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Performance Measurement Framework with Formal Indicator Definitions

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Outline

- Key concepts
- Five-step lifecycle of indicators
  - Five groups of indicator properties
- Model of Indicator definition
- Performance Measurement Systems
  - Data warehouse as a PMS
- Conclusions and future work

Key concepts (I)

- *Performance measures* refer to indicators used by management to measure, report and improve the performance in an organization.
- Performance measures are classified as:
  - result indicators,
  - key result indicators,
  - performance indicators,
  - key performance indicators

Key concepts (II)

- In the measurement, the following hierarchical structure is considered:
  - attributes → base measures → derived measures → indicators → information.
  - *An indicator* is a measure that ensures the evaluation for particular attributes and is gained by means of an analysis which is performed according to an analysis model.
  - Analysis model is an algorithm that combines two or more base and/or derived measures with decision criteria.
  - Indicators provide the basis for a decision making and supply analysts with the necessary *information*.

Key concepts (III)

- The definition of appropriate performance measures should be performed in a systemic way, based on well known approaches
- The set of used performance measures is influenced by *management models* of organizations and *measurement perspectives* defined within these models.
  - e.g. Balanced Scorecard (BSC),
    - four measurement perspectives are defined: Financial, Customer, Internal Process, and Learning and Growth.
  - two more perspectives :
    - Environment/Community and Employee Satisfaction

Features of Indicators

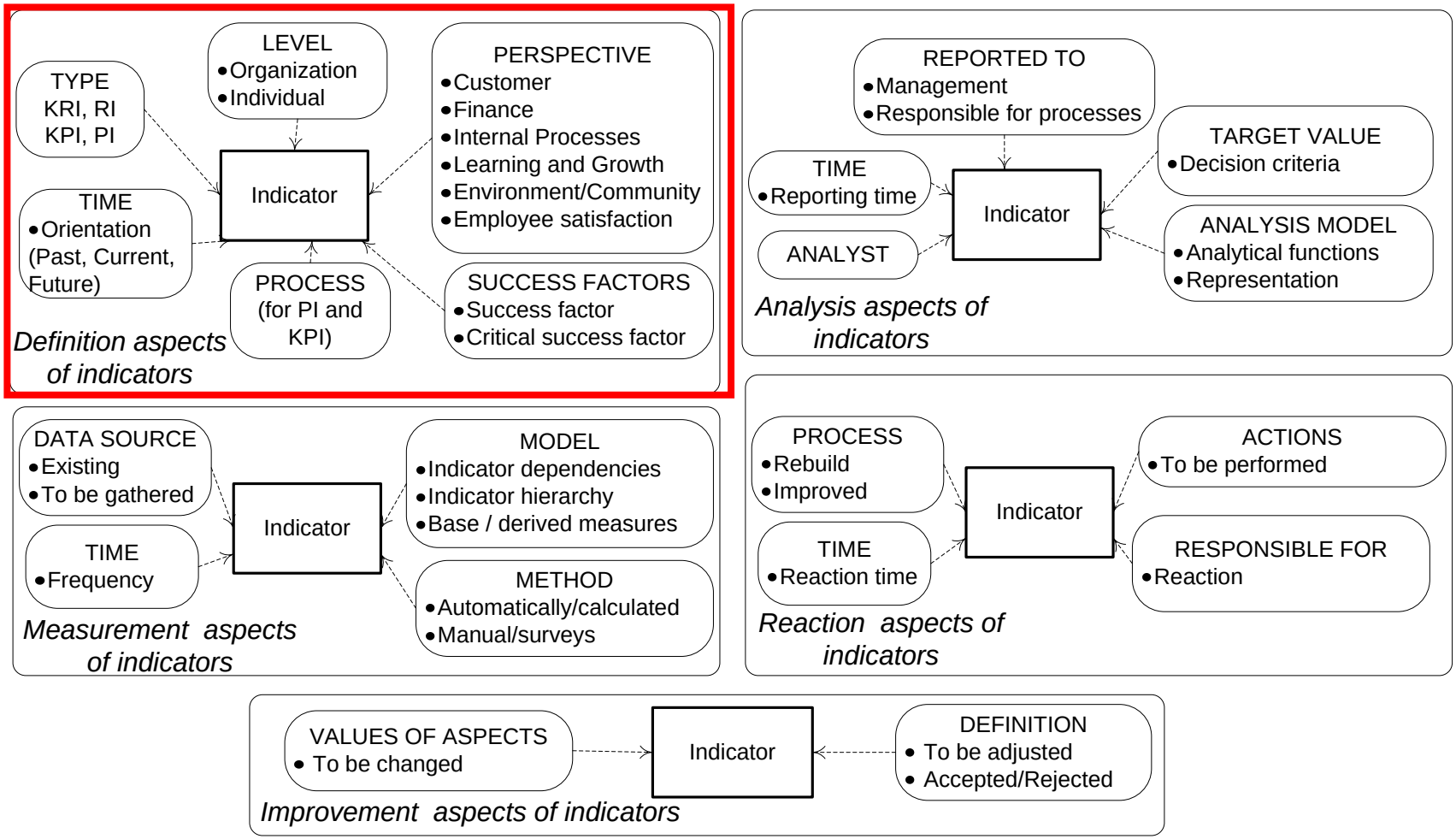
- *Perspectives*
  - not all indicator types cover all perspectives, e.g. financial perspective is related to KRIs and RIs, but not to PIs.
- *Time*
  - measurement periods , reporting periods
- *Responsibility*
  - Persons responsible for different types of performance measures could be at different levels starting from the top management to an individual level,
- *Activities*
  - RIs cannot be tied to a discrete activity; PIs, on the contrary, are tied to a discrete activity.
- *Reporting*
  - Responsibility aspect and Reporting aspect not always have the same meaning.
- Others…

