Managing Operational Risk with Balanced Scorecards

Stefan Blumenberg / Daniel Hinz
Accurate IT risk assessment is becoming increasingly important, but classical IT risk management often lacks statistical rigor.

Bayesian Networks (BNs) can be combined with Balanced Scorecards (BSCs) to quantify and communicate results of IT risk assessments to top management, respectively, as

- Bayesian statistics are ideally suited to quantify IT risks, but the approach is difficult to communicate.
- Balanced Scorecards are a well established communication tool and can be derived from Bayesian Networks due to structural similarities.
- As a side effect also for other domains, the "fuzzy" concept of a BSC can be backed up with the mathematical power of Bayesian statistics.

An example for desktop service providing shows the applicability of both methods and serves as a starting point for an in-depth assessment of IT infrastructure risks.
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*efinance lab*
Motivation

Current IT risk management theory and practice

- IT risk management is becoming increasingly important (esp. for banks)
- Current theoretical approaches mainly focused on data security, confidentiality and availability, e.g.
  - Computer Science and Telecommunications Board of NRC
- In practice IT risk management is often only implicitly assumed, e.g.
  - Failover systems
  - File backup
  - ...

Bayesian statistics

- Bayesian Networks provide strong theoretical toolset for management of operational risks (incl. IT risks), e.g.
  - "Bayesian Methods for Measuring Operational Risk" – Alexander, 2000
  - Application of Bayesian Inference to Operational Risk Management – Yasuda, 2003
  - "Ein Metamodell zur Anwendung Bayesianischer Netzwerke für das Management operationeller Risiken" – Kirchheimer, 2003
- Not widely adopted by practitioners yet
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Combination of BNs and BSCs

**Method**

- **Bayesian Network**
  - A
  - B
  - C
  - D

- **Balanced Scorecard**
  - F
  - C
  - P
  - I

**Short evaluation**

- Calculates probabilities based on:
  - Modeled dependencies of risk factors
  - Integration of expert knowledge and statistical data
- Allows for simulations what-if analyses
- Difficult to communicate
- Presentation tool for key indicators with their causal relationships
- Established also in IT controlling and risk management
- Causal dependencies and hierarchical aggregation not quantitatively modeled

**Combination of both approaches could overcome weaknesses of each method**
Bayesian networks principles

- A Bayesian Network models the cause-effect relationships of its nodes
- Network characteristics:
  - Directed acyclic graph
  - Nodes are variables
  - Edges represent direct relationships
- Each node is a conditional probability distribution describing the effect of the parent nodes on itself
  \[ \text{Prob}(\text{node}|\text{parent nodes}) \]

"What is the probability of my data, given the parameter?"
"What is the probability of the parameter, given what I observe in the data?"

Classical inferential statistics

Bayesians
Bayesian networks evaluation

- Widely used in other domains (e.g., medical) as well as in IS (e.g., help systems)
- Simulation of changes and corresponding effects possible
- Incorporating historical data
- Leveraging expert knowledge
- Creating transparency of dependencies/relationships

- High complexity
  - Of causes
  - Of dependencies
- Difficult to keep model up-to-date
- Difficult to communicate
Balanced Scorecard principles

- Developed by Kaplan / Norton to overcome shortcoming of traditional performance measurement systems
- Combines traditionally used financial measures with soft factors like customer satisfaction (Lead vs. lag indicators)
- Models (cause-and-effect) relationships between entities
- Communicates corporate strategies top down from management to operational level
- Generic BSC contains 4 perspectives:
  - Financial
  - Customers
  - Internal Business Processes
  - Innovation and Learning
Balanced Scorecard evaluation

- Commonly and widespread used management tool
- Can be used as a presentation tool: easy to understand and to communicate
- Perspectives can be added or omitted
- BSC allows double-loop learning

- Double-loop learning is tedious
- Modelled cause effect relationships cannot be validated a priori
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Modelled Desktop Infrastructure with Bayesian Network
Mapping BSC and BN

Target Perspective
Customer
Internal Business Processes
External
BSC evolved of desktop infrastructure

- Desktop infrastructure availability
  - Percentage of downtime

- LAN availability
  - Percentage of downtime

- WAN availability
  - Percentage of downtime

- Application Servers
  - Percentage of downtime

- Infrastructure Servers
  - Percentage of downtime

- Helpdesk calls
  - Number of calls per FTE

- User support calls
  - Number of calls per FTE

- User skill
  - User experience

- Hardware quality
  - Quality level

- Target Internal Business Processes

- Customer

- External
## Classification of Risk Scorecard within Corporate Scorecard Hierarchy

### Management Scorecard

<table>
<thead>
<tr>
<th>Financial</th>
<th>Customers</th>
<th>Internal Business Processes</th>
<th>Innovation and Learning</th>
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<tbody>
<tr>
<td>Reduction of Operational Risk</td>
<td>...</td>
<td>...</td>
<td>...</td>
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<tr>
<td>Increase Market Share</td>
<td>...</td>
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### Operational Risk Scorecard

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<tr>
<td>...</td>
<td>System Risk</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>...</td>
<td>Process Risk</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>...</td>
<td>Internal Fraud</td>
<td>...</td>
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### System Risk Scorecard

<table>
<thead>
<tr>
<th>Financial</th>
<th>Internal Business Processes</th>
<th>Staff/ Customer</th>
<th>Innovation and Learning</th>
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<tbody>
<tr>
<td>Desktop Downtime Costs</td>
<td>Helpdesk Time to Resolve</td>
<td>User Support Calls</td>
<td>User Skill Level</td>
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<tr>
<td></td>
<td>User support Time to Resolve</td>
<td>User Incidents</td>
<td>Virus Scanning</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Desktop Infrastructure Stability</td>
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Outlook: Further Research and next steps

- Refinement of prototype model by literature
- Case study validation of model correctness
- Sensitivity analysis