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Optimized traffic control with benchmarked road weather data

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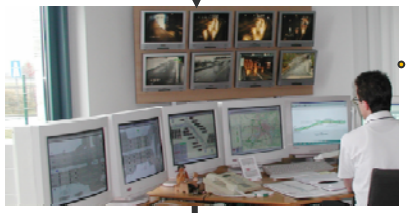
FUNCTIONALITY OF TRAFFIC CONTROL

critical road weather & surface condition

detection by stationary sensor systems

Control algorithms in traffic control centres



Variable Message Signs (VMS): Warnings, Speed limits

Data quality ?

Detection of erroneous measurements

Plausibility checks for road weather data [technical bulletin, 2010]

?

Interpretation & reaction to the results

Benchmarking system

→maximized benefit of the plausibility checks

GERMAN TEST SITE FOR ROAD WEATHER STATIONS

www.vt.bv.tum.de/umfelddaten

GERMAN TEST SITE FOR ROAD WEATHER STATIONS

Situated on motorway A92 near Munich Airport

- Evaluation of different sensor systems from various companies under same weather conditions

→ Published in annual reports (http://www.vt.bv.tum.de/abschlussbericht)

- Development of plausibility checks for aggregated weather data:
  - Single Measurement checks
  - Logical-physical coherence checks
  - Long-term plausibility checks

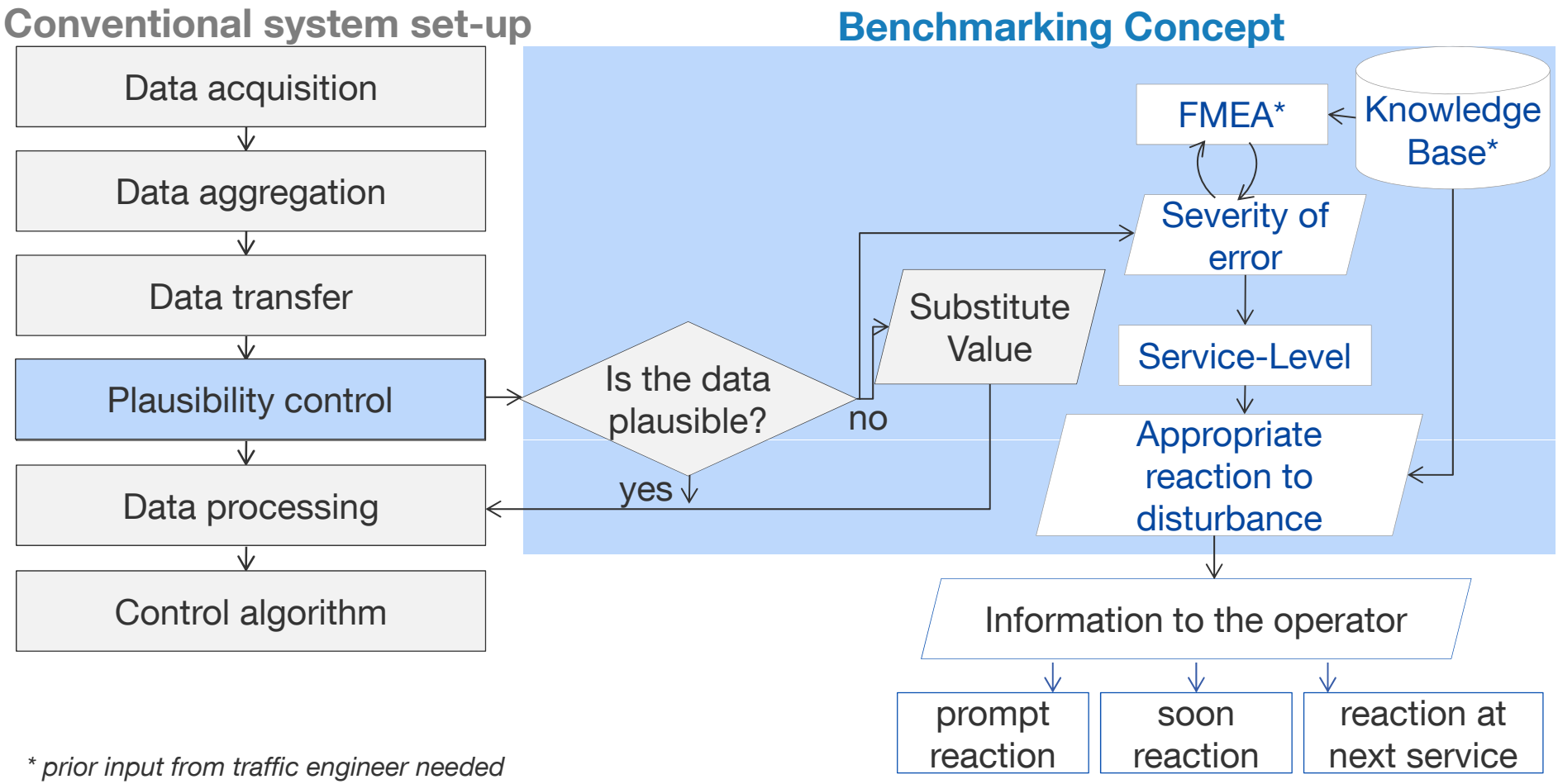
→ Published in a technical bulletin (2010) [FGSV, issue 306]

