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Development of a Methodological Approach to Strategic Fire Service Planning Combining Concepts of Risk, Hazard and Scenario-based Design

PSAM12

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Ing. Adrian Ridder, M.Sc., MIFireE
Prof. Dr.-Ing. Uli Barth

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Project „TIBRO“

- **=** Tactical-strategic Innovative Risk-based Fire Service Planning
- ORBIT (1970s study still referenced and used today)
- Funded by the German Federal Ministry of Education and Research
- From April 2012 to March 2015
- **Objective**: scientific foundations for public fire service planning adaptive for future challenges

- Need for fundamental research

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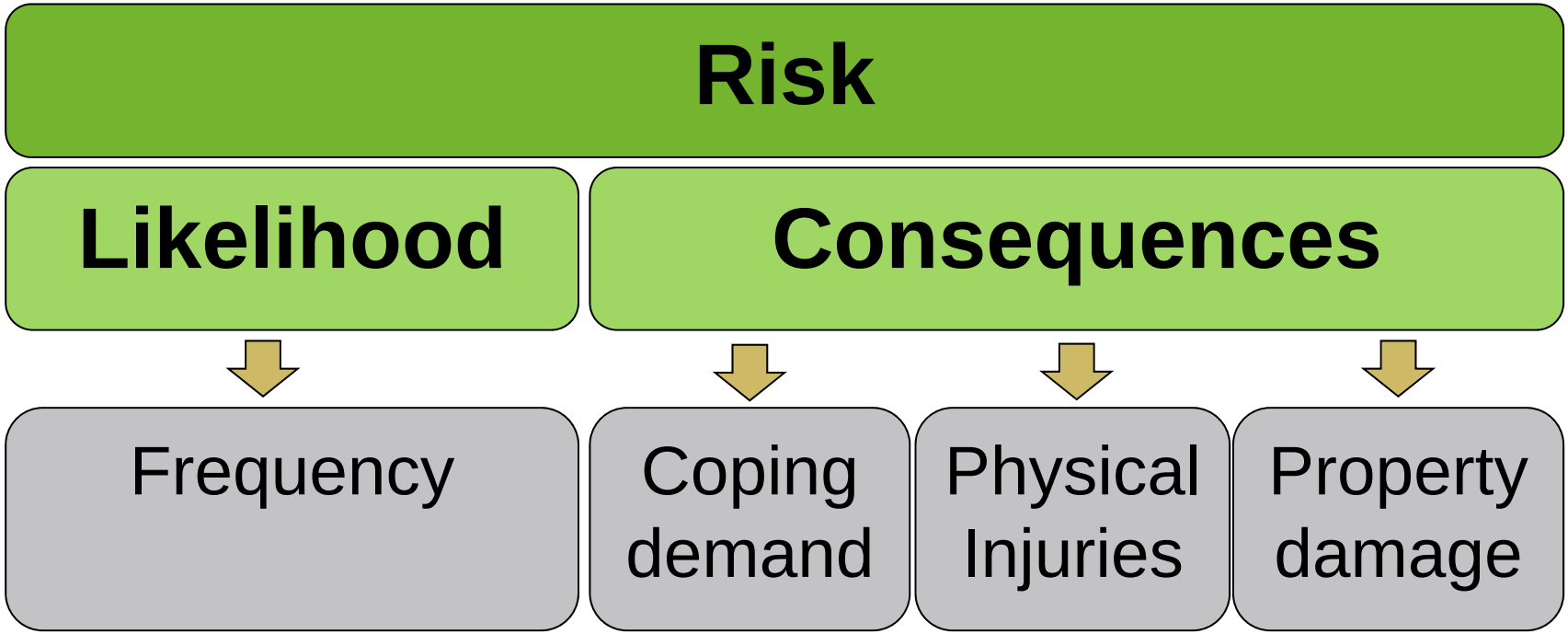
Analysis of fire service incident data

- Hypotheses on risks of different settlement structures in existing planning methods
- Operationalisation of risk:



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Analysis of fire service incident data

- Hypotheses on risks of different settlement structures in existing planning methods

Parameter / **Risk factor**	Height of building	occupancy	Construc-tion type	age of building	category of street
Coping demand					
Property damage					
Physical injury					
Frequency					

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Sample municipalities

- **City 1:** pop. ca. 350.000, 5 years of data, 1.022 data sets (structure fires only) [18]
- **City 2:** pop. ca. 690.000, 4 years of data, 17.093 data sets [17]
- **County*:** pop. ca. 305.000, 2.75 years of data, 330 data sets [19]
- **Fire service data**
  - Logs from control rooms
  - Incident action reports
- **Additional data**
  - Number of buildings, km in each category
  - Type of building per street address

