact of each risk using single point estimates: risks can be described with probability (expressed in actual numerical form, e.g. 50 % or 0.25) and a single impact value (expressed in monetary terms or in other similar relative scale).

Risks can be presented in a risk matrix similar to ones used with simple scoring methods. A typical risk matrix is presented in Figure 10. In this case the risks carry more information as their parameters have meaning in absolute and relative sense and they can be directly compared: e.g. 50 % is twice as likely as 25 % whereas a risk with probability score 4 may or may not be twice as likely as a risk with score 2.

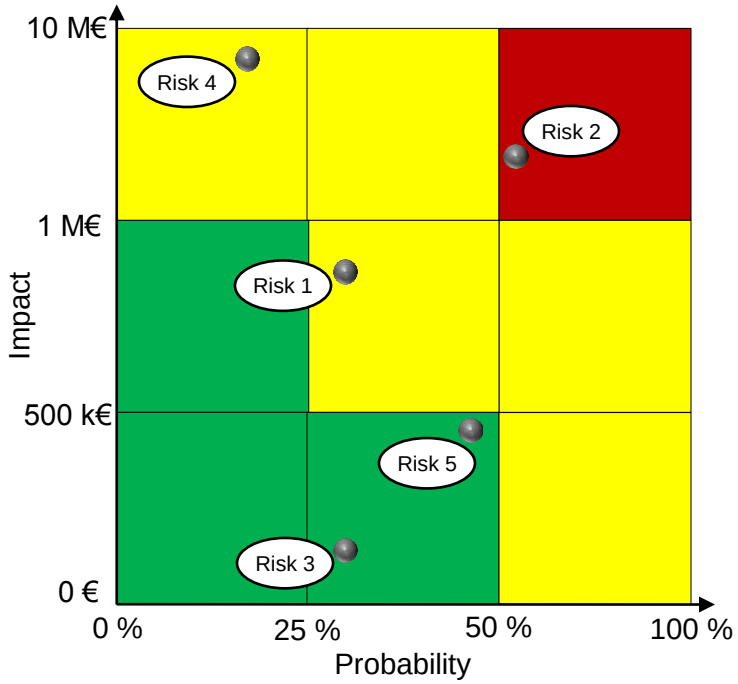

Figure 10. A typical risk matrix with continuous (non-linear) scales.

5.1.6 Simple statistical methods

If a risk has a wide range of potential outcomes or the studied system has interconnected risks it may be feasible to use statistical methods. Instead of attaching single point values of impact and probability to risks a probability distribution is used to describe spread of outcomes. Simple

statistical methods can be used to estimate e.g. how likely it is that consequences of an event will be over some predefined threshold (e.g. an investment will have negative NPV).

For a system with several risks with potential interconnections Monte Carlo calculation can be used. It is commonly used numerical method for solving mathematical problems involving random processes or probabilities. Monte Carlo calculation involves repeated "what if"-scenarios, or cycles, where values of random parameters are varied according to their underlying distributions. Each Monte Carlo cycle represents one potential outcome. With sufficiently large number of cycles the results approximate closely the "real" behaviour of the system. (Hargreaves, 2010, p. 229)

Monte Carlo calculations are straightforward to perform and they require only a limited time. Monte Carlo is purely mathematic method. The results it provides are only as good as the input data and underlying assumptions. Monte Carlo calculation can be used together with most of the methods described in this chapter.

5.2 Methods supporting decision making

5.2.1 Scenarios

Scenario planning and analysis has been widely used in management for a long time. It is basically a qualitative method but it can be used with quantitative tools to obtain quantitative results. The main idea in scenario planning and analysis is to create plausible future states (i.e. scenarios) and to analyse risks and possibilities related to these states. The scenarios are created by bringing together existing information and expert insight. They focus on external environment and how it may impact the studied system. Narrative form of scenarios helps decision makers to understand risks, opportunities and differences between different scenarios and to formulate correct strategies and actions.

The scenario approach takes a high level view to the studied system. Scenarios can be used in envisioning what future may look like. The approach may help to find new paths and to understand risks and opportunities related to each scenario. In such situations purely qualitative scenario analysis may be sufficient. (Miller and Waller, 2003) It is also possible to do scenario analysis in more detailed level and use qualitative methods to evaluate potential gains, losses or risks for each scenario. Scenarios can be used in connection with or as a part of other methods.

5.2.2 Decision trees

A decision tree is a method used for identifying, assessing, organising and presenting information and choices related to decision. It helps decision makers to see and value different options, take probabilities and risks into account and to put numerical value (e.g. expected monetary value) for each option. Decision trees help also in performing and presenting sensitivity analyses. Decision trees can be used in qualitative and in quantitative forms.

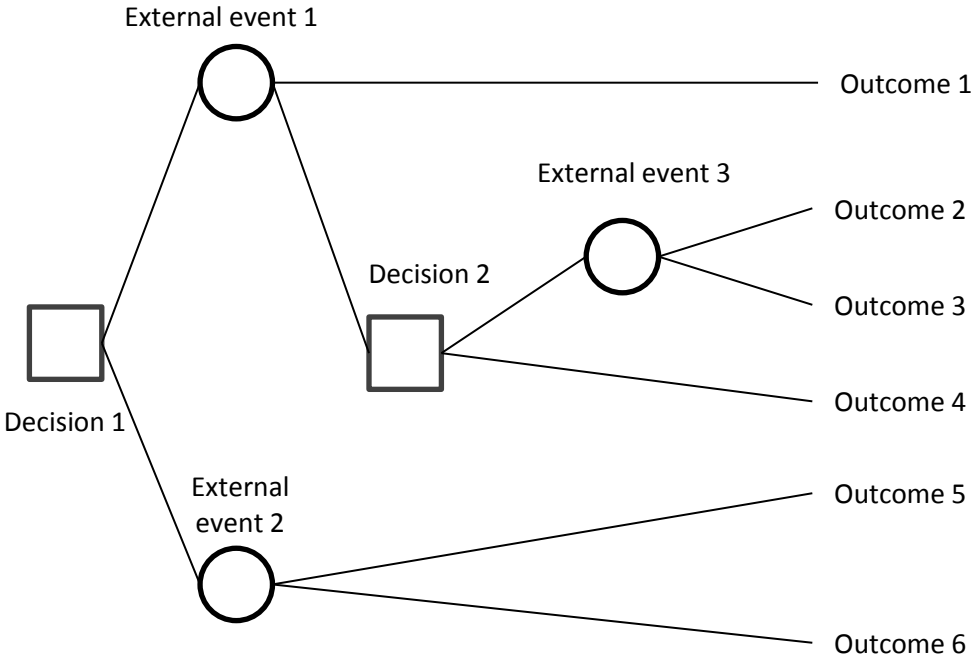

Figure 11. An example of a decision tree.

