



# Towards the Generalized Criterion for Evaluation of Business Process Model Quality

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The logo for SEMiT features the word "SEMiT" in a bold, sans-serif font. The letters "S", "E", "M", and "I" are dark blue, while the letters "T" and "T" are red. The logo is positioned on the right side of the slide, below a decorative horizontal line consisting of several parallel lines in shades of red and white.

# Structure

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- Business Process Model Quality
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- Software Implementation Details
- Obtained Results
- Conclusion and Future Work

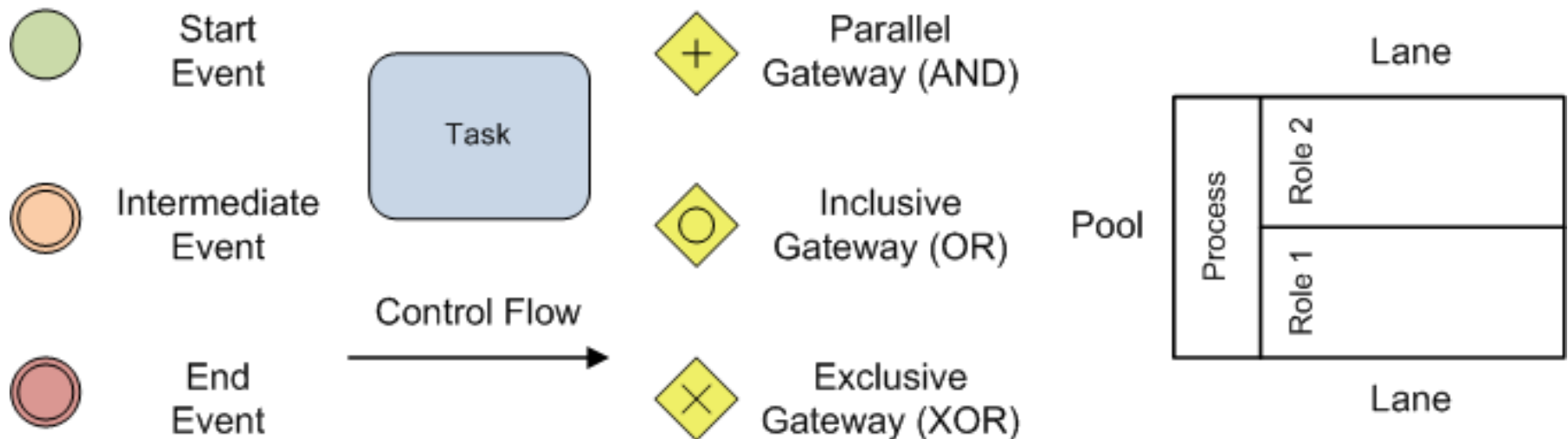
# Business Process Management (BPM)

## Key Terms

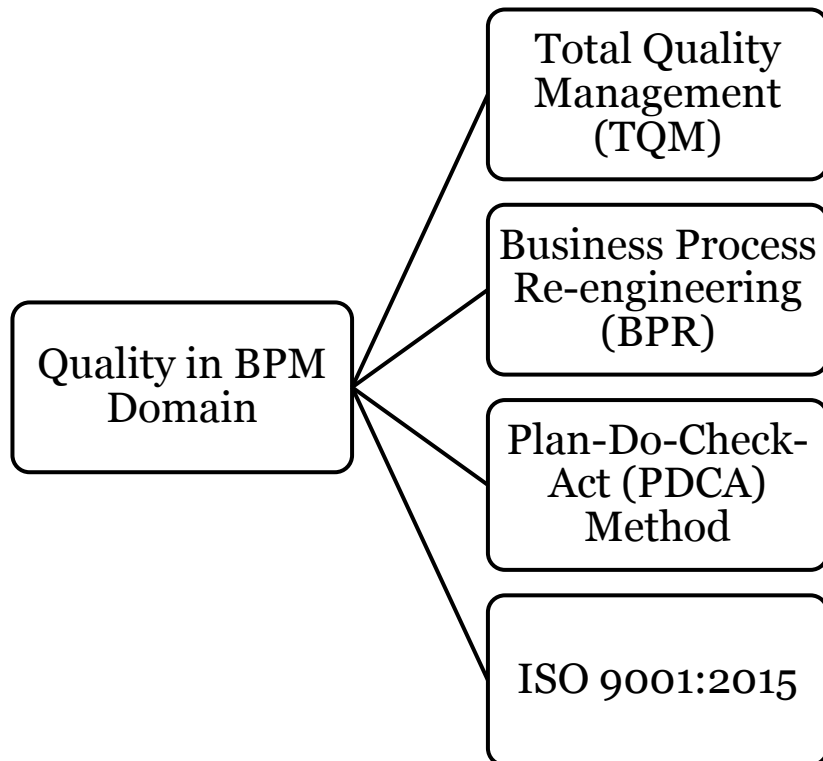
- BPM helps monitoring organizational activities to provide quality products and services, and to find ways to improve these activities,
- which, together with Events and Decisions, form Business Processes,
- which are described using Process Models that are used to:
  - design and analyze of information systems
  - communicate with stakeholders

