

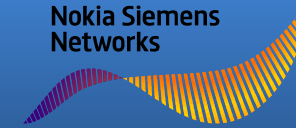
A Fuzzy, Utility-based Approach for Proactive Policy-based Management

Christoph Frenzel, Henning Sanneck, and Bernhard Bauer

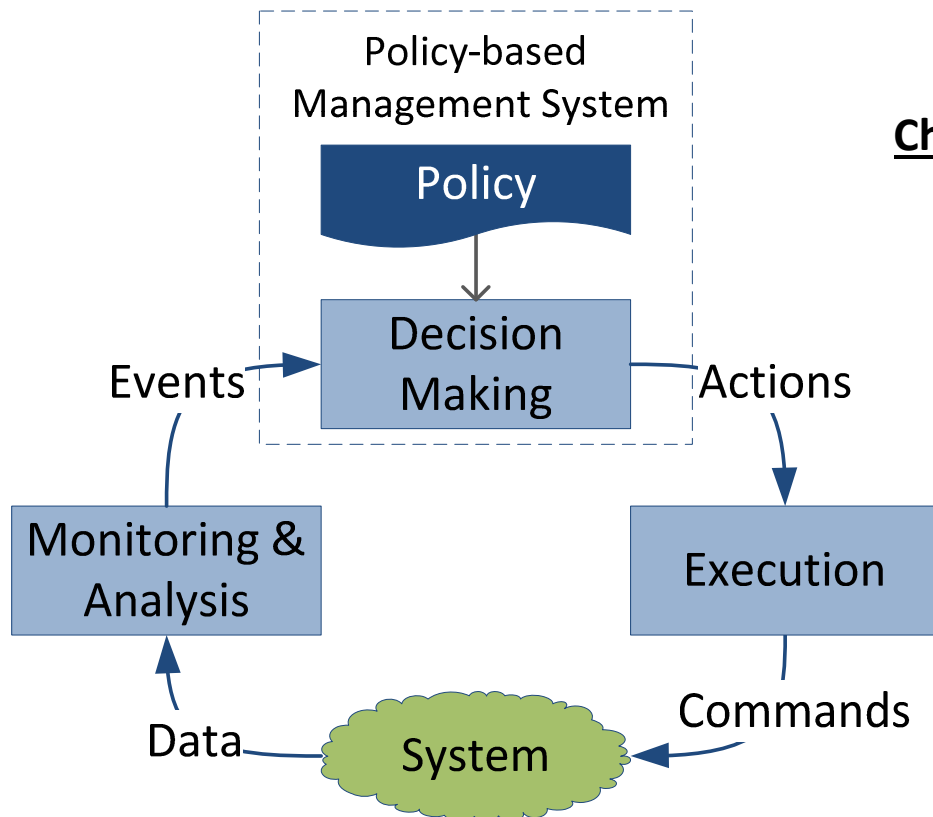
RuleML 2013, July 11 – 13, Seattle, WA, USA

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Policy-based Management (PBM)