In a decision tree all potential choices and probable events are presented in a logical tree structure. The structure helps to understand complex chains of decisions, to see connections between consecutive decisions, and to find the correct decision from the identified choices.

A decision tree can be used to assess and compare risks of different choices. It requires that there is a clear decision to make and potential risks can be identified. Potential decision trees may vary from very simple to very complex. The level of detail depends on the situation at hand. (Baird, 1989, pp. 201-224)

5.2.3 Real options

Real options are opportunities to purchase or obtain real assets in the future. Real options are similar to financial options but in many cases real options are not determined contractually. Thus real options are more of a matter of perspective. The basic reason for using the real option approach is that costs, prices and demand can't be predicted with certainty. Thus it may be beneficial to create initially only a small commitment (e.g. investment) and an option to full commitment later. If assumptions related to commitment change adversely only small commitment has been made. Thus real options are used to reduce uncertainty and impact of price and cost changes. Real option situations include e.g. investments, product development decisions, market selection decisions and entry and exit decisions. (Miller and Waller, 2003)

Real options help managers to identify and improve flexibility of decisions. The approach takes into account learning from experience and value of information and reduction of uncertainty that can be gained by waiting. (Mun, 2010) The real option approach is typically connected to investments but is relevant for risk management perspective as well. The approach can be used to evaluate and manage risks related to decisions that require commitments and it helps to connect strategic decisions and risk management together. (Miller and Waller, 2003)

5.2.4 Game theory models

Game theory focuses on decision situations involving several parties. The parties can be co-operating or competing against each other. Compared to optimisation game theory focuses more on the human behaviour and. In game theory it is not necessarily clear what optimal means. (Peters, 2008, pp. 1-3)

Risk management can be used to support game theory based decision making as well as game theory can be used to support risk management. Risk management provides probabilities and consequences to many events. This information can improve decision making significantly. Risk management and game theory methods can be used iteratively to incorporate increasing knowledge about risks and related events. In addition game theory models can be used to improve risk management and probability estimates especially in situations where a risk is dependent on actions of individuals (e.g. terrorism, espionage, fraud). Game theory models can help to incorporate predictive elements and conditional probabilities into risk management and thus help to provide more realistic risk assessments. (Cox, 2009)

5.3 Advanced methods

5.3.1 Fault trees

A fault tree is a graphical method that helps to identify all combinations of events that may cause an undesirable event (such as a plane crash). The fault tree focuses on the cause and effect chain of a selected event. The effects of the undesirable event are not part of a fault tree analysis. The method takes a top down perspective to the system. Initially all events that can directly cause the undesirable top event are identified. After that underlying events that can cause the events causing the events causing the top event are identified and so forth. The number of required levels depends on complexity of the studied system and goal of the analysis. The events and their connections form a tree where the top event is at the one end and underlying root events are at the other end. (Berk, 2009, pp. 35-45)

Many kinds of qualitative and quantitative tools can be used in identifying causes, effects and probabilities of events. A fault tree can be very simple with only a few levels or it can have thousands of events and large number of levels. A very sophisticated type of fault tree like analysis, PRA, is discussed in the chapter 5.3.5.

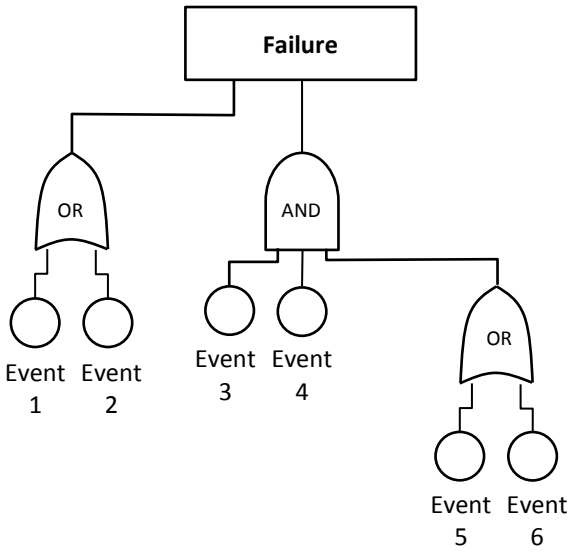

Figure 12. An example of a fault tree.

5.3.2 Bayesian network methods

Bayesian network can be used to model a system where there are dependencies between random variables. Bayesian networks combine intuitive representation with sound mathematical basis. The (random) variables are represented as nodes of a network. Two nodes can have causal connection (i.e. A will cause B), correlation (i.e. A may cause B) or they can be independent of each other. The nodes and connections form a directed non-cyclic network. (Cowell et al., 2007)

A Bayesian network helps to assess uncertainties and risks related to a large system by dividing it into smaller pieces. Expert judgement is used to evaluate probability distributions of each piece and interconnection. (Neil et al., 2005) Bayesian networks are flexible and they can adapt easily to new input. The graphical format of Bayesian networks help to understand dynamics of complex systems. As a downside Bayesian networks can be very time consuming especially if the model is complex. (Cowell et al., 2007)

A simple Bayesian network is presented in Figure 13. The network describes events and systems, their potential states and connections between events and systems. The impact box presents potential outcomes and probabilities for the whole system.

