Management Communication of Complex Risk Assessment

INTEGRATING BAYESIAN BELIEF NETWORKS AND BALANCED SCORECARDS

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Introduction

Banks face a variety of risks every day. While financial risk management has always been a core competency, focus shifted only recently to non-financial risks. A strong motivation for this trend is the regulatory requirement of the New Capital Accord (Basel II) that obliges financial institutions to assess their operational risk level and to hold adequate equity capital. As a result, banks need to thoroughly assess these risks and decide on effective mitigation strategies. Therefore, the communication of relevant risk assessment results to top management is as essential as the prior measurement. Theory provides powerful methods for risk modeling, e.g. Bayesian Belief Networks. However, these methods are not only complex to employ but also complex to communicate to management. It is shown how causal risk modeling employing Bayesian Belief Networks (BBN) and a Risk Balanced Scorecard (BSC) can be used to assess and communicate operational risks and to simulate the effects of risk mitigation decisions. Especially IT risks resulting from disruption of business or system failures have received increasing attention as they substantially affect overall business performance. Therefore this risk category is employed as an example in the following, although the presented toolkit can be transferred to other operational risks. With this method, top management can be supported with decision-relevant information on operational risks and their impact including sensitivity analyses while the underlying sophisticated causal modeling logic of the BBN remains hidden. As the BBN and the related BSC are totally transparent towards each other, management can simulate actions on a BSC level, which have direct impact on the BBN. In turn, results appear as instant feedback in the BSC. Moreover, figures in the BSC may serve as controls for management and can be tied to an incentive system.

Methodology

Bayesian Belief Networks have been studied for management purposes for some time now and have been successfully applied within several disciplines. Their employment for operational risk management is highly advocated by current research. In contrast to classical statistics, which require large test samples to assess the likelihood of the actual occurrence of incidents, e.g. rogue trading or fire in a data center, Bayesian Belief Networks combine expert estimations and historical data in a causal model thus compensating for poor data availability. Based on this sophisticated method of risk measurement, Balanced Scorecard is used as a communication tool for the measured risks. Balanced Scorecard is one of the most important and widely adopted performance measurement methods, and especially its recently evolving usage for IT makes it an attractive tool to communicate IT risks.

Bayesian Belief Networks at work: Risks of Desktop Service Providing

Figure 1 shows a sample Bayesian Belief Network for desktop infrastructure risk that contains the major risk elements for the functioning or failure of a PC desktop system. The shown graph has the main measuring objective to calculate and communicate the percentage of desktop infrastructure uptime and downtime (1 - uptime). The nodes above the bottom node *Desktop infrastructure availability* contain the potential risk sources for desktop infrastructure failure. The edges between the nodes describe the risk dependencies. For instance, if LAN uptime drops by 1 percentage point, WAN access is reduced by the same amount. In this example *Desktop infrastructure availability* is ultimately decreased by 0,97 percentage points to 95,08%, as people working with networked applications are hindered within their work. In this way the BBN in figure 1 allows for the software based simulation of the likelihood of *Desktop infrastructure availability* dependent on the states of all pre-

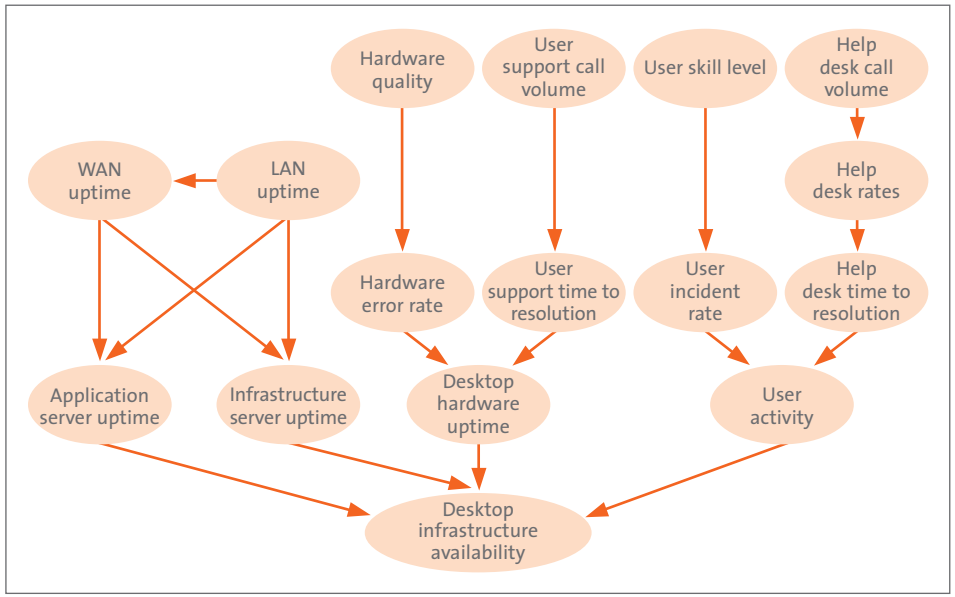

Figure 1: Bayesian Belief Network of desktop infrastructure risks.