* Not in paper, manual data collection

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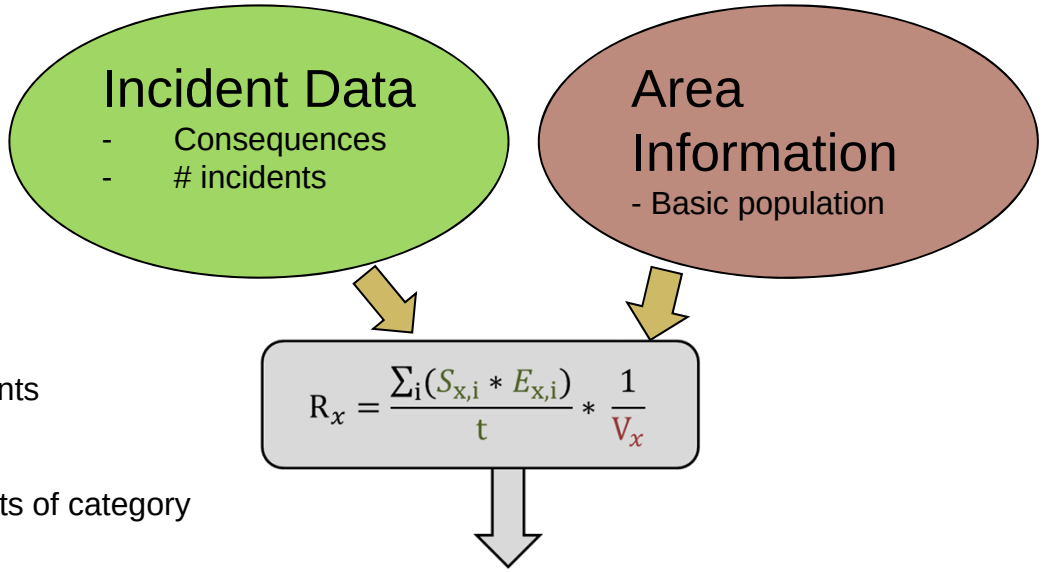
Analysis methods

- Calulation of risk numbers

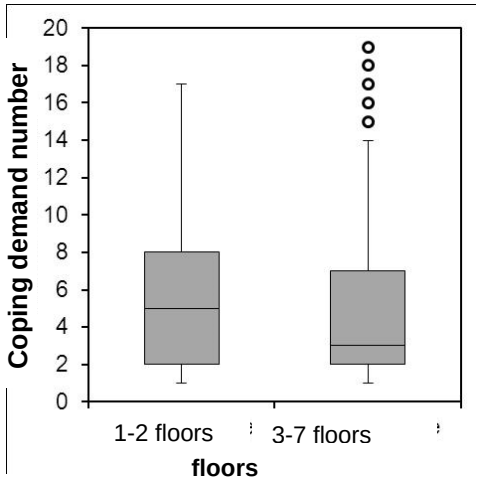


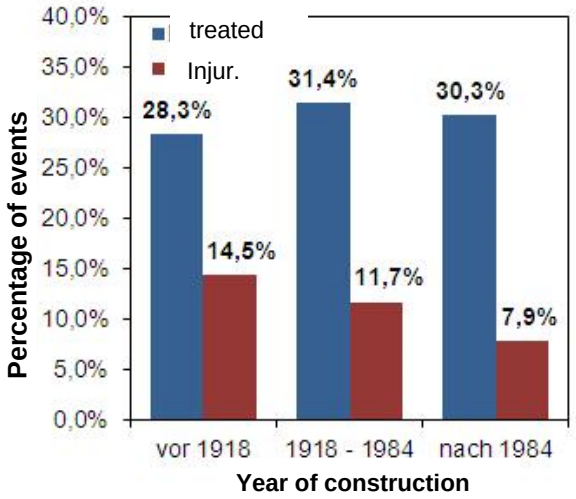
City 2

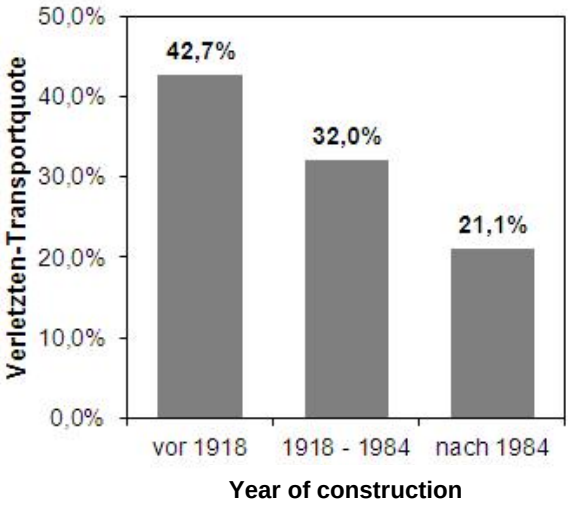
E= number of incidents
S= Loss
t = time frame
V = number of objects of category