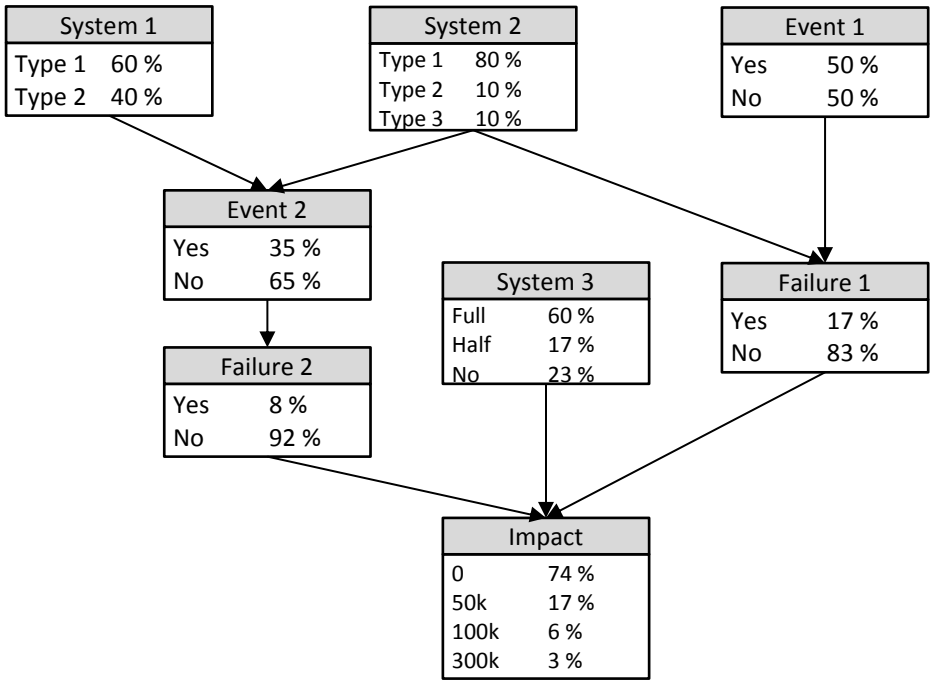

Figure 13. A simple Bayesian network. (Cowell et al., 2007)

5.3.3 Simulations

In a simulation a complex system is studied using a numerical model that approximates a real system on an appropriate level of detail. The simulation model attempts to describe or imitate the real system as much as possible. Typical statistical methods assume certain distributions but make no attempt to explain reasons for variation. Simulation methods offer more insight as they attempt to explain the mechanisms that cause observed outcomes. (Hubbard, 2008, pp. 215-216)

Purpose of simulations is to reproduce important aspects of behaviour of the real system. If simulation models are constructed correctly simulations are able to closely approximate the reality. They can provide new insights to the dynamics of the system. Simulation can be used e.g. to study how a planned system works, to study potential strategies, to estimate how a system works in abnormal situations etc. Simulation can replace expensive testing and reduce uncertainty in situations where testing or piloting is not feasible. (Singh et al., 2007, pp. 437-438)

5.3.4 Stress testing

Stress testing is a generic term that refers to methods that aim to study and uncover vulnerabilities to unexpected but plausible events. Stress testing can be done to physical entities (e.g. power plants), IT systems and processes, business processes and whole companies. Stress testing goes beyond normal risks and instead focuses on extreme situations which have very low frequency. (Chorafas, 2007, pp.40-42) In certain industries such as banking and nuclear power there are authority requirements regarding stress testing.

In most cases historical data can't be used to predict potential consequences of extreme events. Stress testing helps to circumvent this problem by simulating plausible extreme events and their consequences. Stress testing helps to understand how a studied system behaves under extreme conditions as well as to study what kind of extreme events the system can withstand. (Christoffersen, 2012, pp. 312-316)

5.3.5 Probabilistic risk analysis – PRA

Probabilistic risk analysis (PRA) models are essentially systematically constructed and very complex fault trees. A PRA model provides a probability estimate of a selected event. They are used in industries such as aviation, nuclear power, oil exploration and chemicals manufacturing where very high reliability is needed and certain events may have severe consequences. (Lee and McCormick, 2011, pp. 1-12)

PRA has similarities to several methods presented in previous chapters: they focus on failure modes, use of statistical methods and a fault tree structure. As PRA focuses on extreme events it also shares many aspects with stress testing. The use of PRA requires detailed knowledge about the studied system. Creating and using a PRA model requires significant amount of time and effort. (Hubbard, 2008, p. 61)

6 APPLICABILITY OF RISK MANAGEMENT METHODS

Risk culture dictates how risks are understood and managed in organisations. The typology presented in the chapter 4.5 can be used to study many aspects of organisational life and to assess with kind differences there are between different types. In this chapter one important way to use the risk culture typology is presented.

Risk culture has major implications on what risk management methods should be used and how they are used in different organisation. The following chapters discuss applicability of the risk management methods presented in the chapter 5 for each sixteen risk culture type. The focus is on operative risks.

Table 11. General guidelines used in the assessment of applicability of risk management methods.

Intuitive methods	Should be used only in the most non-technical and non-numerate organisations if speed of decisions is critical
Simple ranking and scoring methods	Should be used in organisations with behavioural focus in fluid environment
Structured scoring methods	Should be used in organisations with behavioural focus in fluid environment
Structured qualitative methods	Should be used in formal and deliberate organisations with behavioural focus
Simple quantitative methods	Should be used in organisations in fluid environment
Simple statistical methods	Should be used in organisations with technical focus in fluid environment
Scenarios	Should be used in organisations with behavioural focus
Decision trees	Should be used in organisations with technical focus
Real options	Should be used by deliberate organisations that accept risk and have technical focus
Game theory models	Should be used by flexible organisations with technical focus
Fault trees	Should be used in technical organisations with less stable environments
Bayesian network methods	Should be used in technical and stable organisations
Simulations	Should be used in technical and deliberate organisations
Stress testing	Should be used by risk avoiding organisations. Less preferred by technical organisations compared to other complex methods.
Probabilistic risk analysis (PRA)	Should be used only in technical, deliberate organisations that seek to minimise risk.

An overview of applicability of risk management methods is presented in Table 12. The general guidelines and assumptions used in Table 12 and the chapter 6.1-6.16 are listed in Table 11. In the guidelines the term “stable” refers to deliberate and formal characteristics while the term “fluid” refers to dynamic and flexible characteristics. The guidelines are developed for purposes

of this thesis. In an actual business setting these guidelines must be reviewed in order to take the context into account.

Each culture type is linked with four types of methods. This does not mean the other methods couldn’t be used successfully. Effectiveness of any risk management method is strongly dependent on the characteristics of an organisation and its environment. The following discussion provides only general guidelines that should be taken into account when selecting and developing risk management methods. Even if a method is well aligned with particular risk culture type it is still possible to use it ineffectively. The descriptive risk culture model and the following discussion do not take this aspect into account. Other ways such as the formative IRM model (chapter 4.1) can be used to study effectiveness or "goodness" of risk management efforts.

Table 12. The most applicable risk management methods for each culture type.