Systems Management with Policies

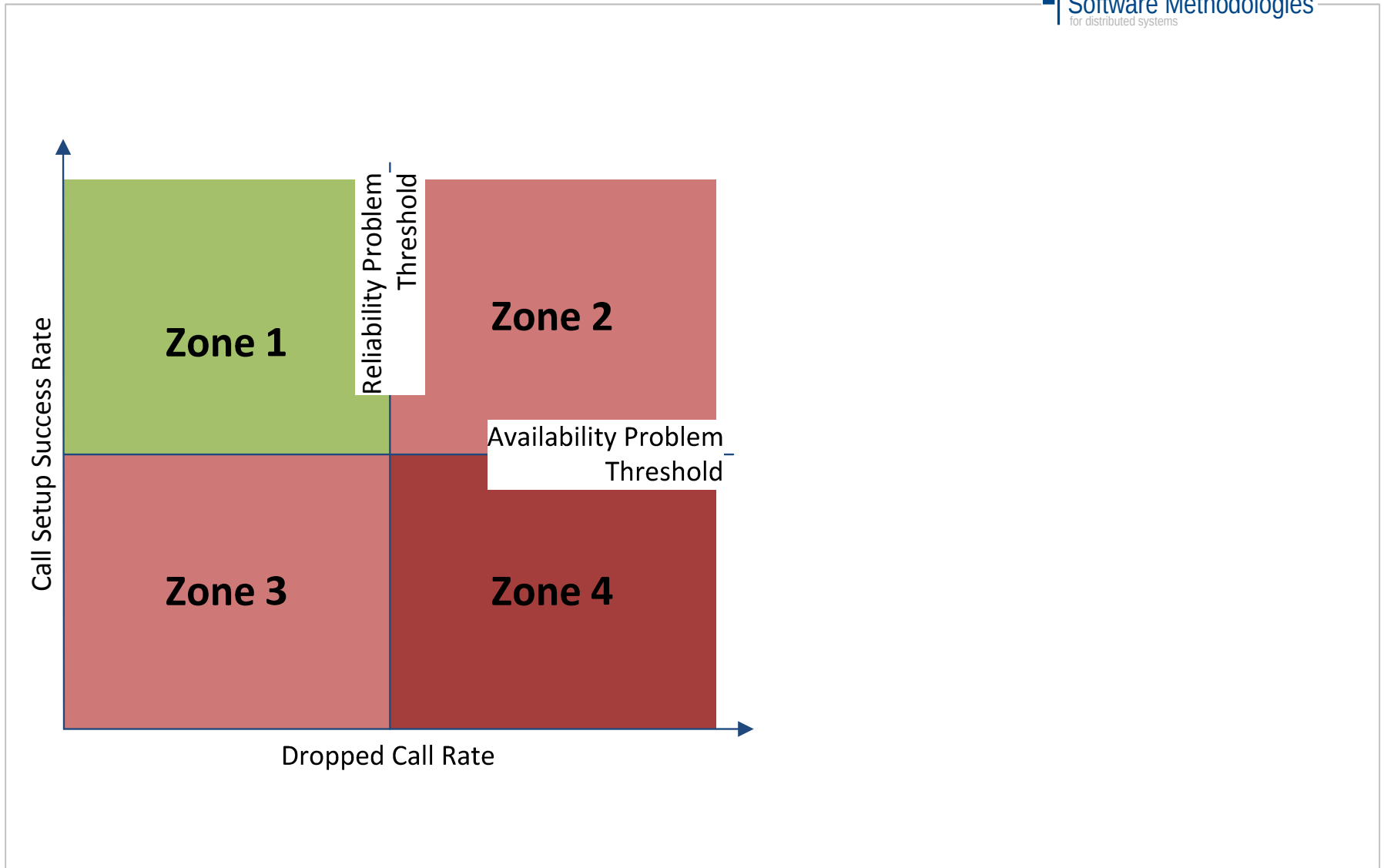


Challenge: increase the level of automation

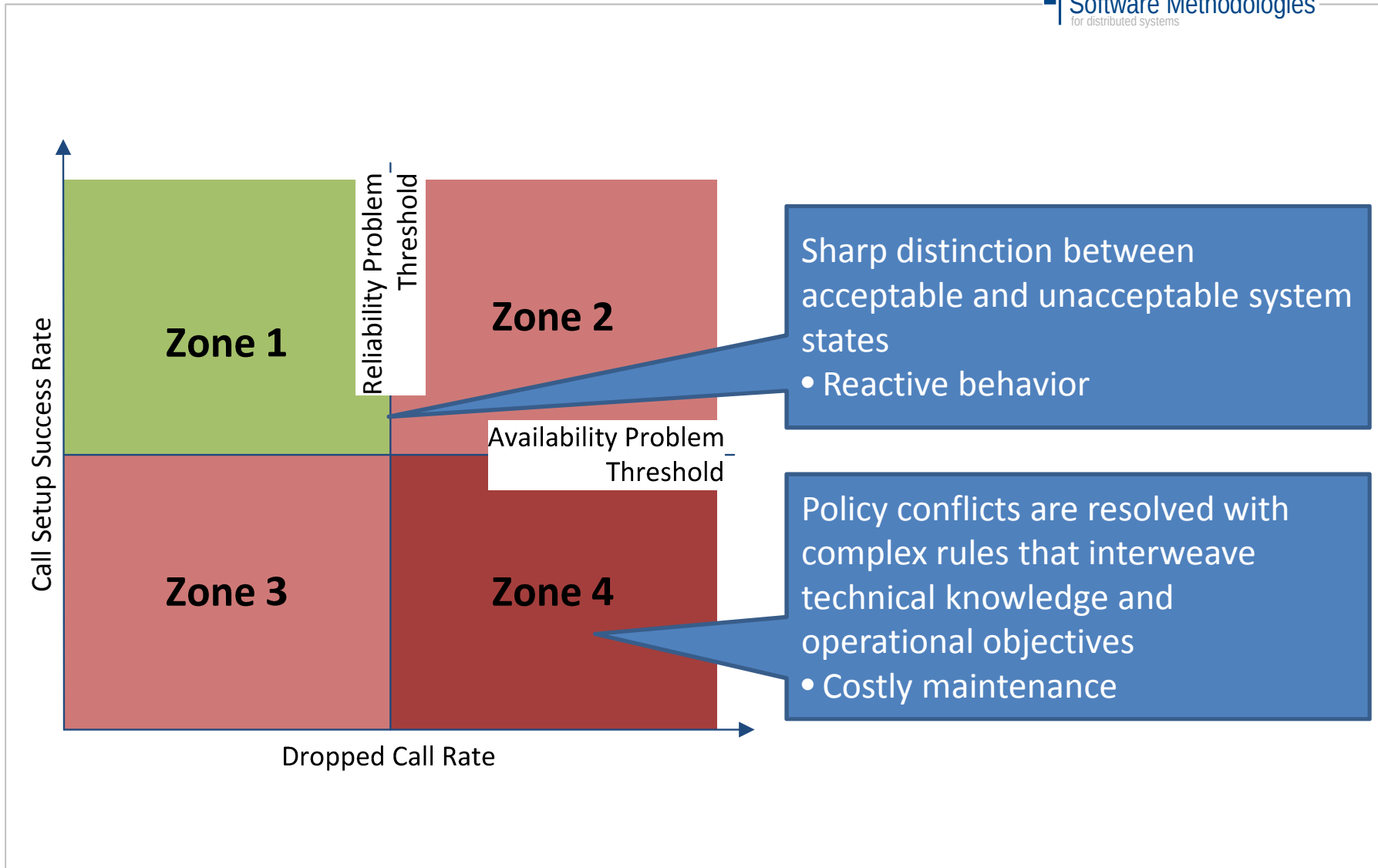
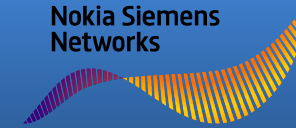
The system should make complex decisions guided by operational objectives, e.g., maximize capacity.