# Business Process Model and Notation (BPMN)

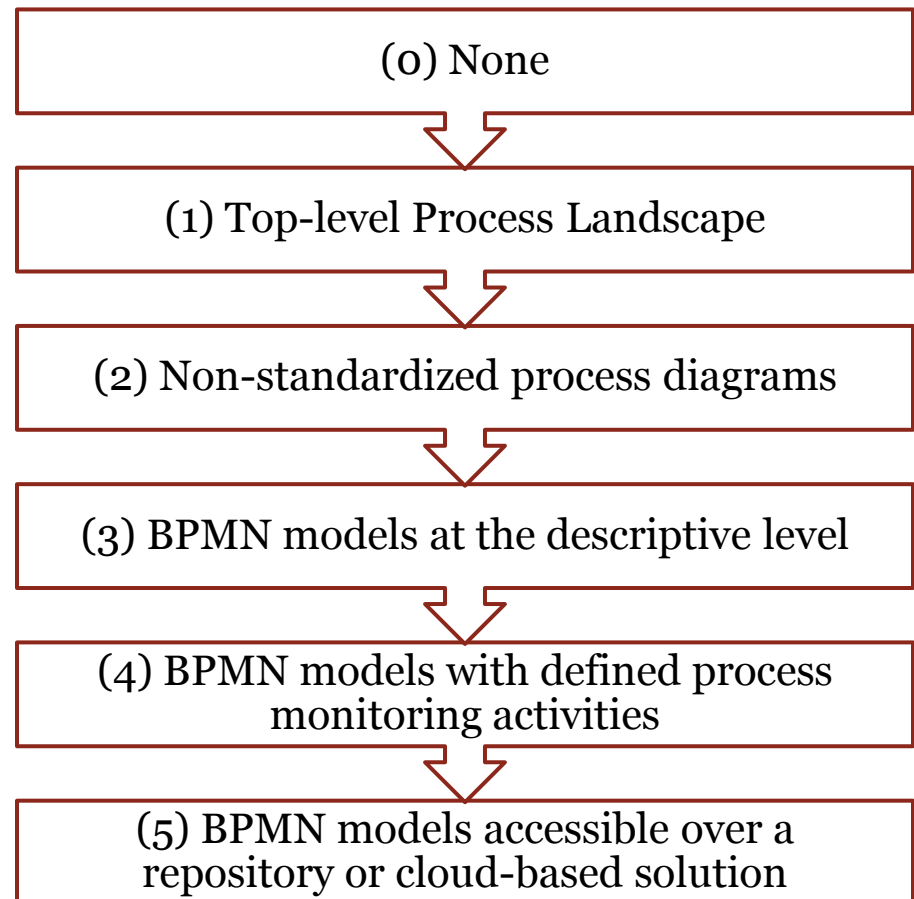
- Object Management Group (OMG) standard
- Business-IT alignment and collaboration between stakeholders
- XML-based exchange file format (BPMN 2.0)



