RISK ANALYSIS AND RISK MANAGEMENT. DEVELOPMENT OF RISK INDICATORS IN ELECTRICITY TRANSMISSION COMPANIES

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Abstract: **Lucrarea prezinta aspecte din procesul de identificare a riscurilor critice, a cuantificarii impactului acestora si implementarii acelor strategii de management al riscului pentru a maximiza valoarea companiei. Principalele etape in construirea sistemului de managementul riscului sunt sumarizate in baza experientei inregistrate de companii de electricitate europene, care se află în diverse etape de implementare, cu focalizare pe cuantificarea riscurilor si indicatorii de risc.**

Se prezinta totodata realizarile Transelectrica in dezvoltarea procesului sistematic si cuprinzator de definire a riscurilor critice si de cuantificare a impactului materializarii acestora, in vederea implementarii unui program integrat pentru minimizarea si controlul riscurilor si stabilirea strategiilor pentru limitarea, protejarea si, transferul riscurilor si restabilirea activitatii, pentru protejarea valorilor companiei.

***Key words*: risk management, indicators, risk analysis**

***Descriptori*:** managementul riscului, indicatori, analiza de risc

Notatons:
BIA - Business Impact Analysis / Analiza de impact
SEN – Sistemul Electroenergetic National

1. RISK MANAGEMENT

Risk management may help an organization make informed decisions, the concept being used to identify and assess the consequences of events in terms of the key business values of companies and to compare the corresponding risks in order to prioritize risk treatment measures. In the ideal situation, all risks are expressed in financial terms so that return on risk treatment costs becomes a discriminating parameter for comparing risk treatment options. Risk is defined as the product of the probability of an event and its consequences /1/. The term risk is generally used only when there is at least the possibility of negative consequences. In some situations, risk also arises from the possibility of a deviation from the expected outcome or event.

In this paper, the term risk includes several other factors beyond the reliability of the power system, trying to link the management of business risks by electricity transmission companies and the risk management of the power system and the physical assets involved.

Therefore since 2002, CN Transelectrica, with the external consultancy implements an Enterprise Risk Management (ERM) Program, to address the following objectives:

- anticipate and prevent major disruptions in operation
- ensure adequate liquidity / cash flow for operating expenses, debt payments and strategic investments.
- protect long-term viability and strength of the Company,

the paper presents some of our achievements as case study /4/.

2. RISK ANALYSIS

The management of risk involves the analysis of events for a system (organization, network etc.) that may have a negative impact. And it involves the design, decision making, execution of the measures to treat the risk and the evaluation of the effectiveness of the measures.

Utilizing risk management on a regular basis i.e. to identify and assess the risks helps a company or organization to account for possible future events with a negative impact on the organization and its environment. It creates awareness of risks and the possibility to evaluate the actions or decisions to be taken to treat i.e. minimize or mitigate the risks.

Risk analysis is applied for decision support; for example to choose between alternative measures to be taken with regard to maintenance of assets or to provide support in go/no go decisions, for example whether to invest now or a few years later in network reinforcement in a specific area of load growth.

Risk analysis is also applied to enhance control of risks. A risk analysis made explicitly has the advantage that risk information can be shared and discussed between experts and managers.

Risk Management lays the groundwork for decisions about allocating resources to manage risk and reduces the element of surprise. In Transelectrica, was set The Risk Management Program that effectively integrates the risks across the entire Company, allowing tailoring imaginative and cost-effective options for risk reduction and risk transfer. Transelectrica is developing the process of a systematic and comprehensive definition of the critic risks and of quantifying their impact, with the view of implementing an integrated program, to minimise and control the risks and to set the appropriate strategies on treating, preserving, transferring and recovery procedures meant to protect the values of the company.

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Risk analysis can be applied to several topics. For example on projects: the timely and cost effective erection of a substation of sufficient quality involves many risks varying from the time – consuming permitting procedures from authorities, to the variable and long delivery times from equipment manufacturers that are part of a sellers market. Risk analysis is also applied to processes, for example, network operation and the development of emergency restoration plans.
In Figure 1 a flowchart is shown to illustrate the relationship between the different risk management processes, [IEC 60300-3-1].