- Integration of plausibility checks into traffic control centres
- Implementation of automatic plausibility analysis for aggregated data

→ Data Distribution Tool

BENCHMARKING CONCEPT

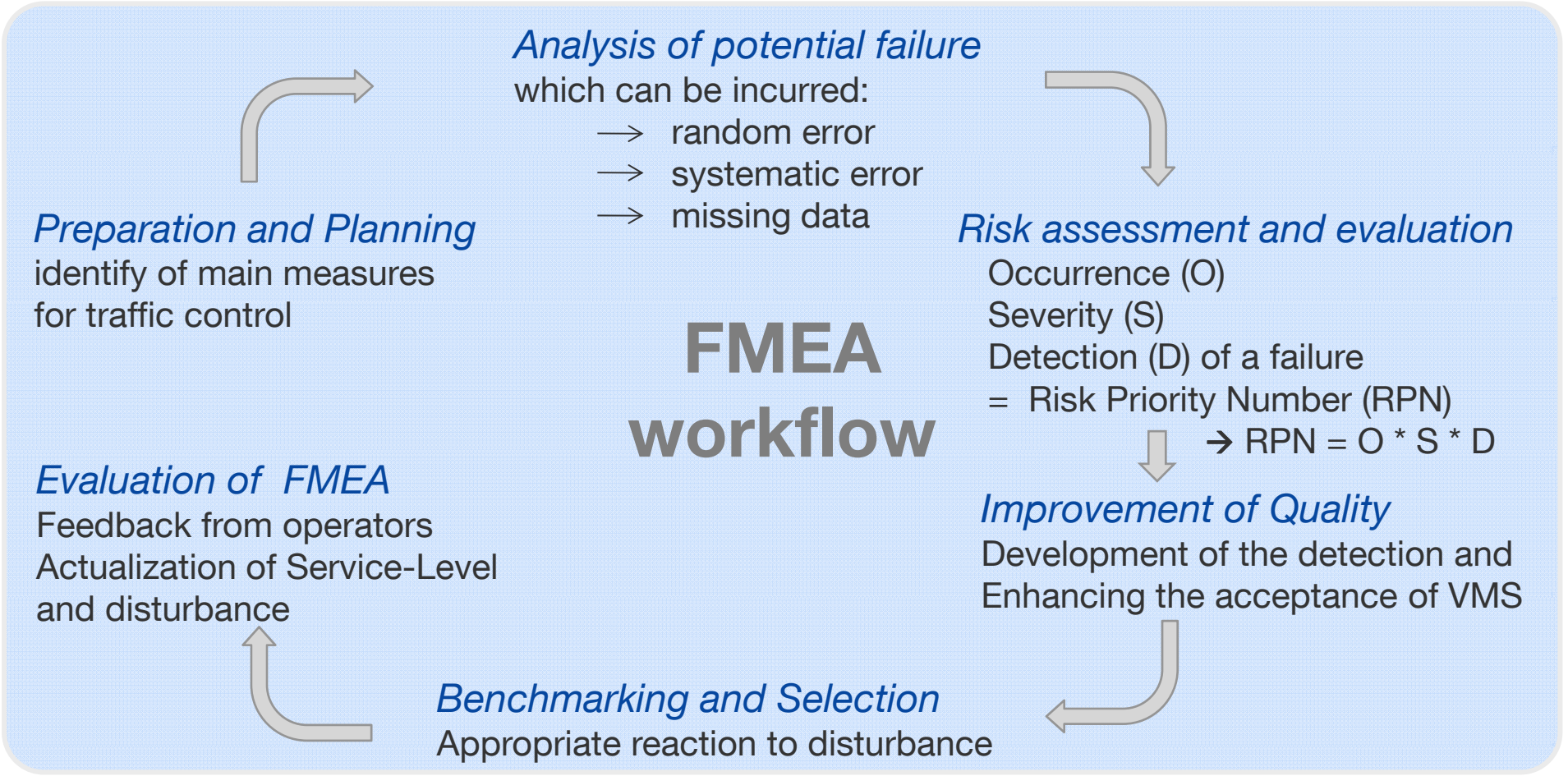
Conventional traffic control set-up according to German Technical Bulletin



