Course title: Selected economic and financial risks

Topic 7: Risk assessment

T7 processors:

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Aims: The aim of the topic is to acquaint students with specific methods of risk assessment and show their strengths and weaknesses

Tasks for independent work:

Answer the following questions

1. For what purposes serves to Koring above model credit risk rating and which is based on assumptions?
2. What is family accounts statistics, what does it tell us and how is it compiled?
3. What are the basic benefits of ISO 31000 risk assessment ?
4. On what principles does the analysis of failures and their impacts work - FMEA?
5. On what principles is the Delphi technique based and what information can this technique provide us with?
6. What are the principles of the Monte Carlo technique and what information can this technique provide us with?

Content:

- Risk assessment
- Aggregated data from the CZSO
- Family accounts statistics (SRÚ)
- ISO 31000 standards
- Risk assessment process
- Selected methods of risk assessment
- ČSN ISO 31010 and examples of risk management methods

Risk assessment

Scoring model of credit risk assessment

The scoring model is used to assess the credit risk or a non-banking institution when a client applies for a loan. Each loan applicant is assigned a *score* based on this model . The score is usually represented by an estimate of the probability that the client will repay the loan. According to the score, the institution then decides on the conditions under which it will provide the loan. The scoring model is usually based on a database of existing clients who have already been granted a loan, together with information on which of them managed to repay the loan. A suitable client for a banking institution providing a loan is one that has repaid the loan on time and under specified conditions; an unsuitable and bad client is the opposite. Scoring is then BASED n the history of these two groups of clients and their behavior and characteristics, which are characterized. One of the main measures of the scoring model is the diversification of good and bad clients based on the characteristics described above. [1]

According to the characteristic characteristics, the effort is to find in an ideal case a model where there would be a scoring limit for which all bad clients in the database would be rated lower and all good clients would score higher. In such a model, we could then decide relatively well on the allocation of a bank loan based on the achieved score.

In practice, however, we usually do not find a scoring function that would unmistakably capture the quality of all clients in the database, as it is likely that there will be those clients who have low scores but still managed to repay, and those who, despite their high score the loan did not pay. The scoring function then divides good and bad clients only approximately. Overall, the score would set a threshold where everyone above it would be perceived as good and suitable clients and applicants, and vice versa below it would be bad clients.

For graphical representation of the ability to diversify, we use, for example, the Lorenz curve , for numerical quantification then the Gini coefficient .

Aggregated data from the CZSO

Information about clients and the situation can also be obtained for the so-called "average citizen" or "average household". In the Czech Republic, so-called family accounts statistics are compiled in this context.

Family accounts statistics (SRÚ)[2]

Family accounts statistics (SRÚ) monitor the economy of private households and provide information on the amount of expenditure and the structure of consumption in individual types of households (eg in households of employees, non-working pensioners, families with children, single-parent families) or on the influence of various factors (eg price movements , the market situation) on the structure of expenditures and consumption habits of Czech households. The information obtained cannot be obtained from any other sources. The processed data from the survey are a source of information for the Ministry of Labor and Social Affairs and the Government of the Czech Republic in the preparation of a number of measures in the social field, they serve as a basis for social and international comparisons. The survey itself has a long tradition in the Czech Republic, which dates back to 1957. In 2016, a significant reform of Family Accounts Statistics took place, the new method of survey is based on a random selection of households. Statistics on family accounts take place throughout the year, in all regions of the Czech Republic, and since 2017 it has been linked to the Living Conditions Survey (SILC). In the field, it is provided by experienced interviewers of the CZSO regional administrations.

Survey outputs:

- https://www.czso.cz/csu/czso/prijmy-a-zivotni-podminky-domacnosti-2019

Examples of methods usable for risk assessment in investment decision making [3] **:**

1. Expected return on investment - Necessary to determine the risk associated with a particular investment, we calculate it as a weighted average of all possible outcomes, where the weights form the probabilities of their occurrence. Calculating the value of the expected return on an investment is an important step in investment decision-making.
2. The variance of investment returns - is calculated as a weighted average of square deviations from the expected value, where the weights form the probabilities of occurrence of individual results.
3. Standard deviation of investment returns - represents the square root of the variance.
4. Coefficient of variation - used to measure the amount of risk; represents the ratio of the standard deviation to the average expected return on investment. We always compare the standard deviation of the investment in absolute terms to the expected return on the investment in absolute terms or. standard deviation in relative terms to expected yield in relative terms.