- Comparison of statistical distributions

City 1
County







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Results of Data Analysis

- City 1

- Hypothesis falsified
- Hypothesis proved
- Insufficient data
- No data available

Parameter / Risk factor	Height of building	occupancy	Construc-tion type	age of building	category of street
Coping demand					
Property damage					
Physical injury					
Frequency					

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Results of Data Analysis

- City 2

- Hypothesis falsified
- Hypothesis proved
- Insufficient data
- No data available

Parameter / Risk factor	Height of building	occupancy	Construc-tion type	age of building	category of street
Coping demand					
Property damage					
Physical injury					
Frequency					

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Results of Data Analysis

- County

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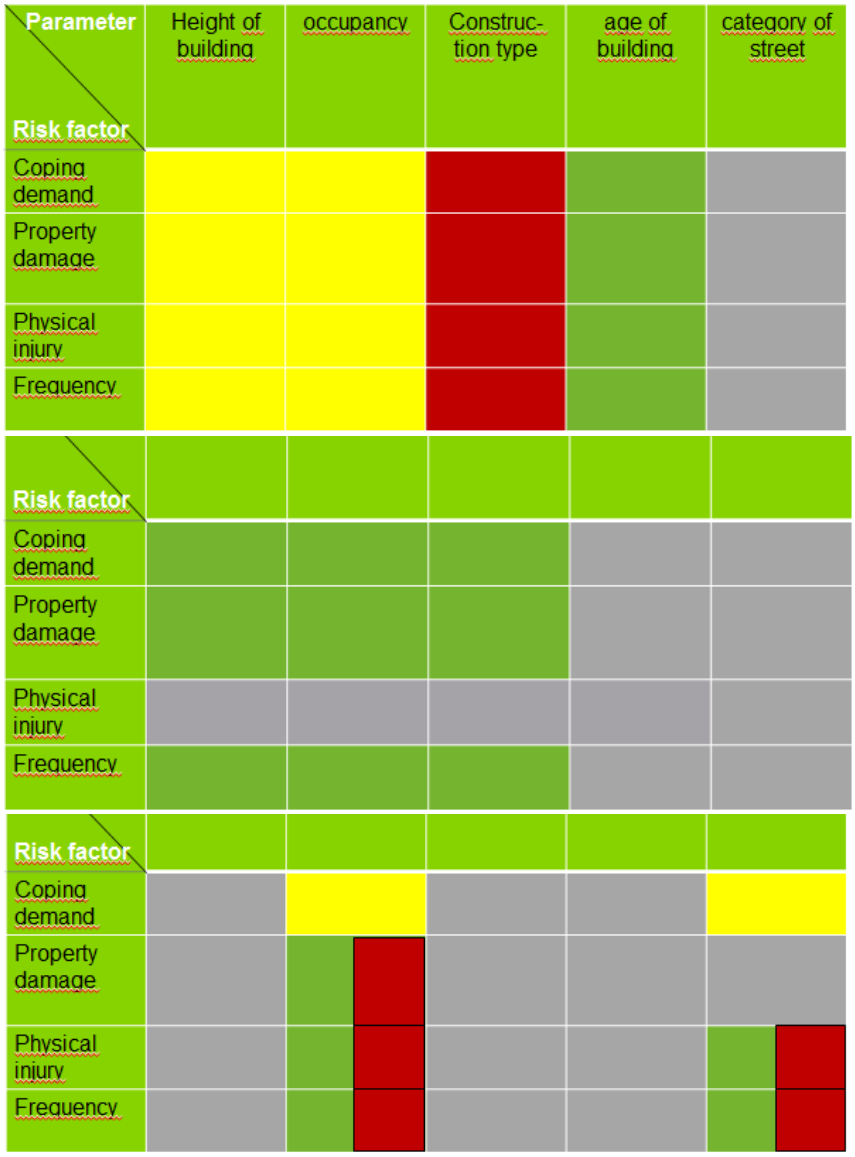
Results of Data Analysis

- Inconclusive results
- Proof of principle
- Cross-checking methodologies
- Issues
  - –municipal responsibility
  - → statistical population (too) small
  - –varying data collection procedures by fire services
  - –incomplete data sets (e.g. the building age)



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Risk-based Strategic Fire Service Planning

- Many hazard-based methodologies available
- „Risk = f (P, C)“
- Paradox of probabilities:
  - Lim ->0 but still need to preplan for seldom events
  - Low probability/high impact events
  - No residential fire for communities < pop. 18,750? **„P =0“** (6 yrs) [9]
- In Germany no approved risk acceptance criteria
- „How safe is safe enough“?
  - No valid scientific answer possible
  - Ethical considerations → political decision-making based on scientific foundations (Analytic-deliberative approach [11])

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Scenario Approach

- reduce virtually infinite number of incidents to a manageable number
- Questions:
  - Necessary number of scenarios
  - Criteria for selecting scenarios
    - Frequency
    - Criticality (spectrum from worst to simplest case)
    - …?