		Flexible		Formal	
		Dynamic	Deliberate	Dynamic	Deliberate
Accepting risk	Behavioural focus	**Start-up**	**Gambler**	**Broker**	**Developer**
		Intuitive methods	Structured scoring methods	Simple ranking and scoring methods	Structured qualitative methods
		Simple ranking and scoring methods	Simple quantitative methods	Structured scoring methods	Simple quantitative methods
		Simple quantitative methods	Scenarios	Simple quantitative methods	Scenarios
		Scenarios	Decision trees	Scenarios	Real options
	Technical focus	**Venture**	**Planner**	**Project**	**Strategist**
		Simple quantitative methods	Decision trees	Simple quantitative methods	Decision trees
		Simple statistical methods	Real options	Decision trees	Real options
		Decision trees	Bayesian network methods	Game theory models	Bayesian network methods
		Game theory models	Simulations	Bayesian network methods	Simulations
Avoiding risk	Behavioural focus	**Consultant**	**Trainer**	**Committee**	**Hierarchy**
		Intuitive methods	Structured qualitative methods	Structured scoring methods	Structured qualitative methods
		Simple ranking and scoring methods	Simple quantitative methods	Simple quantitative methods	Scenarios
		Simple quantitative methods	Scenarios	Scenarios	Fault trees
		Scenarios	Stress testing	Fault trees	Stress testing
	Technical focus	**Expert**	**Optimiser**	**Process**	**Machine**
		Simple statistical methods	Decision trees	Simple statistical methods	Decision trees
		Decision trees	Bayesian network methods	Decision trees	Bayesian network methods
		Game theory models	Simulations	Game theory models	Simulations
		Fault trees	Probabilistic risk analysis (PRA)	Bayesian network methods	Probabilistic risk analysis (PRA)

6.1 Start-up type

The start-up type is the most fluid and non-structured of the culture types. A start-up type organisation has no interest or possibility to use extensive and time consuming methods. The most applicable methods are flexible and scalable. Therefore pure intuition and simple scoring methods can be sufficient in many situations. Scoring methods and simple quantitative methods are superior to pure intuition in all other than very straightforward or extremely time critical situations as they provide structure and force assumptions to be stated more explicitly.

Start-up type organisations operate in rapidly changing environment and they are strongly future-oriented. Scenario analysis is the best method to ensure that focus of the risk management is on big decisions affecting future risk profile. Simple quantitative methods are the most feasible methods to create numerical data to support decision making and scenario analysis. When selecting risk management methods a trade-off between ability to reduce uncertainty (effectiveness) and time and effort required (efficiency) must be made. In the case of start-up type cultures the focus must be in the efficiency end of spectrum.

6.2 Gambler type

The gambler type organisations are analysis oriented focusing on behavioural aspects. The most applicable methods are either structured scoring methods or simple quantitative methods. These methods provide structure to risk assessment and help to prioritise risks and to allocate resources properly. These methods can be implemented in such way that they have non-technical focus suitable for gambler type.

In decision making the most feasible method for gambler type cultures is scenario analysis. Scenarios help to cover all risks areas related to potential choices without restricting focus on purely numerical parameters. In more complex situations decision trees methods can be used in order to provide more insight into scenarios and to improve risk-informed decision making.

6.3 Venture type

The venture type cultures operate in fluid environment and thus they need lightweight methods that can be applied swiftly in all kinds of decisions. Technical focus of venture type

organisations enable wider use of statistical methods compared to similar but less technical focused types, such as start-up or consultant types.

Simple quantitative methods and simple statistical methods are likely to provide best balance between agility and adequate support for management. These methods provide numerical results that can be used to compare risks, to directly assess whether current risks are on acceptable level and to define how much should be spent to reduce risks.

The most feasible methods to ensure risk-informed decision making are decision trees. Decision trees can be used to incorporate numeric data more comprehensively than e.g. in scenario analysis. In situations where risks are related to actions of external actors game theory methods may be suitable. Due to fast paced nature of venture cultures the decision tree and game theory models should not be overly complex in order to find proper balance between effectiveness and efficiency.

6.4 Broker type

The broker type organisations act fast and are flexible in decision making. The type requires fast and flexible methods. In some situations simple scoring methods may be sufficient. The formal management structure associated with the culture type means that more structured methods, such as structured scoring methods, are better. Simple quantitative methods may be more appropriate in riskier environments. Simple scoring methods, structured scoring methods and simple quantitative methods all can be implemented in such way that they support formal management methods but do not inhibit dynamic decision making.

To support efficient decision making relatively lightweight scenario analysis is feasible solution. This helps to cover risks in different choices without require too much time or effort. To ensure more aligned risk management the scenario methods can use the results provided by the other risk management methods.

6.5 Consultant type

Consultant cultures are one of the most flexible types. Flexibility requires simple and agile methods that provide timely guidance for decision making. Human factor focus of the culture means that qualitative methods are preferred over quantitative methods. For the simplest and

most straightforward situations purely intuitive methods may be sufficient. However, pure intuition should be reserved only for very straightforward or time critical situations.

For more complex situations simple scoring methods or simple quantitative methods are the most applicable due to relatively small amount of effort required. Compared to pure intuition they provide clear structure and force assumption to be stated more explicitly. Scoring methods and simple quantitative methods allow ranking and priorisation of the risks. Quantitative methods allow also relative comparison.

For situations having multiple choices scenario analysis is the most feasible method type. It helps in comparing risks related to each choice. Scenario analysis can be easily scaled and thus its resource requirements are very much situation dependent. This is important in an organisation which values flexibility.

6.6 Planner type

The planner culture type requires methods that try to create a detailed picture of future risks. Technical focus and deliberate decision making processes are well suited for structured methods that require time and effort. Bayesian networks can be used to identify weaknesses and connections of current processes and systems. Simulations help to understand current situation as well as potential future choices. Both methods can provide extensive and detailed information that would be difficult to obtain with simpler methods. However, operating environment must be relatively stable to use such methods successfully.

For risks related to decision making decision trees and real option methods are the most applicable methods. These methods, like Bayesian networks and simulations can be used to provide extensive and detailed information about risks. If decisions are time critical these methods can be used in more simplistic way.

6.7 Developer type

The developer type cultures operate in stable business environment where risk is inherent part of the everyday life. Structured qualitative methods and simple quantitative methods can be used in normal everyday risk analysis. The structured qualitative methods are used to identify and assess risks in structured way. In order to such methods to be successful the system or process under

study must be relatively well known and stable. The simple quantitative methods can be used alone or to complement structured methods. Both method types can be scaled depending on the need and available resources.

To assess risks related to future choices scenario analysis is the most applicable method. It is less technically focussed than e.g. decision tree methods. Scenario analysis can be very detailed and deep it there is need and available resources. In certain situations scenario analysis can be reinforced with real option perspective in order to provide adequate risk-informed support to decision making.