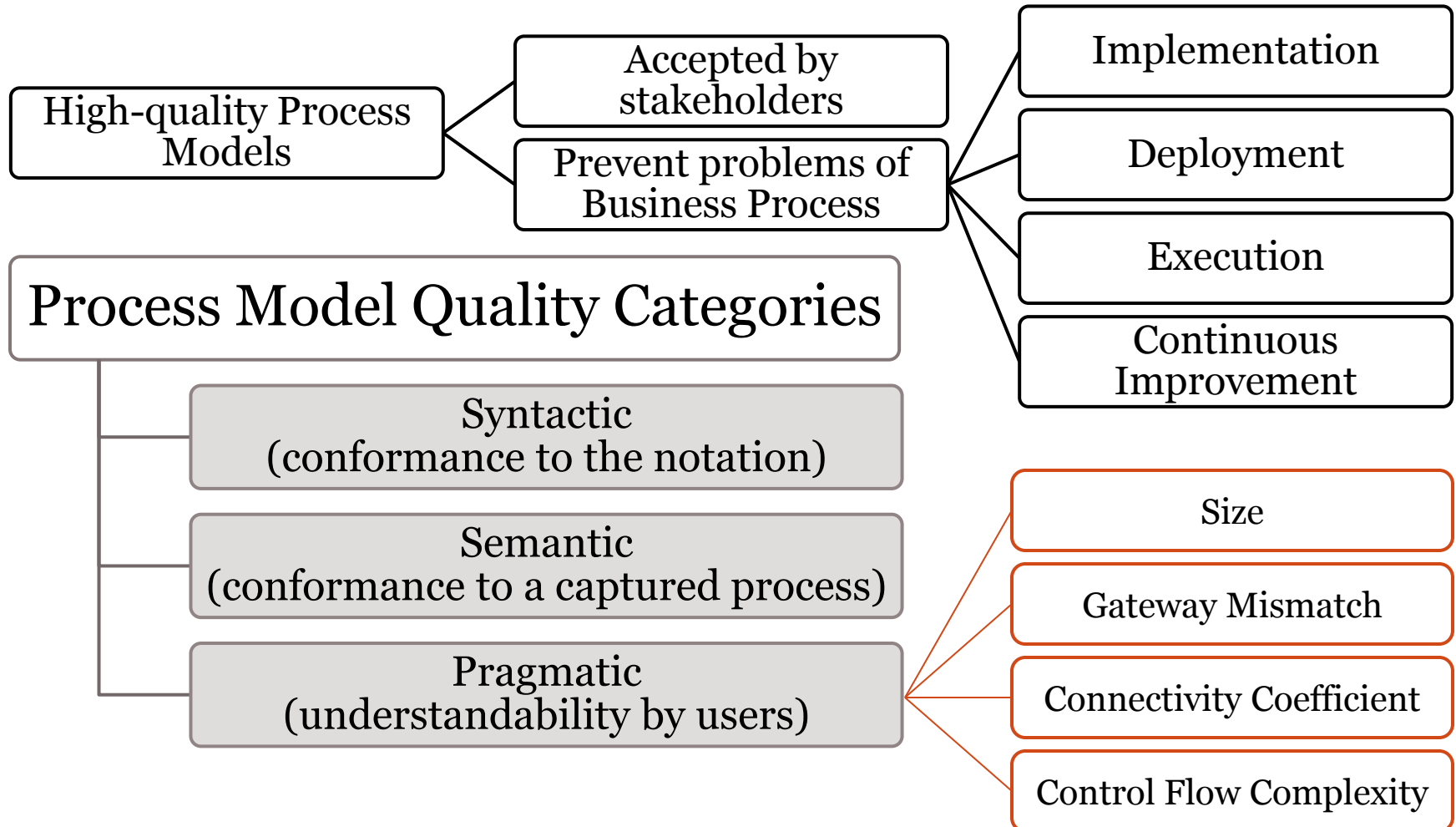
# Business Process Quality and Maturity



## Maturity vs. Process Modeling



# Business Process Model Quality



# Business Process Model Measures

- Total number of nodes:  $TNN = |N|$
- Number of invalid elements ( $t \in T$  – set of tasks,  $e \in E$  – set of events,  $g \in G$  – set of gateways,  $in$  – incoming flows,  $out$  – outgoing flows):