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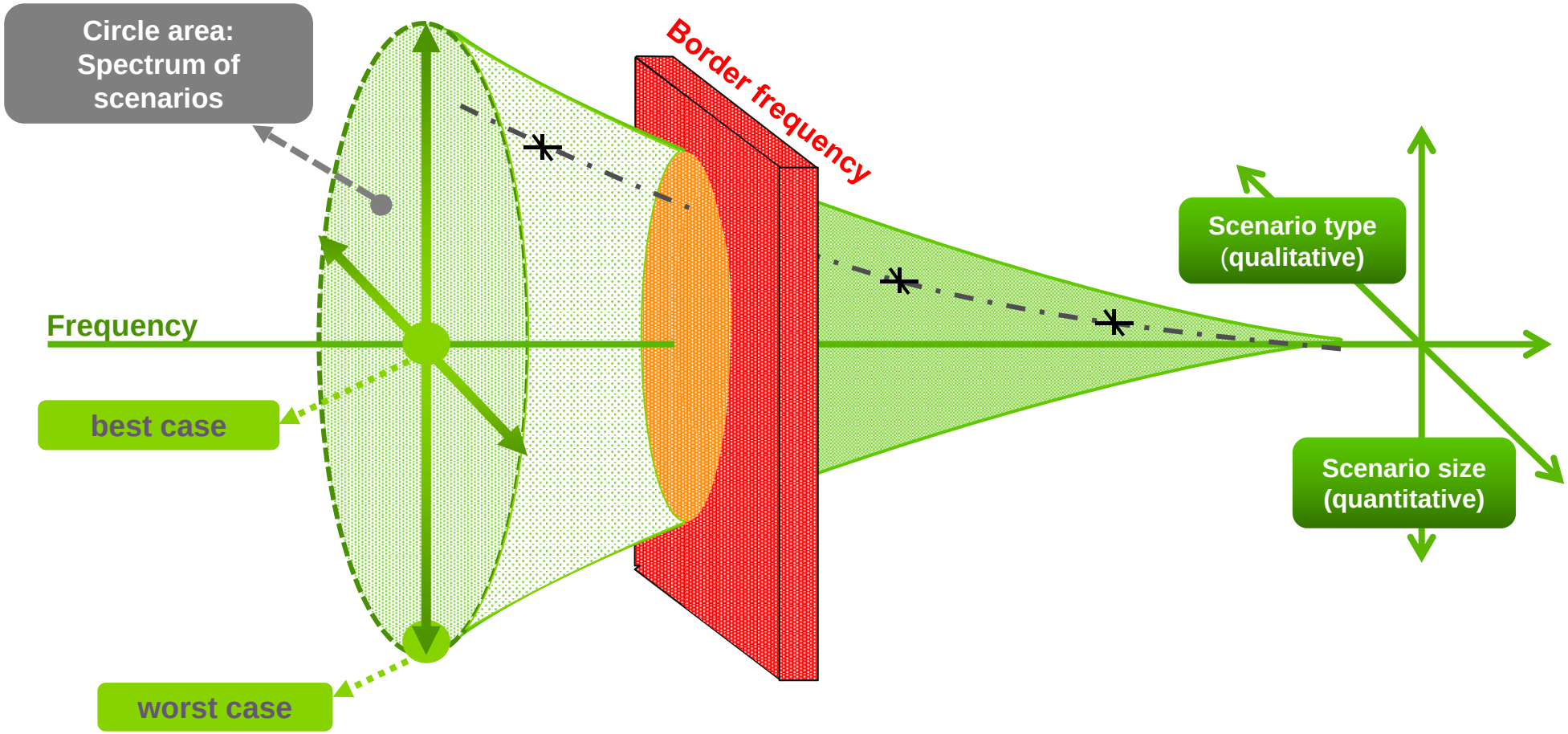
Criterion: Frequency (?)



Number of scenarios = f (frequency, scenario type, scenario size)

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Conclusions

- Risk-based approach appropriate
- Goal: Determine adequate level of risk (spending, safety)
- fundamental research necessary on risk characteristics
- Valid data base required (lack of national fire service statistic)
- Studies with city data confirmed principle of fire service data analysis for risk research

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Thank you

University of Wuppertal
Chair Methods of Safety Engineering and Incident Research
Prof. Barth
c/o Ing. Adrian Ridder, M.Sc.
ridder@uni-wuppertal.de
Tel. 0202-439-3921
Fax. 0202-439-3922
Gaußstraße 20, 42119 Wuppertal/Germany

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