6.8 Project type

The project culture type organisations have formal structures and need for swift decision making. Risk is accepted as part of everyday life. Straightforward quantitative methods are the most feasible methods for risk management.

Simple quantitative methods and simple statistical methods provide numeric risk information that can be used in decision making. They both require only limited amount of effort and time and thus they are compatible with swift decision making characteristic to project organisations. Bayesian networks can also be applicable to project type cultures when more time and effort can be spent to risk management.

For risk-informed decision making decision trees and game theory methods are the most applicable methods. They provide a structured way to compare different alternatives using hard parameters. Decision tree methods help to see risk-included value of each choice. Game theory methods can be used in more complex decisions involving other parties.

A small project type group can be identified from the questionnaire data (respondents 22 and 23). The group members use simple quantitative methods, simple statistical methods and decision trees regularly. Bayesian network models are not currently used by any of the respondents.

6.9 Trainer type

The trainer type organisations are conservative with focus on human aspects. Therefore qualitative methods and simple quantitative methods are the most successful. Structured methods are feasible as the trainer type organisations prefer analysis over speed. Structured scoring

methods and structured qualitative methods such as FMEA and HAZOP can be used. If numerical results are needed simple quantitative methods are the most applicable. These models provide detailed enough information about risks facing the organisation. The structured methods can be implemented in such way that they take into account both soft and hard factors. In some situations stress testing can be feasible method to trainer culture types to study their overall risk level and vulnerabilities.

In situations where risks are related to decisions scenario analysis is the best method. It helps to incorporate soft factors into risk analysis and decision making. Scenario analysis can be used as stand-alone method or it can be combined with the structure methods.

6.10 Expert type

The expert culture type is flexible and agile and focuses on reducing risks that can be measured with hard parameters. Due to technical focus of the culture numerical methods are the most suitable. To ensure operational agility the methods must be sufficiently lightweight.

For structured problems (e.g. failure analysis of a process system) fault trees are the most applicable methods. They help to dig deep into the problem and provide detailed information for action planning without being too time consuming. Fault tree methods can be scaled to appropriate level of detail and effort.

For more general risk analysis simple statistical methods are the most suitable. They methods are relatively simple but they provide sufficient data to support decision making and action planning without consuming too much resources or time.

For decision making related risk management decision trees are the most applicable models. They are scalable and they can be used in such way that they provide concrete numerical results. Game theory models are suitable for expert cultures in important situations whose outcomes are dependent on actions of other parties.

From the empirical part two different expert type groups can be identified (group 1: respondents 2, 3, 7 and 8; group 2: respondents 15, 16, 21 and 31). Simple statistical methods, fault trees and decision trees are successfully used by these groups. Game theory models are not currently used by the groups.

6.11 Strategist type

The strategist type cultures operate in stable environment and they focus on long term performance. Due to stable environment complex, structured methods that require plenty of time and effort are applicable. Bayesian networks can be used to assess current situation and related risks.

For decision making and assessing potential risks of future choices decision trees are the most applicable methods. The decision tree methods provide mode detailed, structured data than scenario analysis. Use of hard, numeric parameters to support decision making is appropriate for strategist type cultures. Real option methods can be used to strengthen the decision tree analysis and to provide more risk informed perspective into decision making.

Simulations can be used to study current situation and to support decision making. Due to stability and long term focus of strategist type organisations even extensive simulation models can be used.

6.12 Optimiser type

The optimiser culture type is risk aversive and analytic. Thus the most suitable methods are structured methods that focus on mitigating risks. When feasible, complex mathematical models can be used. For situations that do not require extensive analysis simple fault trees can be used. In most cases fault trees provide detailed enough information about selected prioritised risks.

Operating environment for optimising type organisation is relatively stable thus complex structured methods are feasible for the most important risks. These methods include Bayesian networks and even probabilistic risk analysis (PRA). Bayesian network methods are more general. They can be used to identify and assess risks and connections concerning the whole organisation or selected parts of it. PRA studies require extensive amount time and effort and they should be reserved for critical risks.

Simulations can be used to support other methods or they can be run independently. Simulations are feasible way to increase understanding about the current situation as well as to study potential future scenarios. Depending on the situation simulation methods can range from

relatively simple to very complex. Optimiser type cultures can use very complex simulation models.

For decision making situations decision trees are the most applicable methods. The decision trees can use extensive and detailed information provided by Bayesian networks, simulations or PRA models.

6.13 Committee type

The committee type cultures are risk aversive and formal. They focus on human aspects of risk. For general risk management the most feasible methods are structured scoring methods and simple quantitative methods. Simplicity of the methods ensures that risks can be taken into account even in a fast paced environment.

The scoring methods can easily incorporate softer, harder-to-quantify factors. They help to identify and prioritise the most important risk areas. With quantitative methods relative importance of different risks can be assessed and it can be estimated how much effort and resources should be spent to control each risk. For the most important risks fault tree approach can be used. Fault trees provide detailed information about selected risks with reasonable effort.

For decision related risks scenario analysis is the most applicable method. It takes into account the fast pace of the decision making and human factor focus in the committee cultures.

6.14 Hierarchy type

The hierarchy type is stable and deliberate but unlike e.g. machine or process types it focuses on human aspects. The methods most applicable for hierarchy types are "softer" and less mathematically complex. For simpler situations structured qualitative methods may be sufficient. These methods provide help to identify and prioritise the most important risks and risk areas.

For the risks that require more attention fault tree methods can be used. They provide detailed information about selected risks. To understand vulnerabilities, margins and overall risk level of a hierarchy type organisation stress testing methods can be used.

For risks related to different choices scenario analysis is the most feasible tool. It provides rigour to decision making without need for overly technical models.

6.15 Process type

The process type cultures operate in stable environment but they have fast decision making mechanisms. Statistical methods that require relatively little effort are the most feasible for everyday risk management. Simple statistical methods can be used in connection with other methods to provide more concrete results. Statistical methods can also be used to assess overall risk level. In situations that require more detailed and sophisticated risk management Bayesian network methods can be used.

To manage risks in decision making situations decision trees are the most applicable models. They are scalable and they can be used in such way that they provide concrete numerical results. Game theory models can be used in important situations whose outcomes are dependent on actions of other parties.

6.16 Machine type

The machine culture type is the most stable and most technically oriented. Therefore the most complex and resource-intensive methods are applicable. Of course complexity should not be pursued for its own sake. Risk management efforts must be balanced with risk level of organisation even in machine type cultures.