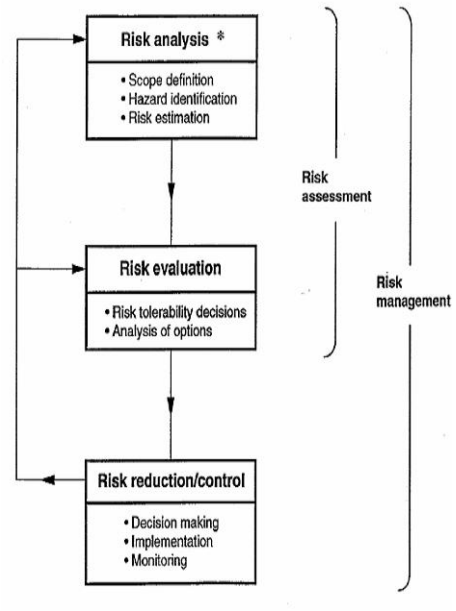

Fig. 1. Risk management relationships, [IEC 60300-3-1]

In Transelectrica the "Business Risk Audit" (BRA) was the initial diagnostic process, which comprised interviews with top management, including the various Head of Departments and Directors. The main objective of BRA was to identify and highlight areas of business risk exposure of Transelectrica, as well as highlighting gaps in the current risk strategies. Once the most critical problem areas or hot spots had been identified from the initial diagnostic process, a more detailed analysis to address these problems would be provided in the following stages. Business Risk Assessment is a Trend Tracker based audit template consisting of 19 headings, such as: Business Strategy, Risk Financing, Business Continuity, Credit and Political Risks, Brand and Reputational Risk, Workplace Health and Safety, Ergonomics, Fleet Safety, Internet Risks, Environmental Management, Human Resources. More than 400 questions had been asked in Yes/No format and the results had been evaluated in terms of percentage scored as well as priority of the heading.
The compliance rate of each heading indicated where is Transelectrica situated according to the Best Practices Benchmarking system /4/. It should be borne in mind that the rate is only based on the percentage scores, therefore the criticality of a category should be evaluated in terms of financial impact to the operations.

3. RISK MANAGEMENT DEFINITIONS

The standard ISO/IEC 73 /1/ presents definitions of generic terms involved in risk management. The risk management process is presented as a set of different subprocesses. Risk management is a set of coordinated activities to direct and control an organization with regard to risk. Risk management includes risk assessment, risk treatment, risk acceptance and risk communication. Risk evaluation is the process used to assign to the probability and consequences of a risk. (see Figure 2)

Risk management			
	Risk assessment		
		Risk analysis	
			Source identification
			Risk estimation
		Risk evaluation	
	Risk treatment		
		Risk avoidance	
		Risk optimization	
		Risk transfer	
		Risk retention	
	Risk acceptance		
	Risk communication		

Fig. 2. Risk management – Sub process relationships /1/

4. ESTABLISHING THE CONTEXT AND RISK CRITERIA

Like in any other survey or analysis, the objectives, the scope of and the reason to perform the risk analysis need to be well defined in a risk analysis. For example, the scope may consist of a specific asset, a group of assets of the same type, a subsystem (regional electricity network) and the reason to perform the risk analysis may be a deviation from a norm or limit-value for performance or condition or many other possible topics.
For a risk analysis the unwanted top events need to be defined, for example events with significant negative impact on the company as a whole and its financial position, events which may impact the performance or security of supply, or the quality of service or public or personnel safety and the environment. Many companies define their key business values and the range of potential impacts from these top events can be directly expressed in terms of the key business values /6/.

5. IDENTIFYING, ANALYZING AND EVALUATING RISKS

A risk is quantity associated with an unwanted event that may or may not occur and which may lead to a failure to get the desired output. The output can be defined in terms of financial performance or performance on security of supply, quality of service, safety & environment or any other key performance measure in a company. Risk is the product of the probability of an event and its consequences. Characteristic for risk is that uncertainty is involved.

Risk assessment attempts to answer the following fundamental questions /3/:

1. What can happen and why?
2. What are the consequences?
3. How likely are they to occur?
4. Is the level of risk acceptable or does it require further treatment?

A risk description can not be expressed as a question or as one word. It needs to be as specific as possible. In Figure 3 an example of a risk description is given. A risk description should be as systematic and complete as possible and regarded from different perspectives. In addition to technical risks, which are the primary concern of this brochure, financial business risks can also be described. Internal business risks, for example a lack of up to date procedures or external risks, like the relationship of the business with the neighbouring citizens and municipalities can be documented.