5. The variance of portfolio returns - is calculated as the sum of all possible combinations of the product of standard deviations, the proportions of financial resources and the correlation coefficient of two investments in the portfolio.
6. Standard deviation of portfolio returns - represents the square root of the variance.
7. Portfolio variation coefficient - expresses the relative rate of profit (the ratio of the standard deviation and the expected return of the portfolio.

ISO 31000 standards

International standards of 31 000 international Organization for Standardization (International Organization for Standardization - ISO) focus on risk management system in the organization (Enterprise Risk Management system). A large number of an organization's activities pose a risk, and the organization identifies and manages risks, in particular by assessing whether it will change the risk by conducting a risk assessment. The purpose of this published standard is to provide possible and general (applicable in all types of organizations) methodologies for risk management. Organizations shall use ISO 31000 standards to streamline the management of their existing risks or the risks they may face in the future and shall adapt their documentation accordingly. This International Standard supports proactive governance in all areas. The 31000 series standards are subject to a certification process [4]

Risk assessment is one part of risk management that provides a structured process to identify how objectives can be affected and to analyze risks in terms of consequences and their likelihood before deciding whether further risk treatment is necessary. The risk assessment seeks to answer the following questions: What can happen and why? What are the consequences? What is the probability of their future occurrence? Are there any factors that mitigate the consequences of the risk or that reduce the likelihood of the risk? Is the level of risk tolerable or acceptable and requires further treatment? [5]

ISO 31010 is intended to reflect current good practice in the selection and use of risk assessment techniques and does not refer to new or evolving concepts that have not reached a satisfactory level of professional consensus. The standard is general in nature, so it can provide guidance for many industries and many systems. This International Standard supports ISO 31000 and provides guidance on the selection and application of systematic risk assessment techniques. Risk assessment performed in accordance with this standard contributes to other risk management activities. [6]

ISO 31010 does not specify specific criteria for determining the need for a risk analysis, nor does it specify the type of risk analysis required for a particular application. This standard does not refer to all techniques, and the omission of a particular technique from this standard does not imply that the technique is not valid. The fact that a method is applicable in certain situations does not necessarily mean that the method is to be used. [7]

The purpose of risk assessment is to provide fact-based information and analysis in order to make an informed decision on how to treat certain risks and how to choose between options. The basic benefits of performing a risk assessment include [8] :

- Understanding the risk of potential impact on goals.
- Providing information to decision makers.
- Contribute to the understanding of risks in order to assist in the selection of treatment options.
- Identify important factors contributing to risks and weaknesses in systems and organizations.
- Comparison of risks in alternative systems, technologies and approaches.
- Communication of risks and uncertainties.
- Assistance in setting priorities.
- Contribute to the prevention of incidents through post-incident investigations.
- Selecting different forms of risk.
- Meeting the requirements Fill ý dripping with rules and regulations.
- Providing information to help assess whether the risk should be accepted.

The risk assessment includes the main elements of the risk management process, which are defined in ISO 31000 and include the following elements [9] :

- Communication and consultation.
- Determining the context.
- Identification, analysis and assessment of risks.
- Risk treatment.
- Monitoring and review.

Risk assessment is not an independent activity and should be fully integrated into other parts of the risk management process. Risk assessment is assumed to be performed within the risk management framework and process described in ISO 31000. The risk management framework provides policy procedures and organizational arrangements that incorporate risk management throughout the organization at all levels. Risk assessment will enable decision-makers and responsible parties to better understand the risks that could affect the achievement

of objectives as well as the adequacy and effectiveness of the risk management elements that are already in use. This provides a basis for deciding on the most appropriate approach to use to address the risks. The output of risk assessment is the input to the process of the organization. Risk assessment is an overall process consisting of risk identification, risk analysis and risk assessment. The way in which this process is used depends not only on the context of the risk management process, but also on the methods and techniques used to carry out the risk assessment. [10]

Risk assessment process

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Risk identification

Risk identification is the process of finding, recognizing and recording risks. The purpose of risk identification is to identify what could happen or what situations could occur that could affect the achievement of the objectives of the system or organization. The risk identification process involves identifying the causes and sources of the risk, events, situations and circumstances that could have a material impact on the objectives and nature of that impact. [13]

Risk analysis

Risk analysis concerns the development and understanding of risk. Provides input into risk assessment and the decision about whether to treat risks, and about which strategies and methods of treatment are the most suitable. Risk analyzes include the determination of the consequences and their probabilities for identified risks, taking into account the presence and effectiveness of any existing elements of risk management. The consequences and their probabilities are then combined to determine the level of risk. [14]