The system should act proactively in order to avoid problems

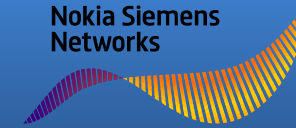
Classical PBM and Its Problems



Classical PBM and Its Problems



Concept of Proactive PBM



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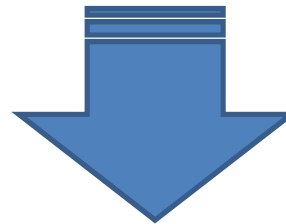
Utility-based Rule System

ECA rule-based Policy system (technical knowledge) with utility-based conflict resolution (business objectives)



Fuzzy Logic System

Replace boolean predicates with continuous memberships to allow reasoning in inaccurate domains



Fuzzification of monitoring events to create fuzzy events indicating their severity

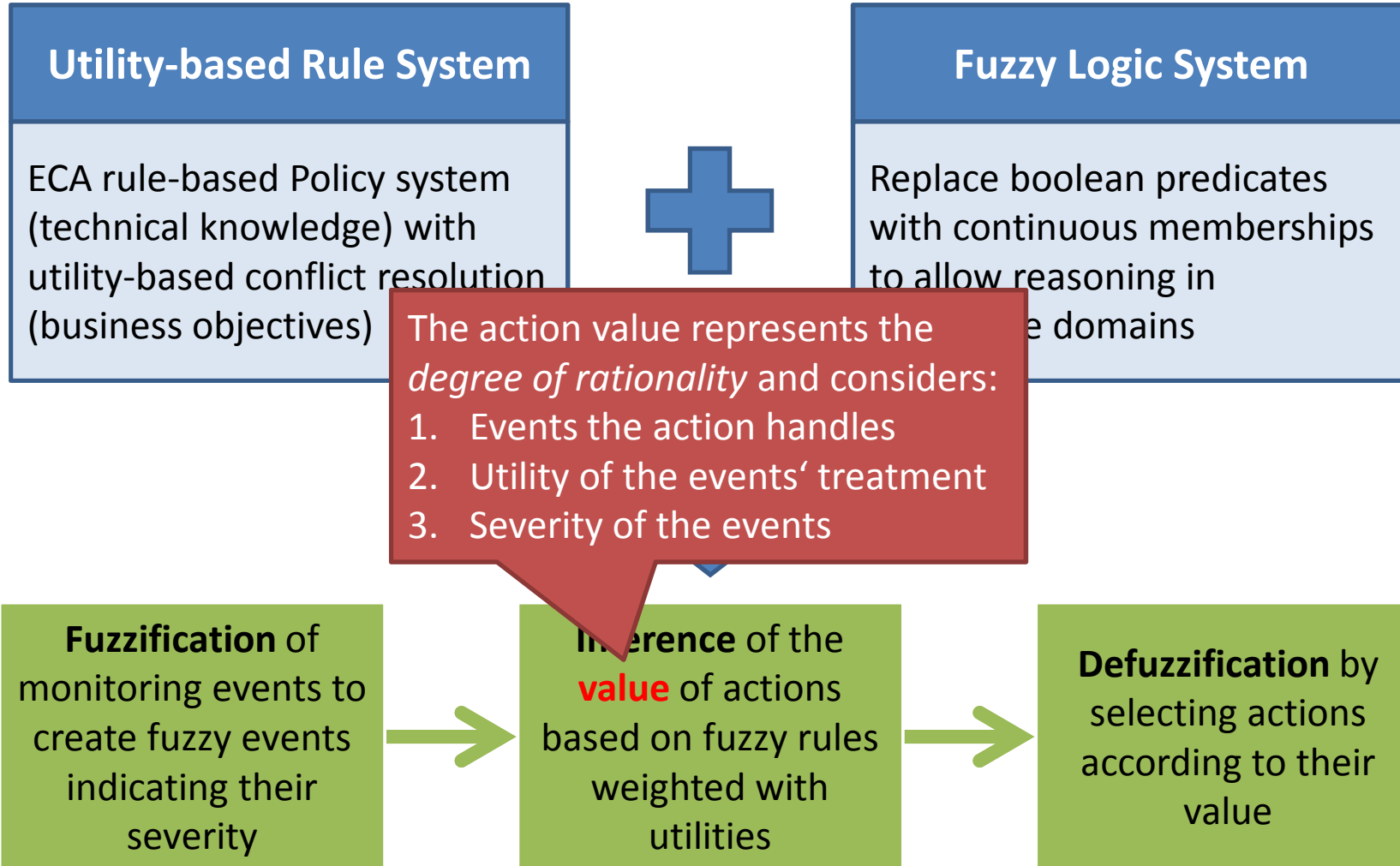
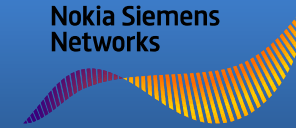