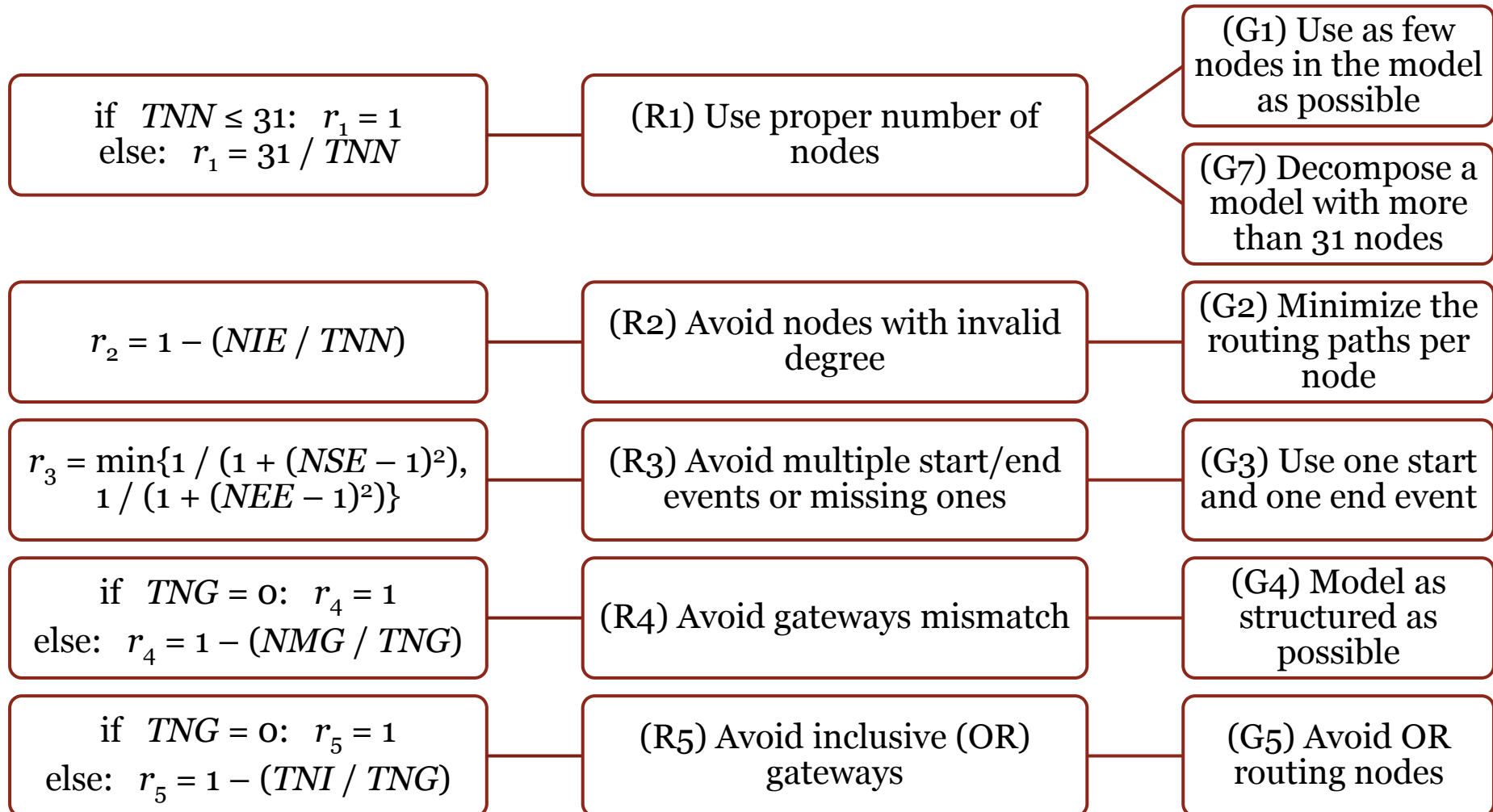
$$NIE = \sum_{t \in T} (|t^{in}| \neq 1 \vee |t^{out}| \neq 1) + \sum_{e \in E} (|e^{in}| > 1 \vee |e^{out}| > 1) + \sum_{g \in G} \neg[(|g^{in}| = 1 \wedge |g^{out}| > 1) \vee (|g^{in}| > 1 \wedge |g^{out}| = 1)]$$

- Number of start events:  $NSE = |E_s \subseteq E|$
- Number of end events:  $NEE = |E_e \subseteq E|$
- Number of mismatched gateways:

$$NMG = |\sum_{g \in G} (|g^{in}| = 1 \wedge |g^{out}| > 1) - \sum_{g \in G} (|g^{in}| > 1 \wedge |g^{out}| = 1)|$$

- Total number of gateways:  $TNG = |G|$
- Total number of inclusive (OR) gateways:  $TNI = |G_{or} \subseteq G|$