** prior input from traffic engineer needed*

FAILURE MODE AND EFFECTS ANALYSIS (FMEA)

Concept: failure prevention instead of error correction



POTENTIAL ERRORS: MEASUREMENT RANGES

Definition of risk priorities of failure modes:

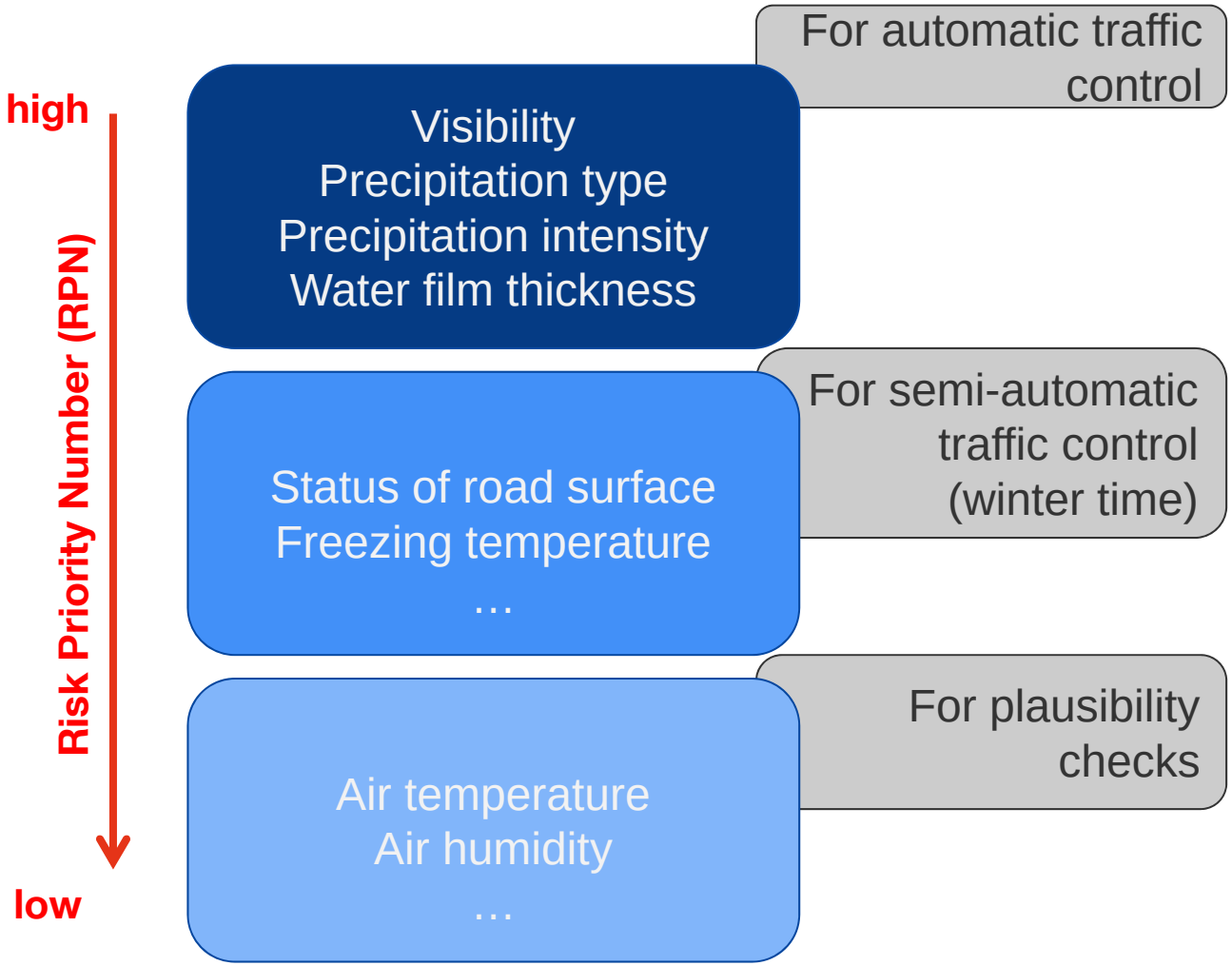
RPN = O * S * D

priority

Rating	*Occurrence (O)*	*Severity (S)*	*Detection (D)*
10 9	Very high: Frequent failure	Very critical: Direct influence on traffic control	Unlikely: No plausibility check available
8 7	High: Repeated failure	Critical: Indirect influence on traffic control	Incidental detection at service work
6 5 4	Moderate: Occasional failure	Moderate: Influence on plausibility check of a primary measurement	Plausibility check or Information from road users/police
3 2	Low: Relatively few failures	Influence on plausibility check of a secondary measurement	Few plausibility checks available
1	Unusual failure	No influence on traffic control	Evident failure

high RPN: high importance, high priority
additional check of single highly ranked factors