Risk assessment

The risk assessment shall include a comparison of the estimated levels of risk with the criteria set out in the context of determining the context in order to determine the significance of the level and type of risk. The risk assessment uses an understanding of the risk acquired during the risk analysis in order to decide on future interventions. The decision as to whether and how to treat a risk may depend on the costs and benefits of taking the risk, and on the costs

and benefits of implementing better risk management elements. A common approach to risk assessment is to divide risks into 3 groups:

- The upper group, where the level of risk is considered unacceptable regardless of whether the activity can bring any benefit and the treatment of the risk is necessary at any cost.
- The middle group or gray area, where both costs and benefits are taken into account, and opportunities are considered in terms of potential costs.
- Lower group, where the level of risk is considered to be negligible or so small that no risk management measures are needed .

The risk assessment process should be documented together with the results of the assessment. Risks should be expressed clearly and units , in which the expressed level of risk , should be clear. [15]

Choice of risk assessment techniques

A separate part of ISO 3101, which describes how risk assessment techniques can be chosen. The annexes provide a list and range of tools and techniques that can be used to carry out a risk assessment or that can help with the risk assessment process. Occasionally, it may be necessary to perform more than 1 assessment method. Risk assessment can be performed at varying degrees of depth and detail and using one or many methods from simple to complex. Overall, suitable techniques should have the following characteristics:

- The technique should be justified and appropriate to the situation or the organization under consideration
- The technique should provide results in a form that improves understanding of the nature of the risk and the ways in which the risk can be addressed
- The technique should be designed to be used in a manner that is repeatable, visible and verifiable

Reasons should be given for the choice of techniques with regard to importance and suitability. [16]

Selected methods of risk assessment [17]

The subject of the methods is the regular identification and assessment of risks, for example at the supplier. In practical activities, especially for the objectification of decision-making opinions in the selection and assessment of risks, it is possible to use various tools and

methods. For specific use, the standard ČSN EN 31010 Risk Management - Risk Assessment Techniques idt . IEC / ISO 31010: 2009.

Definition of the term risk[18] There is an inexhaustible amount. There are several of them in the list below, for example:

- Risk is an event or fact that can occur and, if it does, has a negative impact on the value of the company. The risk should be measurable depending on its impact and the likelihood that it will occur (D. Haidler).
- An unexpected event or condition which, if it occurs, has a positive or negative effect on the objective of the project (ČOS 051655).
- Risk is the probability that a phenomenon will have a negative impact on an organization. Risk is a term used to describe a situation that can cause potential losses to a company or organization (J. Dvořáček: Internal audit and control).
- Risk is a situation in which there is a possibility of an unfavorable deviation from the desired result that we hope for or expect (V. Šmejkal, K. Rais: Risk Management).
- Risk is the uncertainty as to whether an event will occur that could adversely affect the achievement of set objectives. The risk is measured according to the possible consequences and the probability of occurrence. (Standards for the performance of internal audit).
- Risk is a possible problem that can have a negative impact on the result or the value of the company.
- In business, there is also a risk of an untapped opportunity.

We use risk analysis for assessment. It is a control method by which risks related to the activities of a public administration body are recognized and searched for in a timely manner, resp. identified, evaluated (ie determining the degree of significance of the risk measured according to possible adverse effects and the probability of exposure to this risk). This is followed by providing information about them to the appropriate level of management. It will evaluate them and use them to decide how to eliminate or minimize these identified risks or their adverse effects. The risk analysis shall determine the nature and manner of acceptance of the risk and the degree of significance of the risk. These overall characteristics are based on the measures taken by the head of the public administration body and the managers of this body, which are taken with regard to the assumed risk containing measurable properties.

The risk analysis includes these sub-steps[19] :

- analysis of mutual relations, context and context of processes connected with activities, operations, programs, projects in the activity of public administration body. This is related to ensuring the approved intentions and goals of the public administration body;
- creating a basic set of potential risks in processes, operations, programs, projects and activities based on individual and team perception. This should include in the outputs a precise identification of the risks together with the formulation of a basic opinion on the possibilities and probabilities of the risks being affected. It includes a statement of their adverse effects on the fulfillment of the approved intentions and objectives of this body;
- selection of a set of risks that are important for the responsibilities of the head of the public administration and senior staff;
- determination of the degree of significance of risks by a team of respondents based on the measurement of risk factors;
- compiling the order of risks according to the determined degree of significance (values of measurement of risk factors) for determining risk priorities.

This involves a factual assessment of the levels of risk and, in connection with this, the adoption of appropriate corrective or preventive measures to limit the identified levels of risk to an acceptable level. Each of the existing methods for determining risks is generated for a specific problem .