# Business Process Model Quality Criteria





# Generalized Quality Criterion for Business Process Model

$$PMQ = \sum_{i=1..5} w_i \cdot r_i$$

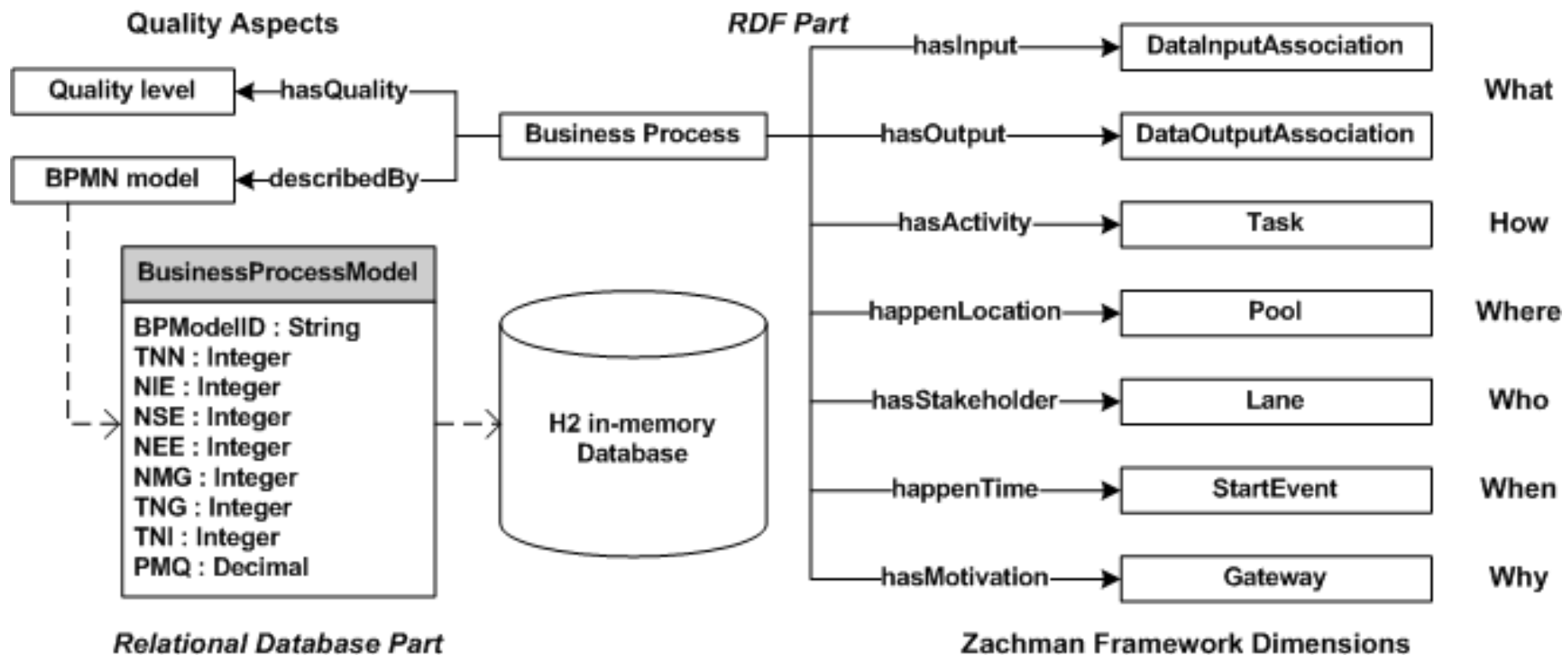
Weights  $w_i$  are derived from ranks of modeling guidelines:

Variables	$w_1$	$w_2$	$w_3$	$w_4$	$w_5$
Ranks	80.5	86.5	101	58.5	104
Weights	0.21	0.19	0.16	0.28	0.16