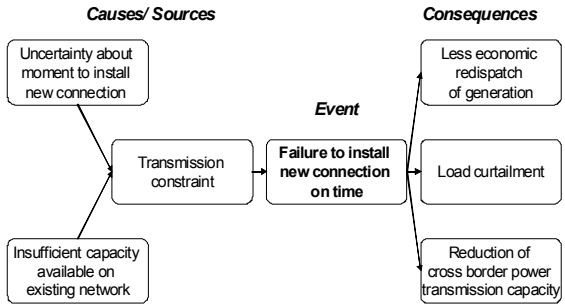

Fig. 3. Example of risk description for a project delay

When the risks have been identified and described, the next step is to assess the severity of the consequences to be able to select the most important risks for risk treatment. To enhance objectivity in risk estimation, the probability and the consequence are estimated separately and later combined to form an assessment of the risk. Estimation can be discriminated into qualitative estimation and/or quantitative estimation. Qualitative estimation means determination of the order of magnitude of the consequence or probability or division of the consequences or probabilities into categories. Quantitative estimation means using a calculated or approximate value for the probability and the consequence.

When probability and consequence categories are estimated the risk can be assessed by using a two dimensional risk assessment matrix as illustrated in Figure 4. This matrix show, which risks have high priority for treatment, which risks have medium priority etc.

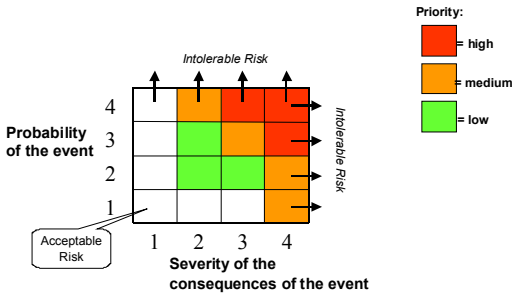

Fig. 4. Risk assessment matrix

In Transelectrica, once risks have been identified they should be assessed to determine the potential magnitude and likelihood of a given scenario and mapped accordingly. This enables the management to address risks with high to low priority order. The function of risk has two variables:

Frequency/probability: it determines probability of occurrence in a defined time interval.

Severity: it measures financial impact of a risk.

Therefore we had utilised comparative risk assessment for both Probability and Severity factors. The use of a two component definition for Risk Assessment (in this case Probability and Severity) allows a grid to be established for the potential loss scenario, which can then be measured against a desired maximum risk tolerance level.

6. RISK TREATMENT

First the potential optional treatment measures need to be identified, for example wait and accept the current risks, take action by investing in maintenance procedures, or refurbishment or ultimately replacement of the assets. Risks can be treated or modified, by such technical solutions, but also by improved operating procedures. As illustrated in Figure 5 preventive measures inhibit the causes or source that might lead to the unwanted event, while corrective measures mitigate the consequences of the event.

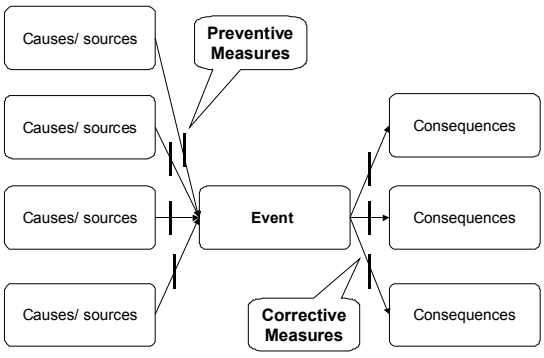

Fig. 5. Preventive and corrective measures depicted in risk description

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The company may decide to accept the consequences of a risk -this is called risk retention. The company may decide to retain the risk or to transfer the risk to another party. For example the company may transfer the risk to an insurance company or to a supplier of equipment. Risk transfer will not take the risk away but it will reduce the risk to a party, because the other party is more capable to bear or manage the risk. Risk transfer will increase operational expenditures. There is always a certain level of risk acceptance where risk treatment is impossible or too expensive.

To decide on the alternatives of risk treatment measures the concept of return on risk reduction is introduced. To determine the return on risk reduction first the reduction of risk caused by the alternative risk treatment measures needs to be estimated /7/. As illustrated in Figure 6.

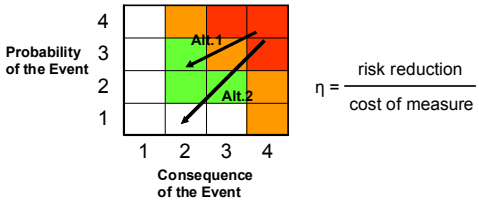

Fig. 6. Risk reduction of two alternative risk treatment measures

From the example it can be seen that alternative 2 has the largest risk reduction. Risk reduction may be expressed quantitatively if possible in financial units or qualitatively by risk points. The return on risk reduction of a risk treatment measure is then given by the formula: η = risk reduction / cost of measure.