decessors. In Bayesian statistics, the importance of individual nodes for the entire model is represented in the parameters of the nodes. But only the most important objective figures (key risk indicators) and their most important drivers (key risk drivers) are going to be communicated. All other intermediary nodes are merely simple risk indicators, which are measurable but not directly controllable. They are not a lever for management and therefore omitted in the Balanced Scorecard. So when identifying the different risk factors and their dependencies for the Bayesian Belief Network, it is important to differentiate between key risk drivers, key risk indicators, and risk indicators. As management requires decision relevant information, only the following key risk indicators and key risk drivers described in figure 1 need to be communicated to management:

Key risk drivers: WAN uptime, LAN uptime, Hardware quality, User support call volume, User skill level, Help desk call volume

Key risk indicator: Desktop infrastructure availability

Transformation of BBN to BSC

The main objective of mapping the previously presented BBN onto a BSC is to reduce information complexity. Considering that the mapped BSC will be used as a management presentation tool, all information relevant for top management must be included as described in Figure 2. The key risk indicator and drivers are distributed to four perspectives of the BSC, which are related as closely as possible to the generic BSC perspectives.

Results

Only the BSC will be presented to top management, the underlying BBN remains hidden. Both are completely transparent towards each other. The BSC is a reduced version of the BBN, containing all relevant nodes for management information and the major dependencies. The management can alter figures within the BSC, the changes link to the corresponding nodes of the BBN resulting in new calculations, which are then returned to the BSC. Without the risk indicators, which are not a lever for risk mitigation, management can focus on the important objective figure in the perspective *Objective* and the related adjusting levers in the other three perspectives of the BSC. More importantly, deviations from predetermined boundaries of the figure *Desktop infrastructure availability* can be (financially optimally) adjusted by changes of the figures within the other three BSC perspectives. Moreover, figures serve as controls for management and can be used as incentive goals. For example, increasing transparency allows control of key figures like server uptime and lower level management is incited to improve performance.

Conclusion

Current research is proposing the use of advanced causal modeling to better understand and predict operational risk. Bayesian Belief Networks (BBN) fulfill this objective as they can integrate expert judgments and historical data to model operational risks in a causal model. BBNs allow for a complex modeling of the environment at the cost of results that are difficult to present to management. To overcome this issue, a Balanced Scorecard (BSC) is used, as this is a globally established management tool. Practitioners can use this integrated approach to hide the complexity of causal models from top management deciders without sacrificing the explanatory power of these networks. Besides the primary focus for banks to control their operational risk, there are other fields of application for this method. In the outsourcing domain especially in early stages of an outsourcing project there is currently a lack of risk estimation. This method can be used to support make-or-buy decisions by comparing actual with expected risk levels by simulation, to determine adequate prices of service levels, and also for provider management (achievement of objectives). Internally, this method supports the calculation of business cases for risk mitigation measures, and when tied to an incentive system also serves as a management control.

References

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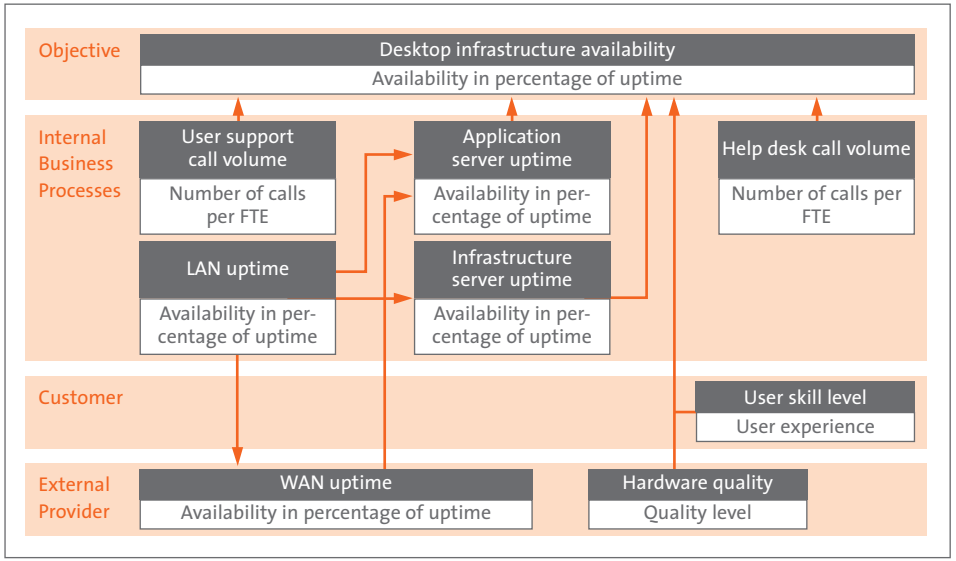

Figure 2: IT risks mapped onto a Balanced Scorecard.