Check List (checklist) j e procedure based on systematic monitoring compliance with predetermined conditions and measures. Each table or form always serves a specific purpose to which their construction must be subordinated (usually we do not find a standardized template). In order to be used for analytical and control purposes, each table or form must contain the necessary particulars:

- own content (what information to capture and in what context),
- the way in which the information is obtained,
- an indication of the person responsible for recording the data,
- method of recording (numbers, symbols),
- time data of the record,
- place of recording.

Safety Audit is a process that looks for risk situations and proposes measures to increase safety. The method is a procedure for finding a potential accident or operational problem that may occur in the system under consideration. Formally, a prepared list of questions and a matrix for risk scoring is used.

Failure Mode and Effect Analysis - FMEA (FEA) is a procedure based on the analysis of failure modes and their consequences, which allows the search for impacts and causes based on systematically and structured failures. The FMEA method is used in quality planning in the form of design analysis, process analysis or product analysis. The aim is to identify at various stages of product or process creation, as soon as possible the possibility of defects, determine their possible consequences, assess the risks and prevent them safely. Typical elements of the method are:

- functionally oriented way of thinking and progressing,
- systematic workflow,
- teamwork,
- use of creativity methods,
- formulation of proposals for quality improvement.

Risk assessment, assessment and evaluation: Significance (importance) of the defect "R&D"; the probability of occurrence of a "PV" defect; the probability of detecting a "PO" defect; All three factors are probabilistic assumptions. A ten-point scale is usually used for evaluation, according to which team members, event. other invited externalists evaluate the occurrence with the appropriate number of points (see table ČSN IEC 812).

Calculation of the risk / priority level "RPN" (Risk Priority Number): RPN = VV x PV x PO

This is followed by a selection of the causes with the highest RPN risk number and the most serious significance. High RPN values (eg over 125) or high ratings of individual factors must be renegotiated. Within the FMEA process, weak points in procedures and activities, equipment, processes, individual stages of product creation, etc. are analyzed . It is based on a list and causes of potential process defects. It specifies the necessary corrective action (such as FMEA design). The working group is led by an employee of the relevant organizational unit or quality assurance. Within the FMEA of a product (system), the product and the process of creating the product or the system as a whole are examined. Analyzes and improves both in one FMEA .

ČSN ISO 31010 and examples of risk management methods:

Monte Carlo simulation[20]

It is used for systems that are too complex in terms of the consequences of uncertainty affecting the system and thus cannot be modeled using analytical techniques. The inputs are considered random and proportional and *N* calculations (simulations) are performed by sampling the input in order to obtain *N* possible outputs. The process of using the method was time consuming, but advances in computers and theoretical development have made the processing time for many applications almost negligible. Its use p oskytuje means to assess the implications of uncertainty in the systems in a wide range of situations. It is commonly used to evaluate the range of possible outcomes and the relative frequency of values in this range for quantitative system indicators (cost, duration, production capacity, demand, etc.). It can be used for two different purposes: Extending conventional analytical models with uncertainty. Probabilistic calculations when analytical techniques are inoperative.

Hazard analysis and critical control points[21]

It provides the structure used to identify hazards and to place risk management elements in place in all important parts of the process to protect against hazards and maintain product quality and reliability. The analysis aims to ensure that risks are minimized through risk management elements during the process rather than during the control of the final product.

Use - The analysis was created to ensure food quality for NASA's space program, and is now used by organizations in the food chain to manage the risks from physical, chemical or biological contaminants in food. Its use has been extended to the production of medicines and medical devices.

Inputs - starts with the basic development scheme and information about hazards that may affect the quality or reliability of the product, the input to the analysis is information about hazards and how they can be managed

The process - consists of 7 steps: Hazards and preventive measures are identified; Points in the process are identified where hazards can be controlled or eliminated; The critical limits needed to manage hazards will be established; The critical limits for each control point are monitored at specified intervals; Corrective actions will be agreed; Verification procedures shall be in place; Records are kept of procedures for each step

Outputs - Documented records include a worksheet and a plan for hazard analysis and critical control points. The strengths are: Focused on practicality; Ability to identify hazards

endured by human intervention; It allows risk management during the process rather than relying on the control of the final product; Structured and provides documented evidence for quality management. Limitations of the method include: the need to identify critical control points and risks and to understand their significance, appropriate elements of risk management need to be identified

Delphi technique[22]

Procedure for obtaining a reliable consensus of opinions in a group of experts. Unlike brainstorming , the basic feature was originally that the experts expressed their views individually and anonymously, while having access to the views of other experts as the process progressed.