Bayesian networks can be used to study current risks. The networks help to identify critical areas and connections between different events. Sufficiently stable environment is needed for successful implementation of Bayesian network. For the most critical risks and complex systems probabilistic safety analysis may be appropriate. For PRA to be worth the effort studied risks must be significant and the system that is modelled must be stable. Otherwise lighter methods are more appropriate.

Simulations can be used to support the other methods or to assess effects of potential choices. Machine type cultures are especially suited for extensive simulation models as they are particularly stable and focus on long term results.

For decision making situations decision trees are the most applicable methods. The decision trees can use extensive and detailed information provided by Bayesian networks, simulations or PRA models.

These suggestions are backed by the questionnaire data. For example simulations and PRA are used effectively in certain machine type groups (respondents 4, 10, 17 and 18). Also decision trees are used. Bayesian network models are not currently used by any of the respondents. Nevertheless the method is applicable for the identified machine type groups.

7 CONCLUSIONS AND DISCUSSION

7.1 Summary

In this thesis a descriptive model for risk culture is presented. The model is based on the theories reviewed in the chapters 2 and 3. The model has three plus one layers. The three basic layers are: individual perception of risk, organisational culture, and decision making. The risk culture layer is mostly based on the three underlying layers but there are some topics that are risk culture specific (e.g. use of risk appetite). These four layers cover all the important areas that influence risk management in organisations. The aim of the model is to improve understanding about how risks are understood and handled in organisations. The model emphasises the fact that there are many different ways to understand and manage risk.

To underline differences between organisations a typology for different risk cultures was created. Typology creation was supported by two-phased empirical study. A questionnaire covering 30 important risk management related topics was sent to 35 people. The answers (from 31 people) were used to create four dimensions for risk culture typology. The dimensions were created using factor analysis. The dimensions are called: formality, decision making, risk perception, and focus.

The selected dimensions cover important areas of the risk culture and they can be used to form sixteen different culture types. Each culture type is described in the chapter 4.5. The typology helps to identify differences in risk cultures and to find potential areas of application for the model.

Risk management methods are reviewed in chapter 5. The selected methods range from very simple and subjective to very complex and objective. The methods are classified into three groups: basic methods, methods related to decision making and advanced methods.

Applicability of risk management methods is an example of how the descriptive risk culture model can be applied in practice. For each risk culture type the most applicable methods are proposed. Applicability of each method is also justified.

7.2 Potential areas of application

The thesis provides a descriptive model that provides insight into areas that influence risk perception, management and decision making. Understanding risk culture is the first step in improving risk management. In order to effectively improve risk management it is important to know what are the basic principles influencing risk management and what are the differences between different groups. By studying organisations from the perspectives stated in the risk culture model one can learn how risks are seen and what are the potential weak and strong points. As one understands better what kind of risk culture each group has it is easier to:

- Understand peculiarities of risk management actions
- Identify potential problem areas
- Identify potential conflicts between different groups
- Understand which methods, processes and structures can be successful

The risk culture typology provides a qualitative framework that can be used to classify different risk culture types. The simple framework helps to classify different groups. The risk culture classification can be used to support efforts in any organisational area which is related to risk management. The selected dimensions highlight differences between organisations in important risk related areas.

The typology can be used in improving risk management in a single group and aligning risk management between two or more groups. Applicability of risk management methods is just one example of a potential area of application. Other potential areas include: risk communication, organisation of risk management efforts, strategic planning and strategy implementation, decision making, action planning and resource allocation, investment evaluation, and project management.

There are many practical ways that the model and the typology can be used. The ways range from quick and general overview to extensive and detailed analysis. The model can be applied to both small and large organisations. A brief example about how to use the model to study risk communication in an organisation is presented below:

- Clarify what is being studied and what are the goals of the study.
- Define concrete scope. The studied organisations and groups must be identified.

- Study what risk culture aspects are important from risk communication perspective. How these aspects are likely to be seen?
- Identify groups with different risk cultures. It is likely that an organisation will have different risk cultures. One needs to identify different cultures e.g. with interviews and questionnaires. It is possible that culture groups are not the same as the formal organisational groups
- Identify which culture type each group present.
- Study how risks are communicated implicitly and explicitly in each risk culture group.
- Identify major differences between groups, especially if there are differences between some groups and a dominant culture.
- Identify needs for further actions.

7.3 Limitations

The presented descriptive model focuses on operative risk management in energy sector. The general structure and majority of the underlying structure are applicable for other sectors and risks as well. Thus Figure 7 is valid for all risks and all organisations. It is likely that without modifications the more detailed model shown in Figure 8 and the dimensions presented in the chapter 4.4 are not equally universal. Their applicability needs to be ensured before they are used.

The dimensions identified in the study are based on rather limited set of data. The dimensions reflect the assumptions built in the questionnaire and judgements made in the first phase of the empirical study. The current dimensions are intuitive, describe well the limited data and cover the most important areas or risk management. However it is possible that larger and more heterogeneous data might provide results that could be different in same aspects.

Not all important topics are taken into account by the four dimensions. The current dimensions fit well into the current context but it is possible that in some other context different dimensions would be better. In certain situations the presented dimensions would not cover areas under study or highlight differences between groups in sufficiently. Thus it is important that before the typology is used it is ensured that the dimensions really represent areas that are interesting and relevant in the studied case.

Applicability of different risk management methods presented in the chapter 6 is based on judgement and anecdotal evidence. Providing empirical connection between culture types and

different risk management methods is not within the scope of this thesis. The proposals made in the chapter 6 should be taken as a well-grounded hypothesis. Further studies are needed to confirm or adjust the hypothesis. It should be noted that the methods proposed are ones that are most likely candidates for each culture type. Actual characteristics and environment of each organisation will also have major influence on what methods should be used and will be used.

7.4 Areas for further studies

There are several areas to further develop the concept and model of risk culture. The following areas should be studied in order to increase robustness and applicability of the model:

- Completeness of the model
- Coverage of the dimensions
- Alignment of the dimensions
- Context sensitivity of the model

The first area requires study about whether there are some aspects of risk perception, organisational culture or decision making that should incorporated into the model. This requires further theoretical and philosophical discussion about what is risk culture. It should be studied whether there are some aspects that are strongly connected to each other (e.g. certain attitude towards risk is connected to certain organisational culture aspect or decision making structure).