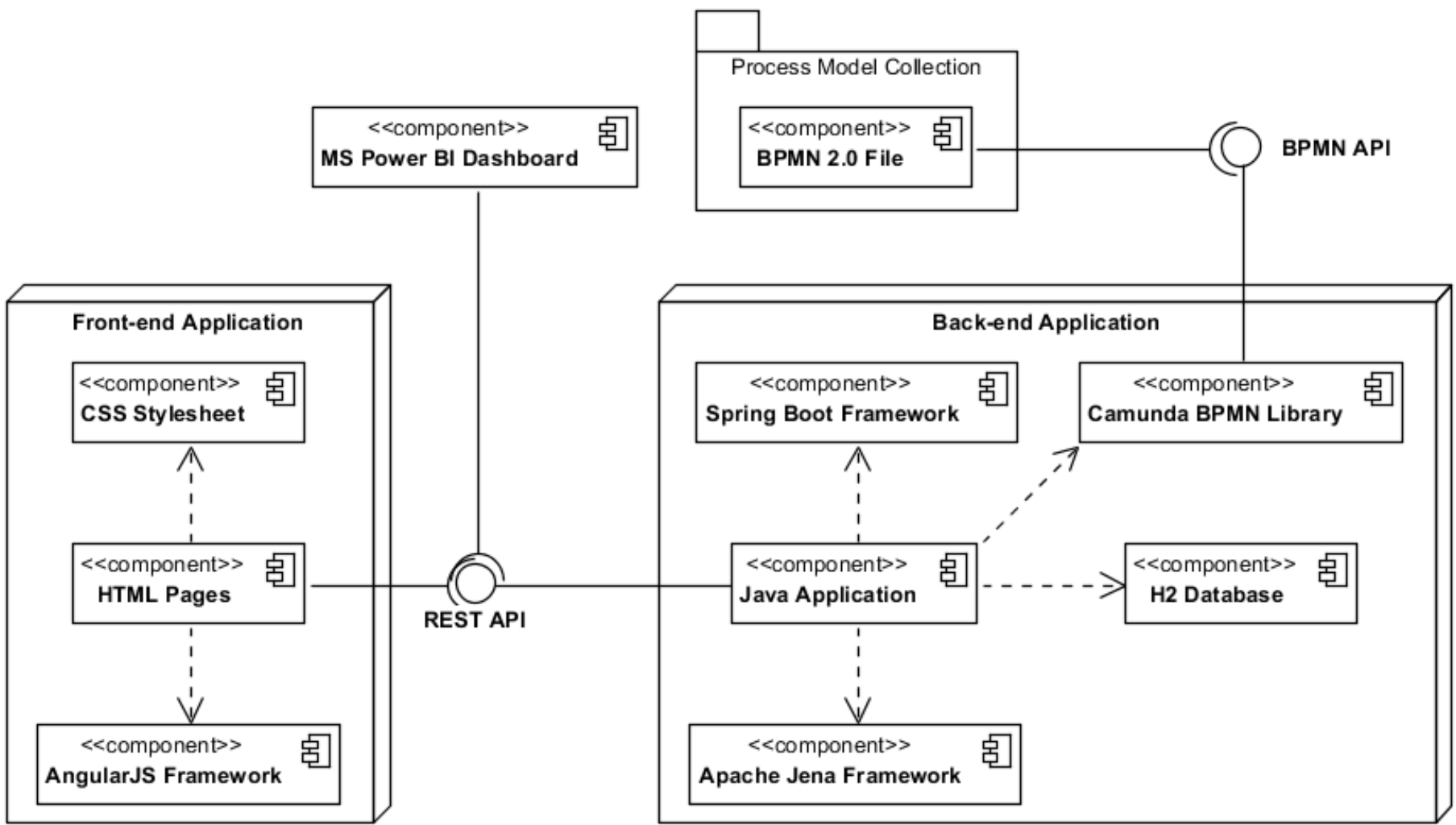
Crisp quality values are then translated into linguistic:

Quality level	Thresholds	Quality level	Thresholds
Very high	$0.8 \leq PMQ \leq 1$	High	$0.64 \leq PMQ \leq 0.8$
Medium	$0.37 \leq PMQ \leq 0.64$	Low	$0.2 \leq PMQ \leq 0.37$
Very low	$0 \leq PMQ \leq 0.2$	Indefinable	$ N  = 0 \vee  T  = 0$

# Data Model for BPMN Models Storage and Querying



# Software Prototype Architecture



# Software Usage Example

Aggregated data about analyzed process models

Business Process Model Quality Application

Total Models: 3390  
 Correct Models: 1132  
 Models to be improved: 2258  
 Show querying form

Models to be improved

Category	Count
Invalid size	1
Invalid degrees	2,161
Multiple events	999
Gateways mismatch	1,259
OR gateways	84

Querying form and retrieved results

?bpModel hasqua Query Reset

hasQuality Very High  
 hasQuality High  
 hasQuality Medium

Invalid Nodes Start Events End Events Unmatched Gateways Total Gateways OR Gateways PMQ Quality

?bpModel hasQuality Medium Query Reset

Result: 311 model(s)