Inference of the value of actions based on fuzzy rules weighted with utilities

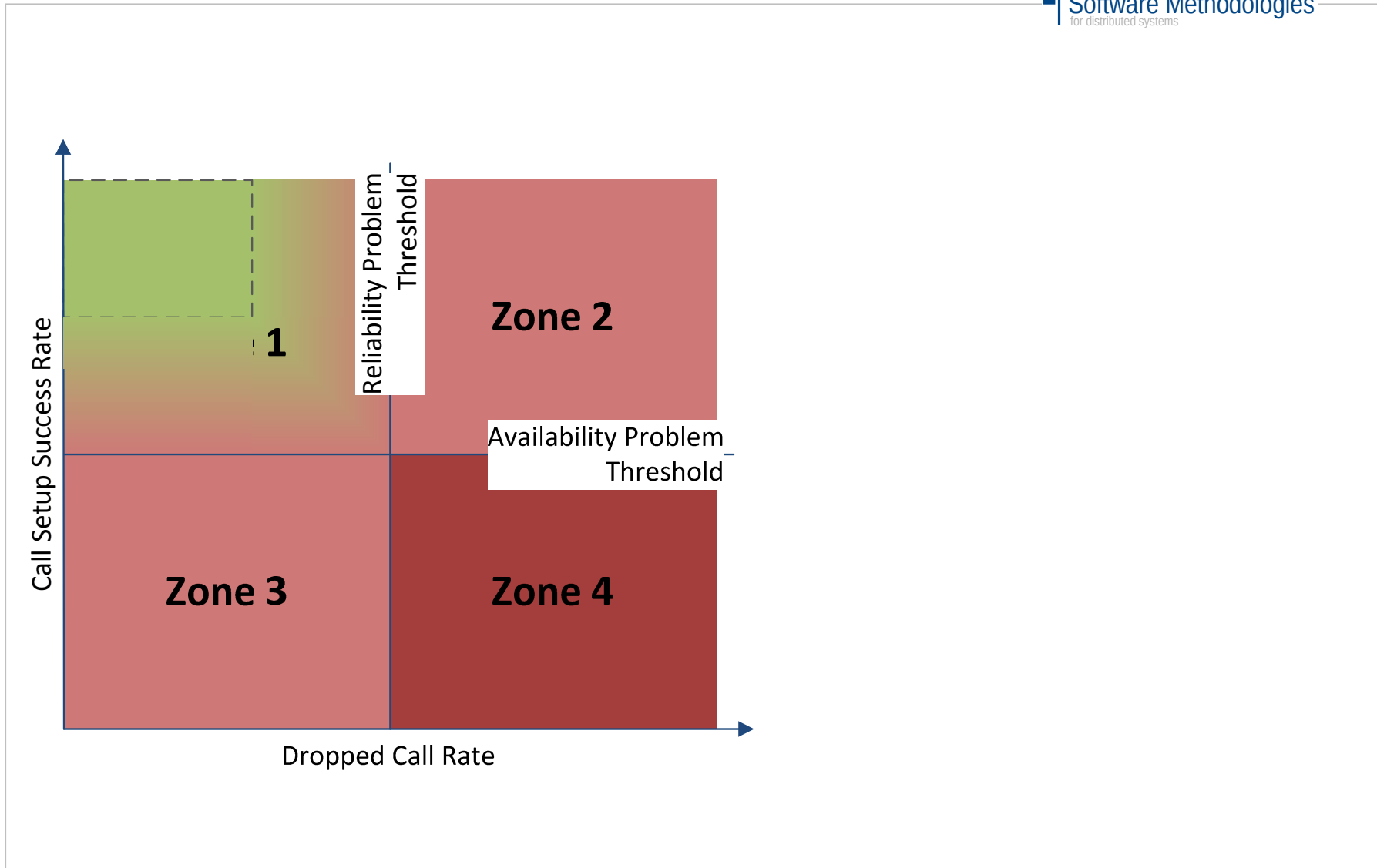
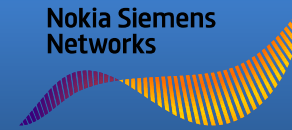