The second area needs empirical research concerning the dimensions of the typology. It is possible that the questionnaire used in this thesis missed some important aspects and overemphasised some unimportant aspects of risk culture. It should be studied how much effect the structure and content of the method used to obtain answer has on the results.

Many important areas were forced to be bypassed when the 10 questions used in the factor analysis were selected. It is likely that these areas include important aspects that were not taken into by the presented dimensions. These dimensions should be studied in order to find optimal set of dimensions. It is possible that the set of dimensions is not fixed but context-dependent.

The third area concerns internal validity of the dimensions. It should be ensured that the selected dimensions are internally aligned as well as that they reflect the way people perceive things. This requires extensive data and statistical analysis. The amount of data used for the factor analysis

was just barely sufficient. Further analysis with much wider set of data would provide stronger justification to the choices made in the chapter 4.4.

The fourth area concerns overall applicability of the model. It should be studied how stable the dimensions are from group to group. If the dimensions vary significantly it is likely there are some underlying factors that should be used instead of varying dimensions. The study requires plenty of heterogeneous data. It is possible that the concept of risk culture can't be described with only four dimensions. In this case it might be feasible to identify larges set of dimensions and to use only selected dimensions in each individual study. This way the relevant parts of the concept would be used without unnecessarily simplifying the model.

All in all usability of the risk culture concept would benefit from further conceptual clarification and wide ranging empirical studies. The concept and proposed model have potential to make significant improvements in risk management in many kinds of organisations. Proper risk management is one of the many things that companies and other organisation need to thrive in the increasingly turbulent and fast paced environment.

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APPENDIX 1 - RISK CULTURE QUESTIONNAIRE

			1	2	3	4	5	
1	Please select 1, 2, 3, 4 or 5	Risks are evaluated based on statistics and rules						Risks are evaluated based on intuition
2	Please select 1, 2, 3, 4 or 5	Operations are controlled with detailed controls and checks						Operations are controlled with managerial/expert judgement
3	Please select 1, 2, 3, 4 or 5	Most KPIs focus on financial performance						Most KPIs focus on other issues than financial performance
4	Please select 1, 2, 3, 4 or 5	As much information as possible is gathered for decision making						Decisions are made even if there are large uncertainties
5	Please select 1, 2, 3, 4 or 5	Risk information is widely shared with other teams						Risk information is not shared with other teams
6	Please select 1, 2, 3, 4 or 5	Risks are communicated openly						Only selected people have access to risk information
7	Please select 1, 2, 3, 4 or 5	Decisions are based on intuition and judgements						Decisions are based on extensive analysis
8	Please select 1, 2, 3, 4 or 5	Processes ensure that everybody operates in the same way						Processes are flexible
9	Please select 1, 2, 3, 4 or 5	Risks are valued using well-defined methods and formulas						Risks are valued using intuition
10	Please select 1, 2, 3, 4 or 5	Risk figures (e.g. impacts) describe the actual values of risks						Risk figures describe an order of magnitude
11	Please select 1, 2, 3, 4 or 5	Processes are well-defined and detailed						Processes are general
12	Please select 1, 2, 3, 4 or 5	Decisions are made fast						Decisions are made after extensive analysis and/or discussions
13	Please select 1, 2, 3, 4 or 5	Explicit rules are used to select the most important risks and actions						Intuition and case-by-case judgement are used to select the most important risks and actions
14	Please select 1, 2, 3, 4 or 5	Risk appetite (accepted level/target level of risk) is stated explicitly						Risk appetite is based on intuition
15	Please select 1, 2, 3, 4 or 5	Risks is something that must be avoided or mitigated						Risk is something that must be accepted
16	Please select 1, 2, 3, 4 or 5	Level of risk related decisions (i.e. who is allowed to make a decision) is guided by formal guidelines						Level of risk related decisions is decided case-by-case
17	Please select 1, 2, 3, 4 or 5	Risk assessments are done by the people who use the risk information in decision making						Risk assessments and decisions are done by different people
18	Please select 1, 2, 3, 4 or 5	Risk information is created by a single person or group						Risk information is created and reviewed by several groups
19	Please select 1, 2, 3, 4 or 5	Targets and tasks are strictly based on the business plan						Actual targets and tasks deviate often from the business plan
20	Please select 1, 2, 3, 4 or 5	Risk management focuses on knowing risk level						Risk management focuses on mitigating risks
21	Please select 1, 2, 3, 4 or 5	Risk management aims to minimise risks in a cost effective way						Risk management aims to maximize profits within the selected risk level
22	Please select 1, 2, 3, 4 or 5	Decisions may be delayed in order to gather more information to reduce uncertainties						Decisions are not delayed – they are made based on existing information
23	Please select 1, 2, 3, 4 or 5	Unit acts independently						Unit is part of a larger process
24	Please select 1, 2, 3, 4 or 5	The main focus is on the next 12 months						The main focus is on the next years
25	Please select 1, 2, 3, 4 or 5	Decisions are changed often						Decisions are changed rarely
26	Please select 1, 2, 3, 4 or 5	The whole team participates to decision making						Only those who are deeply involved into a decision participate to decision making
27	Please select 1, 2, 3, 4 or 5	Risks are evaluated using numerical factors (e.g. costs, lost production)						Risks are evaluated using “soft” parameters (e.g. reputation, motivation, competence)
28	Please select 1, 2, 3, 4 or 5	Risk management focuses on technical factors						Risk management focuses on human factors
29	Please select 1, 2, 3, 4 or 5	Risk is understood as variance or deviation						Risk is understood as a threat
30	Please select 1, 2, 3, 4 or 5	Consensus is seeked in the decision making						Decisions are made by the leader of the team