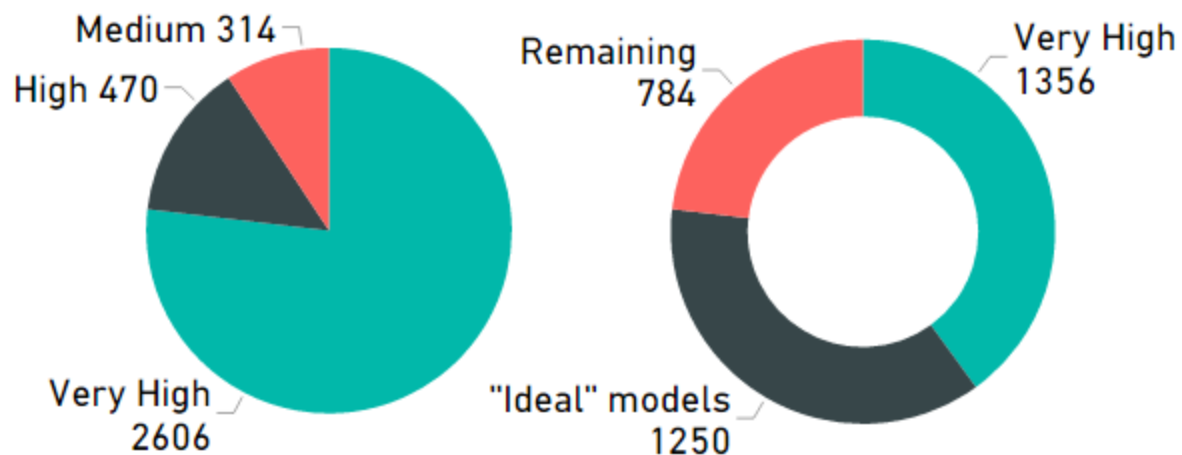
	Total Nodes	Invalid Nodes	Start Events	End Events	Unmatched Gateways	Total Gateways	OR Gateways	PMQ	Quality
af7-2aa7-4030-8307-344782c59f51]	15	3	1	2	2	2	0	0.6	Medium
b1e733c9ed076eed.bpmn_[id-sid-ee14252c-c97a-433c-8838-4970fbb1b3cb]	16	3	1	3	3	4	0	0.63	Medium
l862e539bcded9e65.bpmn_[id-sid-6521cf8a-6d7d-486b-a351-79def6327ad3]	14	3	1	2	2	2	0	0.6	Medium
ab4e34a90047b19fc9077a.bpmn_[id-sid-64714A88-CE34-4F2A-9C72-	16	2	1	3	3	3	0	0.57	Medium
d-60955fc2-a81e-4c1a-873b-9e73e767d3ec]	17	2	1	4	2	2	0	0.55	Medium
af4ff994f84b3aec75396c3b66c.bpmn_[id-sid-FF44264B-3E90-4D73-B68A-	13	3	1	2	2	2	0	0.6	Medium

# Obtained Results

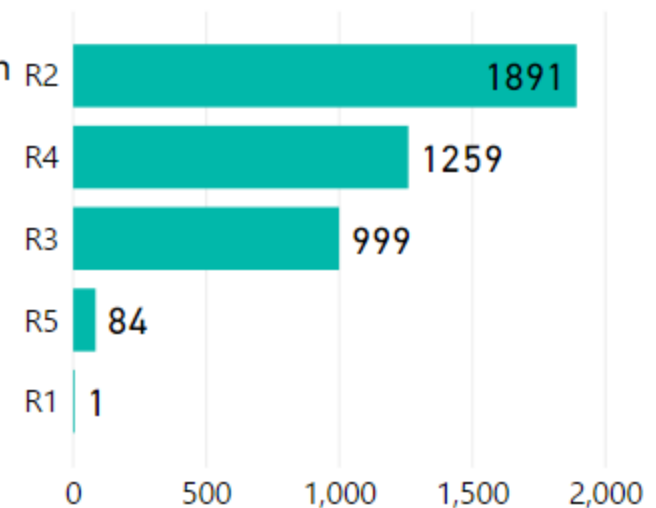
3390 BPMN models analyzed, among them:

- 2606 models are of very high quality ( $PMQ \geq 0.8$ )
- 470 models are of high quality ( $PMQ \geq 0.64$ )
- 314 models are of medium quality ( $PMQ \geq 0.37$ )