PRIORITY AND USAGE OF MEASUREMENT PARAMETERS



DETAILED RPN CALCULATION

Detailed analysis of single measurements concerning the possible failure types and plausibility checks

measurement unit: **visibility**	O	S	D*	RPN
random error / systematic error				
relevant time period				
measurement value is too high	4	6	8	**192**
measurement value is too low	2	4	5	**40**
relevant measuring range for traffic control				
measurement value is too high	4	7	8	**224**
measurement value is too low	2	5	5	**50**
not relevant time period				
measurement value is too high	4	4	8	**128**
measurement value is too low	2	2	5	**20**
not relevant measuring range for traffic control				
measurement value is too high	4	5	8	**160**
measurement value is too low	2	3	5	**30**
missing data				
relevant time period	10	1	3	**30**
not relevant time period	9	1	3	**27**
*dynamic adaptation; here the range of most of the failure is shown				

Is the measured data..
- within the relevant time period?
- within the range for traffic control?
- too high or too low?

How many plausibility checks identified erroneous data?

- Risk factors are set every minute and a new RPN is calculated
- classification of RPN based on the experiences from the German Test Site

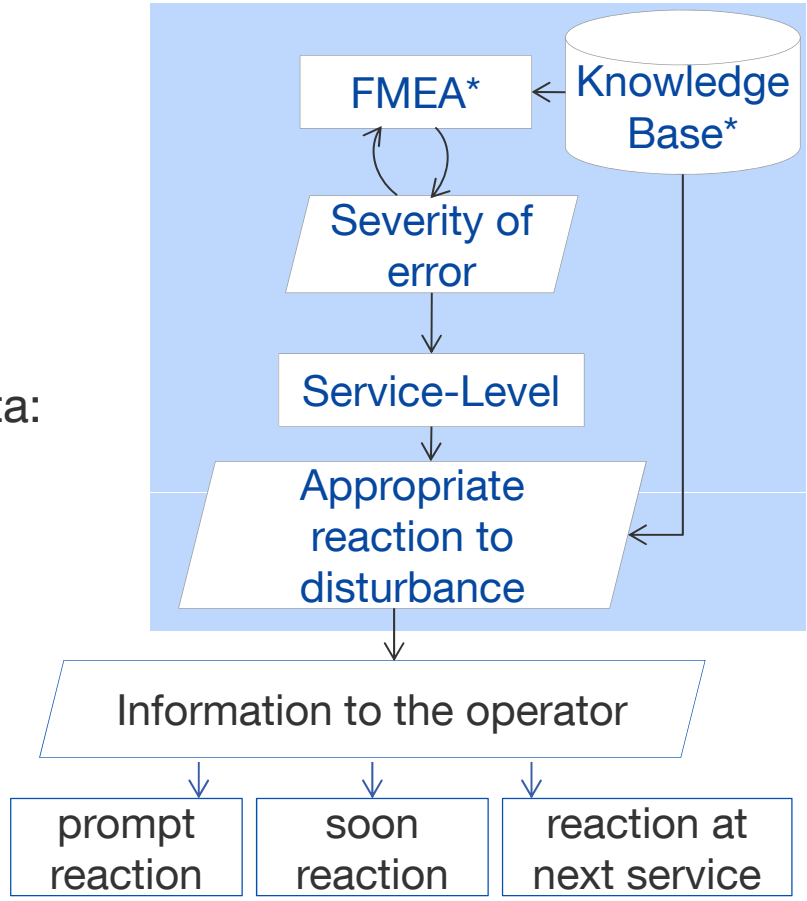
ONLINE QUALITY MONITORING USING SERVICE LEVELS

- Service-Levels are uniform agreements on the desired quality of data and equipment
- Disturbances are identified promptly
- Using Service-Levels helps to detect:
  - failure of equipment
  - low data quality
  - lack of data
- Example: Service-Level on the quality of data:

Classification of service levels

- Data are completely plausible
- Data are largely plausible
- Data are not plausible
- No information on quality of data

- System “tracks” the “history” of a reported error until successful removal of the cause



CONCLUSION AND OUTLOOK

- Development of benchmarking system to maximize benefits from plausibility checks
- Improvement of interpretations and decisions
- Proposal of appropriate reactions on individual errors and disturbances

- Next steps:
  - Implementation of benchmark system
  - Software implementation of schematic procedures

EXPECTED BENEFIT

- Enhancement of the acceptance of traffic control systems
- Increasing of traffic safety on motorways during adverse weather situations

THANK YOU FOR YOUR ATTENTION

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