Use - can be used at any stage of the risk management process, wherever it is necessary to reach a consensus of experts. Inputs - a set of variants for which it is necessary to reach a consensus. Process - a group of experts is interviewed using a structured questionnaire, experts do not meet, so their opinions are independent.

The procedure is as follows: create a group that executes and monitors the Delphi process ; election of a group of experts; elaboration of the first round of questionnaires; testing of questionnaires; sending questionnaires to each participant individually; the information from the first round of responses is analyzed and combined and circulated repeatedly among the participants in the discussion; the participants in the discussion react and the process is repeated until an agreement is reached

Outputs - convergence towards consensus in the matter under discussion. Strengths: opinions are anonymous - they are more likely to express unpopular opinions; all opinions have equal weight, which eliminates the problem of dominant figures; people do not have to be in one place at the same time, the limitation is the complexity of work and tedious; the participants need to be able to express themselves in writing.

Brainstorming [23]

Part of brainstorming is to stimulate and encourage free-flowing conversations in a group of knowledgeable people in order to identify potential modes of failure and risk. Brainstorming is often referred to as any type of group discussion, but actual brainstorming involves certain techniques that try to ensure that the human imagination is set in motion by the thoughts and expressions of other people in the group.

Use - Brainstorming can be used in conjunction with the other risk assessment methods specified in the standard, or it can be used separately as a technique to encourage imagination to stimulate imagination in the risk management process. Great emphasis is placed on imagination. It is therefore particularly important in identifying the risks of new technology where the necessary data does not yet exist.

Inputs - a group of people with knowledge of the organization, system, or process being assessed.

The process - can be formal or informal. Formal is more structured with pre-prepared participants, the session has a defined goal and outcome with means of evaluation, informal is less structured and is often intended for a specific purpose: before the session begins, tools are prepared to think about the problem, session objectives are set and explaining the rules, the facilitator starts a thought process and everyone examines the ideas, identifying as many problems as possible. All inputs are accepted and no one is criticized; When one may be exhausted thinking, the facilitator can turn people in a new direction, the intention is to gather as many different ideas as possible.

Outputs - depends on the stage of the risk management process in which B is applied, eg in the identification stage, the output may be a list of risks and current elements of risk management. Strengths: supports imagination, which helps identify new risks and original solutions; involves key stakeholders and thus helps in overall communication; it can be called up relatively quickly and easily. Limitations of the method: participants may lack the expertise and knowledge to contribute effectively; B is unstructured, so it is difficult to prove that all potential risks have been identified; there may be some group dynamics, with some not manifesting and others dominating - this can be prevented by computer brainstorming, which is anonymous, thus eliminating personal and political problems that may impede the free flow of ideas.

Assessment of trouble-free human activity[24]

It deals with the human impact on the functionality of the system and can be used to evaluate the effects of human error on the system. Use - can be used quantitatively or qualitatively. It is used qualitatively to identify potential possibilities of human error and their causes so that the probability of error can be reduced. Quantitative is used to provide human failure data for other techniques.

Inputs in this method include: Information about specific tasks that people should perform; Experience with the types of errors that occur in practice; Expert opinion on human error and its quantification.

The process of using the method has the following steps: The problem of what types of human participation are to be investigated is defined. The task is analyzed, how the task will be performed and what tools are needed to perform it. A human error is analyzed as to how the task may fail. Presentation of how errors in the performance of tasks can be incorporated into other events in order to calculate the probability failures of the overall system, Classification, there are some errors that do not require detailed quantification, Quantification of how likely individual errors and failures of tasks. The impact of which errors are the most important, which contribute the most to reliability or risk , is assessed . Errors will be reduced as to how better human trouble-free operation can be achieved. Documentation of which method steps need to be documented.

Strengths of the method: the method provides a formal mechanism for incorporating human error into risk considerations in systems where people often play an important role. On the limit: the complexity and diversity of people, which makes it difficult to determine the ways and likelihood of risks; many activities of people can not be described in a simple way passed / failed, the method has a problem to deal with partial disorders or a disorder based on bad decisions

Examples of other techniques:

- Structured or semi-structured interviews
- Preliminary hazard analysis
- Toxicity assessment
- Structured technique "What happens when"
- Scenario analysis
- Business impact analysis
- Root cause analysis
- Analysis of ways and consequences of failures
- Fault state tree analysis
- Cause-effect analysis
- Analysis of causes and consequences
- Analysis of protective layers
- Decision tree analysis

- Butterfly type analysis

Resources:

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