Defuzzification by selecting actions according to their value

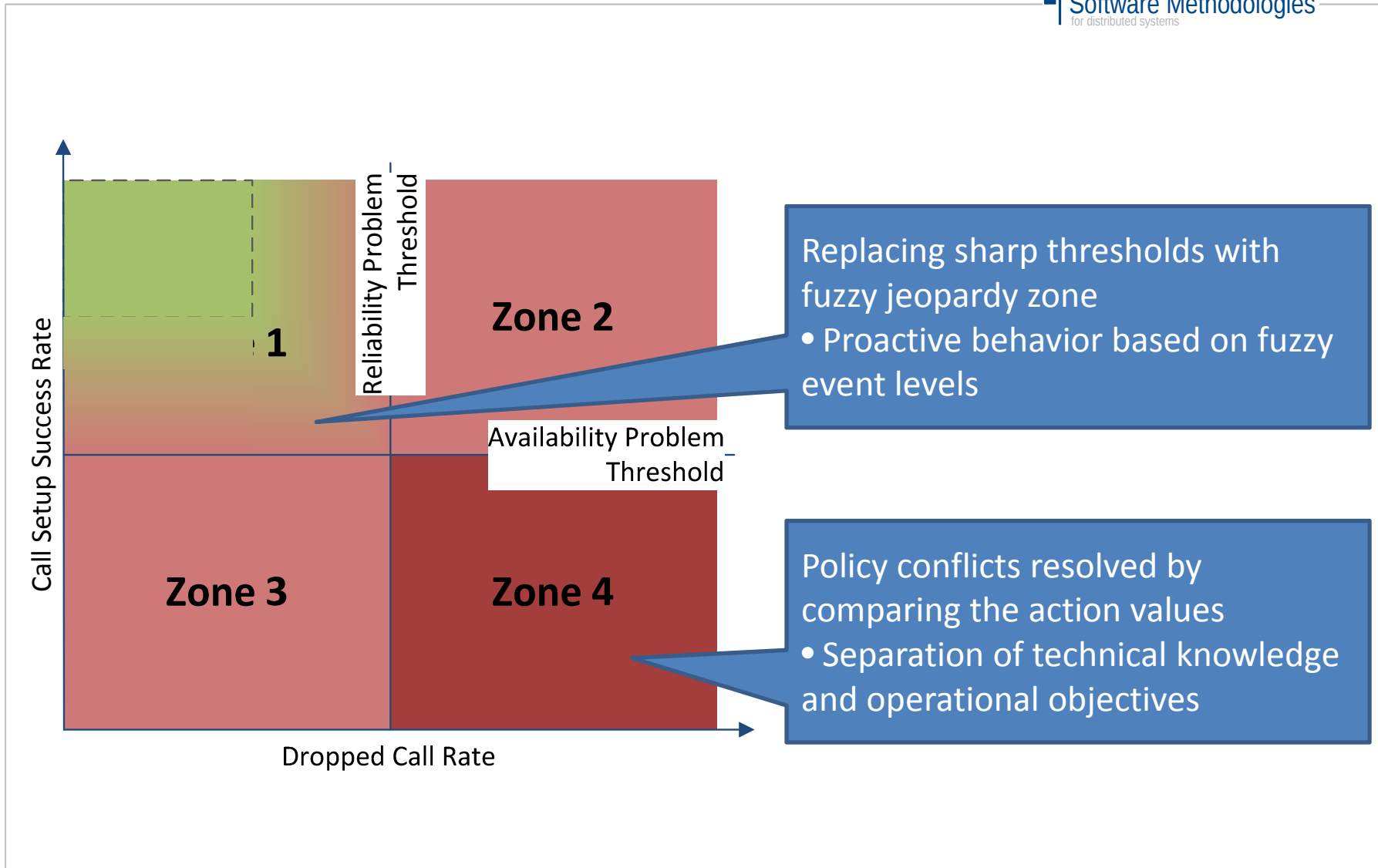
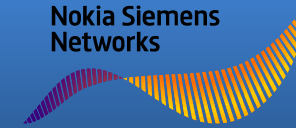
Concept of Proactive PBM

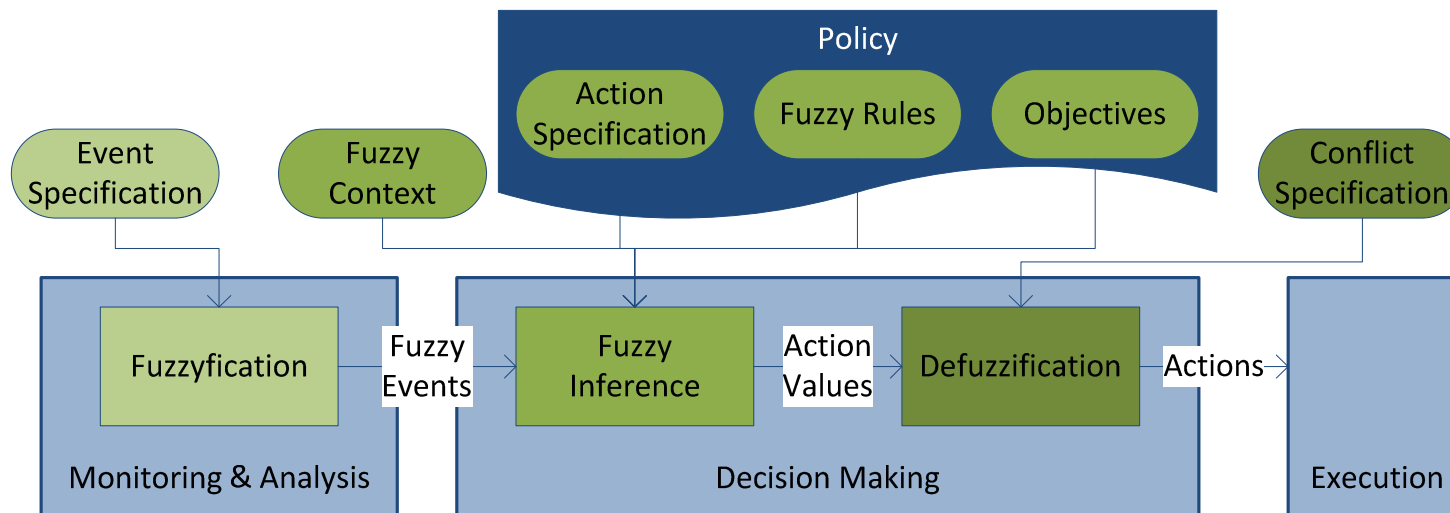
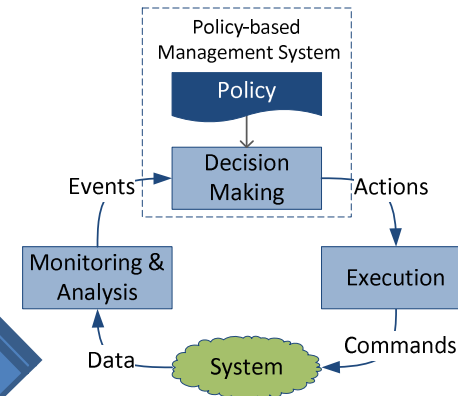
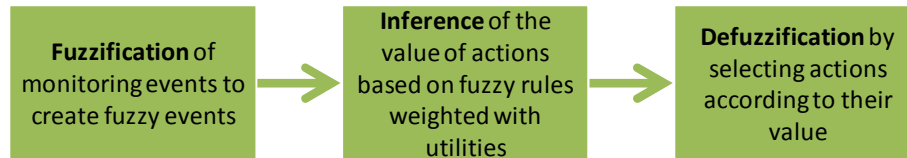