APPENDIX 2 - QUESTIONNAIRE RESULTS

	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7	Question 8	Question 9	Question 10	Question 11	Question 12	Question 13	Question 14	Question 15	Question 16	Question 17	Question 18	Question 19	Question 20	Question 21	Question 22	Question 23	Question 24	Question 25	Question 26	Question 27	Question 28	Question 29	Question 30
Respondent 1	2	2	2	2	4	4	2	4	4	2	4	4	4	2	4	2	4	4	4	2	2	2	2	4	4	4	2	2	4	4
Respondent 2	4	5	4	4	4	4	2	2	2	2	1	4	1	5	2	4	4	2	2	2	4	2	5	1	2	5	1	2	4	2
Respondent 3	2	2	5	4	4	1	4	1	1	2	4	3	2	3	2	4	1	4	2	4	2	2	4	5	4	1	1	1	4	2
Respondent 4	1	2	3	3	2	1	5	2	2	4	2	4	1	1	1	2	1	4	2	4	2	2	4	4	4	3	2	2	3	4
Respondent 5	2	2	4	1	2	4	5	2	2	5	2	5	2	1	2	2	5	4	4	5	1	1	2	2	4	4	5	3	4	2
Respondent 6	4	2	4	5	4	4	2	5	4	5	3	2	4	5	3	2	4	3	5	5	1	4	3	2	2	5	1	4	5	4
Respondent 7	4	4	2	2	4	2	3	2	4	2	2	2	2	5	2	1	2	2	2	2	1	5	4	4	5	4	1	1	2	4
Respondent 8	4	4	2	1	3	5	3	1	2	5	1	4	4	3	2	2	2	1	4	5	1	1	5	4	4	5	2	1	4	5
Respondent 9	2	2	4	3	2	2	4	3	3	2	3	4	3	1	2	3	3	4	3	4	5	2	2	3	2	4	3	3	3	2
Respondent 10	1	2	5	2	1	1	4	2	1	4	3	4	3	1	2	3	5	2	3	5	1	2	4	5	3	4	1	1	5	1
Respondent 11	1	1	2	1	4	4	4	1	1	4	1	4	2	2	2	1	4	5	4	4	4	1	5	2	4	5	2	2	2	2
Respondent 12	2	2	4	2	2	3	4	4	2	2	3	4	4	4	4	2	3	2	3	4	4	2	5	2	3	4	1	2	3	4
Respondent 13	4	4	1	4	4	5	2	4	4	5	3	2	4	4	2	4	5	1	3	4	2	3	1	2	2	5	3	2	5	3
Respondent 14	4	2	2	2	4	3	4	2	4	2	2	4	3	4	3	1	5	4	4	2	3	2	5	4	4	4	2	1	5	3
Respondent 15	4	4	3	5	5	5	2	4	4	2	4	2	4	4	2	2	4	3	4	2	1	3	1	2	4	5	2	2	4	3
Respondent 16	4	2	1	4	4	4	2	2	4	1	1	2	4	4	2	3	2	4	2	3	1	2	2	2	2	2	1	1	5	2
Respondent 17	1	1	4	3	2	2	4	3	1	5	5	4	4	2	1	5	5	1	5	4	1	2	1	4	4	4	1	2	5	1
Respondent 18	2	1	1	4	2	2	4	3	1	4	4	5	4	2	5	4	5	2	1	4	1	1	5	5	4	5	1	2	1	1
Respondent 19	4	4	2	1	4	5	4	4	2	4	2	4	4	2	5	1	4	1	1	1	3	1	4	4	4	4	1	2	4	4
Respondent 20	2	1	2	4	4	4	2	4	4	4	4	2	4	5	4	4	5	2	4	2	4	2	3	2	2	4	4	5	5	4
Respondent 21	4	4	1	2	5	5	2	2	5	2	2	4	3	5	1	2	5	2	4	4	2	3	1	5	4	5	1	1	5	4
Respondent 22	3	3	5	4	1	2	4	2	3	4	2	1	3	5	2	1	4	5	5	2	4	2	1	1	2	3	2	2	1	3
Respondent 23	5	3	1	5	5	4	2	3	4	4	3	3	4	4	1	3	4	2	2	2	1	5	3	2	5	4	3	3	5	3
Respondent 24	5	5	1	5	5	5	1	5	5	5	5	2	5	5	4	5	5	1	5	4	2	5	1	1	2	5	1	1	2	4
Respondent 25	2	2	3	4	4	4	3	1	1	2	2	3	2	1	2	1	4	1	3	4	3	3	4	3	4	5	1	1	4	5
Respondent 26	4	4	2	2	2	2	2	4	4	2	2	3	4	2	2	2	2	4	2	2	3	4	4	5	4	4	3	2	2	4
Respondent 27	4	4	2	2	2	2	3	5	4	4	4	4	5	4	2	1	2	5	2	4	4	1	2	4	2	4	3	3	2	2
Respondent 28	4	1	4	2	4	5	4	2	4	5	2	5	4	4	4	2	4	3	4	4	3	1	5	2	2	5	1	2	4	5
Respondent 29	4	4	2	4	4	2	3	4	4	4	4	4	4	4	4	2	3	2	2	2	2	2	2	2	3	4	4	4	4	4
Respondent 30	1	2	3	4	3	5	4	2	2	4	3	4	2	2	3	4	4	2	5	4	3	1	4	1	4	5	1	1	5	3
Respondent 31	4	4	1	4	4	5	2	5	5	4	5	3	2	5	1	4	4	3	5	4	2	4	2	4	3	3	1	2	5	4

APPENDIX 3 – SELECTION OF QUESTIONS FOR FURTHER ANALYSIS

	Used in the second step	Represented by another question	Discarded	Notes
Question 1				
Question 2				
Question 3				
Question 4				
Question 5				
Question 6				
Question 7				Represented by question 22
Question 8				
Question 9				Represented by question 1
Question 10				Represented by question 15
Question 11				Represented by question 8
Question 12				
Question 13				Represented by question 8
Question 14				Represented by question 1
Question 15				
Question 16				Represented by question 8
Question 17				
Question 18				
Question 19				
Question 20				Possibility that respondents understood the question in several ways.
Question 21				Possibility that respondents understood the question in several ways.
Question 22				
Question 23				Represented by question 8
Question 24				
Question 25				Represented by question 8
Question 26				
Question 27				
Question 28				
Question 29				
Question 30				Represented by question 22

APPENDIX 4 – STEP TWO RESULTS (FACTOR ANALYSIS)

Question	Factor 1	Factor 2	Factor 3	Factor 4	Communality
Q4	0.732	0.008	-0.081	-0.009	0.543
Q12	-0.707	-0.212	-0.031	0.118	0.559
Q22	0.702	0.373	0.079	-0.200	0.678
Q2	0.126	0.948	0.033	-0.036	0.917
Q1	0.319	0.715	-0.060	0.127	0.632
Q28	0.166	-0.141	-0.969	0.115	1.000
Q27	-0.163	0.065	-0.721	-0.117	0.565
Q8	0.401	0.314	-0.461	0.337	0.585
Q15	-0.056	-0.114	-0.091	0.988	1.000
Q29	0.109	-0.115	-0.048	-0.208	0.071
Variance	1.8759	1.7427	1.7010	1.2308	6.5504
% Var	0.188	0.174	0.170	0.123	0.655