The return on risk reduction is used to evaluate alternatives, but also to prioritize risk treatment measures when the budget is limited.

7. MONITORING AND REVIEW

Risk Management is a process that should be continually monitored, reviewed and improved. In the Risk Management Cycle risks are identified, evaluated and treated. The core of the process is the identification and assessment of risks and the decision to accept or reduce the risk.

- the analysis and assessment of the risks within and for the infrastructure along the business value model
- the decision to accept or reduce the risk
- the design and planning of the risk-reducing measures e.g. adaptation of maintenance plans, initiating investments in replacement or refurbishment
- the execution of the risk reducing measures e.g. execution of an asset replacement project

After the decision is made, a new situation exists and the asset manager continues analyzing the risks in the adapted infrastructure. This representation is in accordance with the Plan-Do-Check-Act cycle widely diffused through quality standards applied by most utility companies nowadays. In this way, grid operators use the risk management process as an improvement cycle. ISO standard 31000 (draft standard) /1/ proposes a dynamic representation of the risk management process (see Figure 7).

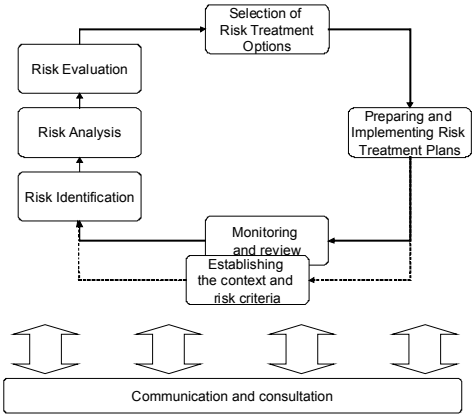

Fig. 7. Risk Management Cycle Risk attitude /2/

To get data for risk analysis of electricity transmission equipment requires effort. From business values and key performance indicators it is generally clear what measures the company considers to be important. The financial records of the company, historic data on unplanned outage costs, historic data on the costs of safety incidents etc. can be used to determine estimates for consequential costs and which consequences are acceptable and which are not for the company.

The decision to accept a certain level of risk depends on the risk attitudes of people or companies. The risk attitude may be neutral, risk avoiding, or risk seeking. Risk attitude is different from individual to individual and from company to company. It is determined by: financial position, reputation, possible influence on risks (or the illusion that this is possible), environment etc. The risk assessment matrix shows the risk attitude of a company.

8. RISK INDICATORS

Risk indicators are needed in risk management for risk monitoring, control and decision making. A risk indicator might be defined as a parameter which provides information about risk /5/.

Note 1: A risk indicator can give information about risk performance or risk exposure information

Note 2: A risk indicator should address probability aspects or consequence aspects or both.

Risk indicators can be classified as follows:

- Risk performance indicators giving historic risk performance information

– Risk exposure indicators mainly giving present and future risk expectation information with respect to different threats and uncertainties

Parameters providing risk information have "always" been used, but not necessarily labelled as" risk indicators" and used within a formal risk management concept. As the asset condition information is important in transmission system management, it will provide relevant input to estimate risk indicators. Health indices for equipment are examples of low-level risk indicators as they provide risk information and can be used in risk management. End of life estimates or fault rate expectations are other examples of risk indicators.

Risk indicators play a role in work processes and decision making. Some indicators are useful in asset management planning and decision making, while others are useful in every day work such as the daily maintenance of the transmission system. Risk indicator information or data are typically collected at the operational level in the organization and aggregated upwards in the organizational pyramid as illustrated in Figure 8.

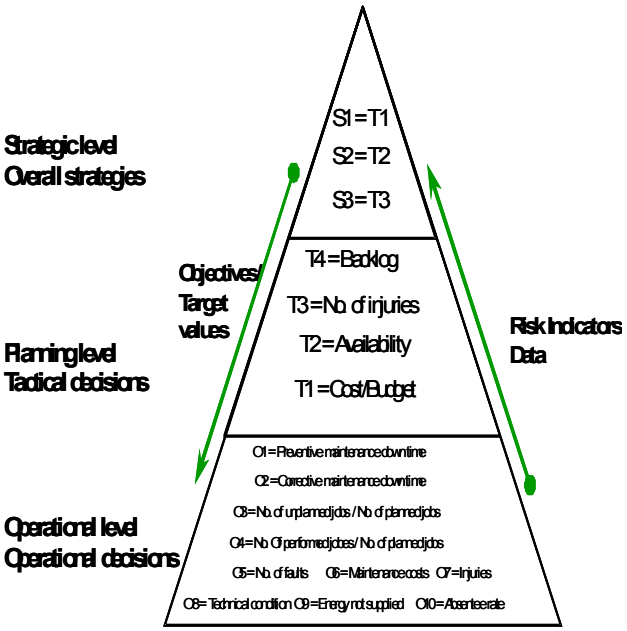

Fig. 8. Example of data and objective flows /5/

Risk exposure can be estimated by using appropriate simulation models that can provide relevant risk indicator information. The indicators themselves are also relevant as part of the input to such simulation models. The principle is illustrated in Figure 9:

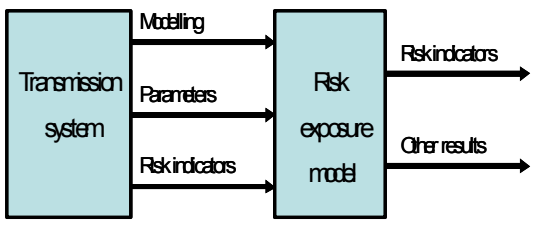

Fig. 9. Risk exposure simulation process

The set of risk indicators used as input to the risk exposure model are different from the set of risk indicators provided as output from the model.

The term simulation model should be given a broad interpretation. It is not necessarily a computer model, but a metaphor for the process of analysing a system or process in order to predict or assess its actual behaviour or state.

Risk exposure models could range from simple rules to more advanced computer based simulation models.

Risk indicators are also helpful when classifying risk elements in risk matrixes as the consequence metrics are examples of risk indicators. In this technical brochure, a number of risk indicators are given e.g. financial risk indicators, quality of service risk indicators, safety risk indicators, legal risk indicators, environmental risk indicators.

Figure 10. illustrates a methodology for the establishment of risk indicators in general. The principles described in the steps below are considered to be relevant guidelines for the establishment of risk indicators within the asset management context.

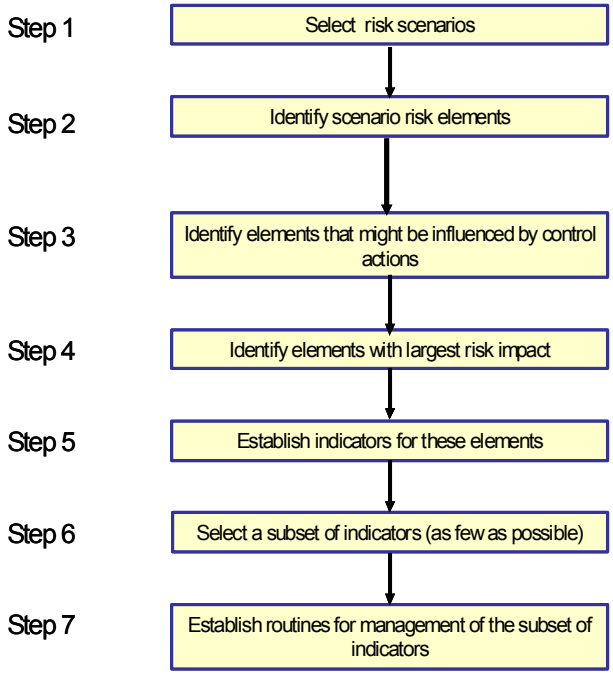

Fig. 11. Development of risk indicators /5/

The following questions form a checklist should have a positive answer when evaluating a risk indicator:

Is the risk relevant?

Is the indicator unambiguous and well-defined?

Is it linked to the company objectives and values?

Are the resources required to provide the indicator proportionate to the expected benefits?

Is it easy to use in decision processes?

Do the users find it relevant for the chosen purpose?

Is it accepted by the involved stakeholders?

Can the indicator be influenced by present or future control actions (or does is it only give historic information)?

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9. CONCLUSIONS

Risk is the combination of the consequences of an event and likelihood of the event, risk management consisting of several steps: risk assessment, risk treatment and risk monitoring and review. These steps are organized in an improvement risk management cycle. To assess and prioritize risks a risk assessment matrix is used to document the risk attitude of the company. The managers may use risk assessment matrices to derive the risk criteria for their decisions, since lastly the electricity transmission companies are monitored for risks using risk indicators.

A successful implementation of complete risk management system would only be achieved by means of adequate co-ordination, fully embedded within well design organizational built-up. It will permit the Company to make both short and long range plans to reduce, eliminate or assume the risks; the Company can better develop contingency plans and improve hazard-control programs. Managing the risks effectively is not only a fiduciary duty of executives and boards, it has also become key to value creation and risk strategy is what drives effective risk management.

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