Behavior of Proactive PBM

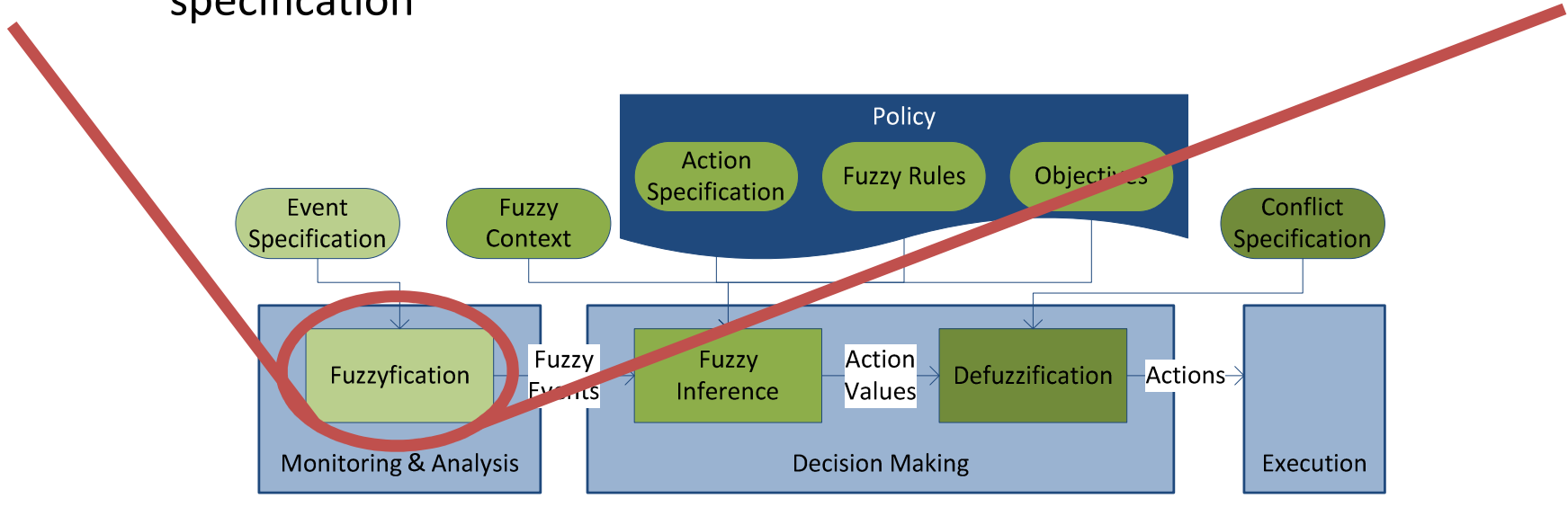
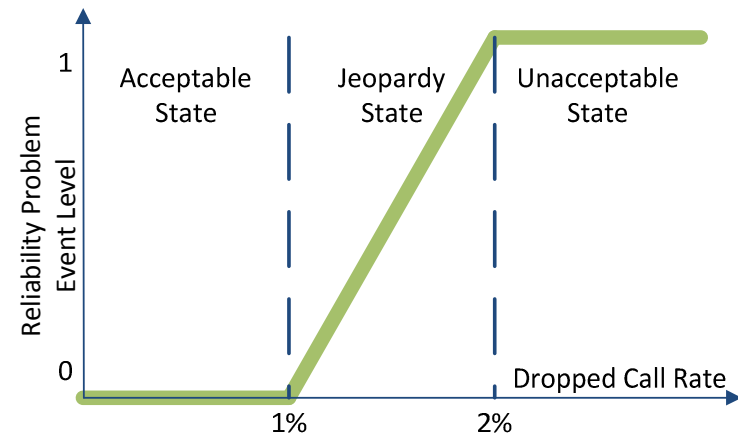


Behavior of Proactive PBM





- Event level determination
 - › Annotate event with fuzzy event level
 - › 3 KPI states: acceptable, unacceptable, and jeopardy
 - › Memberships can be computed by any function provided as an event specification



- Value computation

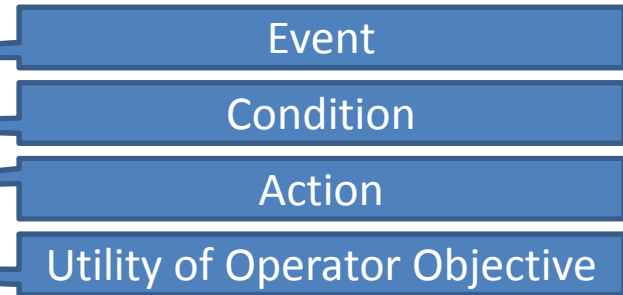
- › Fuzzy rules are technical knowledge:

IF reliability problem IS raised

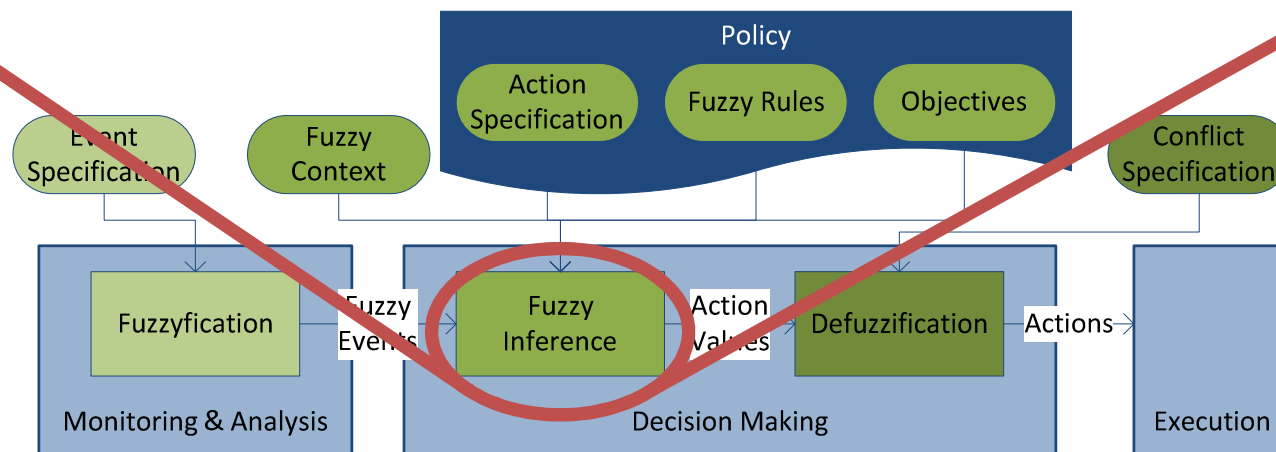
AND ret available IS true

THEN action IS ret optimization

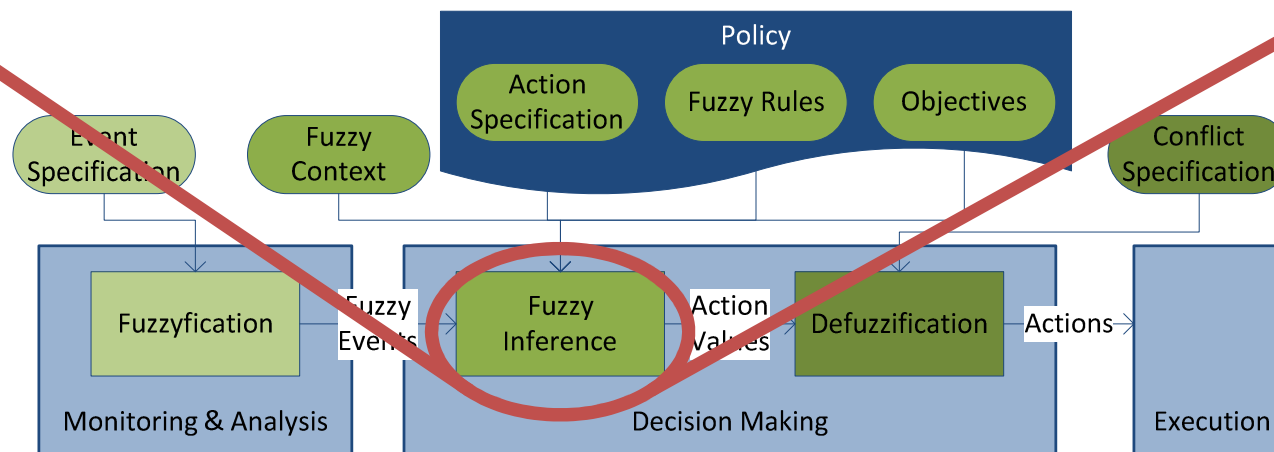
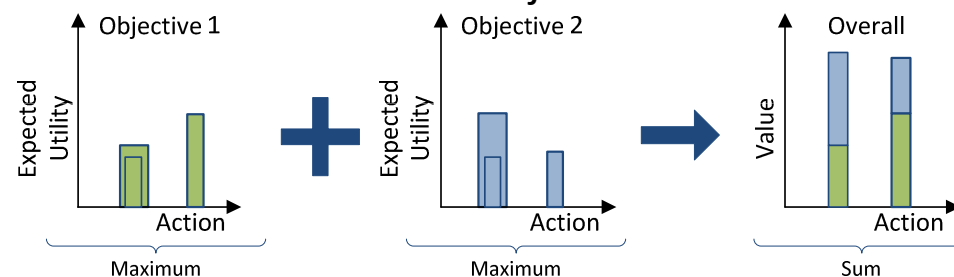
WITH objective_dcr