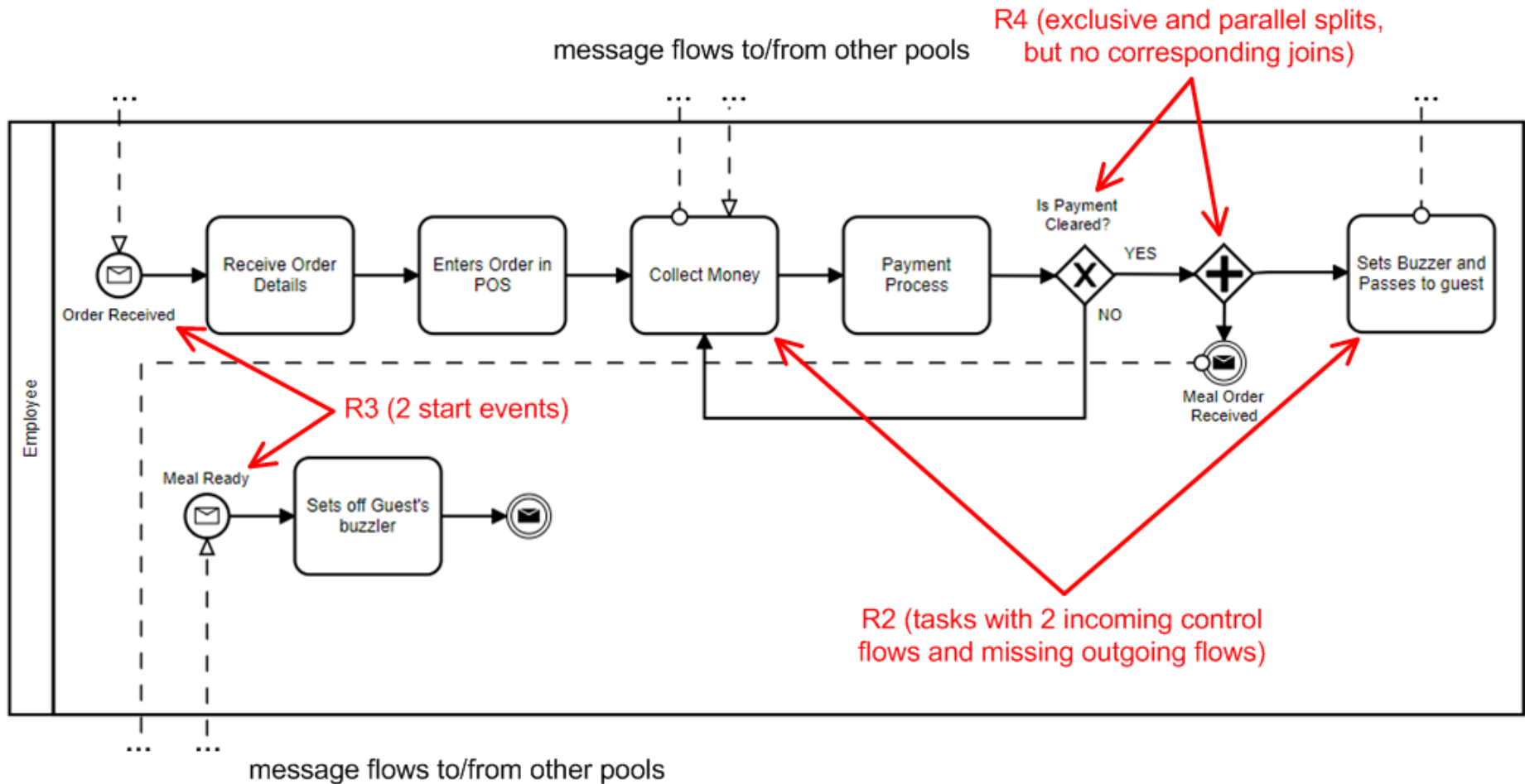
Models by quality levels Total models



Models by rules violations



# Detected Process Modeling Rules Violations



# Conclusion and Future Work

- The set of business process measures and quality criteria are introduced
- Generalized quality criterion based on the WSM model is proposed, as well as the procedure of translation its values into linguistic ones using Harrington scale is described
- The data model based on Zachman Framework dimensions used to store and simplify querying data about business process models is demonstrated
- Results of quality evaluation of BPMN process models are outlined and discussed, most common process modeling errors are shown
- Future work includes research in the field of BPMN ontology design, versions traceability, and advanced querying, as well as new results analysis and demonstration

**THANK YOU FOR ATTENTION!**