- › Objectives are defined using utilities

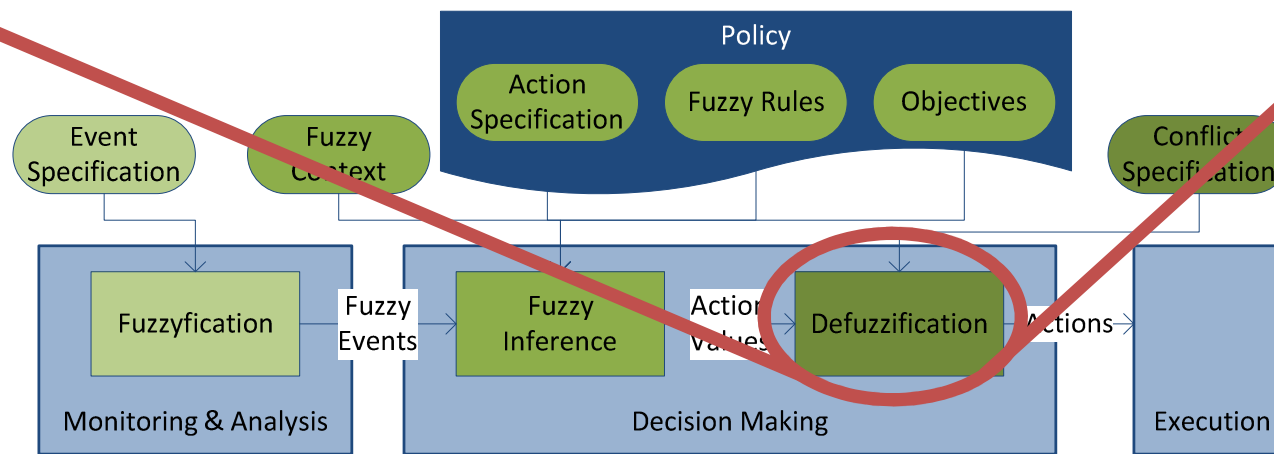
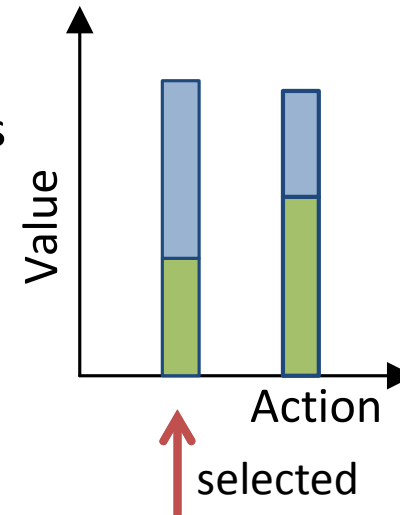


- Value computation
 - › Combine expected utilities of rules to overall value
 - » Domain-dependent aggregation, e.g., sum
 - » Maximum of the rules for one objective to avoid double counting



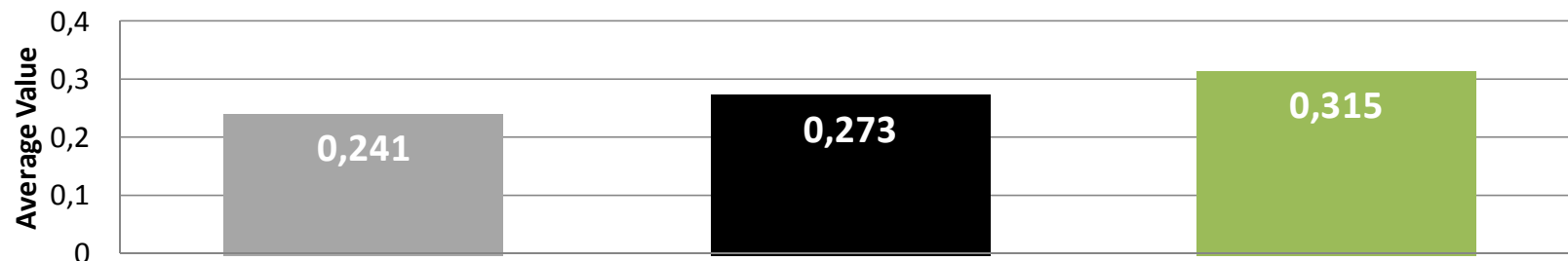
- Conflict resolution

- › Resolve action conflicts by selecting actions with higher value
 - » Constraint optimization problem



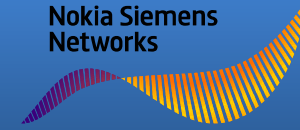
- Scenario taken from mobile networks management
 - › Problem situations and objectives created at random

- Fuzzy, utility-based PBMS has best performance
 - › 15% better than fuzzy PBMS
 - › 31% better than classical PBMS



	Classical PBMS	Fuzzy PBMS	Fuzzy, utility-based PBMS
Fuzzy events	No	Yes	Yes
Utilities	No	No	Yes

- The presented approach models ...
 - › ... a Utility-based Policy System with
 - › ... a Fuzzy Logic System.
- Thus, the system enables ...
 - › ... automatic control of the system guided by operational objectives encoded as utilities and
 - › ... proactive actions triggered by fuzzy event levels.
- In the future, we are working on...
 - › ... include observations, e.g., from ineffective actions
 - › ... modeling approach for the operator objectives & technical knowledge
 - › ... include stochastic actions and estimate their effectiveness using machine learning



Questions?

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