Goal of the research

- to develop performance measurement framework with systematized features of indicators:
  - Proposed framework covers five-step indicator lifecycle
- to propose a formal specification of indicators
  - Model for definition of Indicators

Five-step lifecycle of indicators

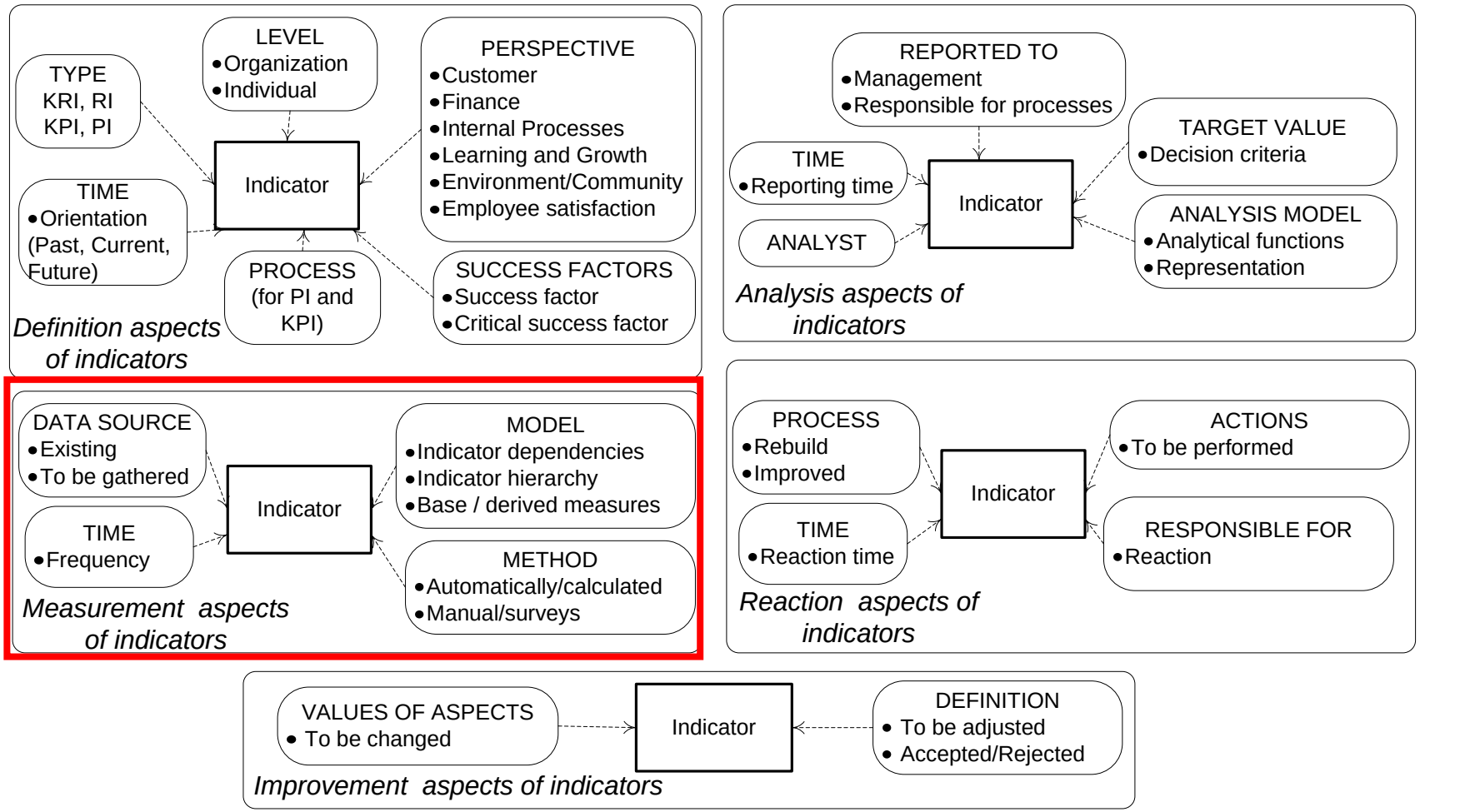
- Definition
  - Indicator definition step describes mostly different features of indicators that help to understand why that measure is introduced.



Five-step lifecycle of indicators

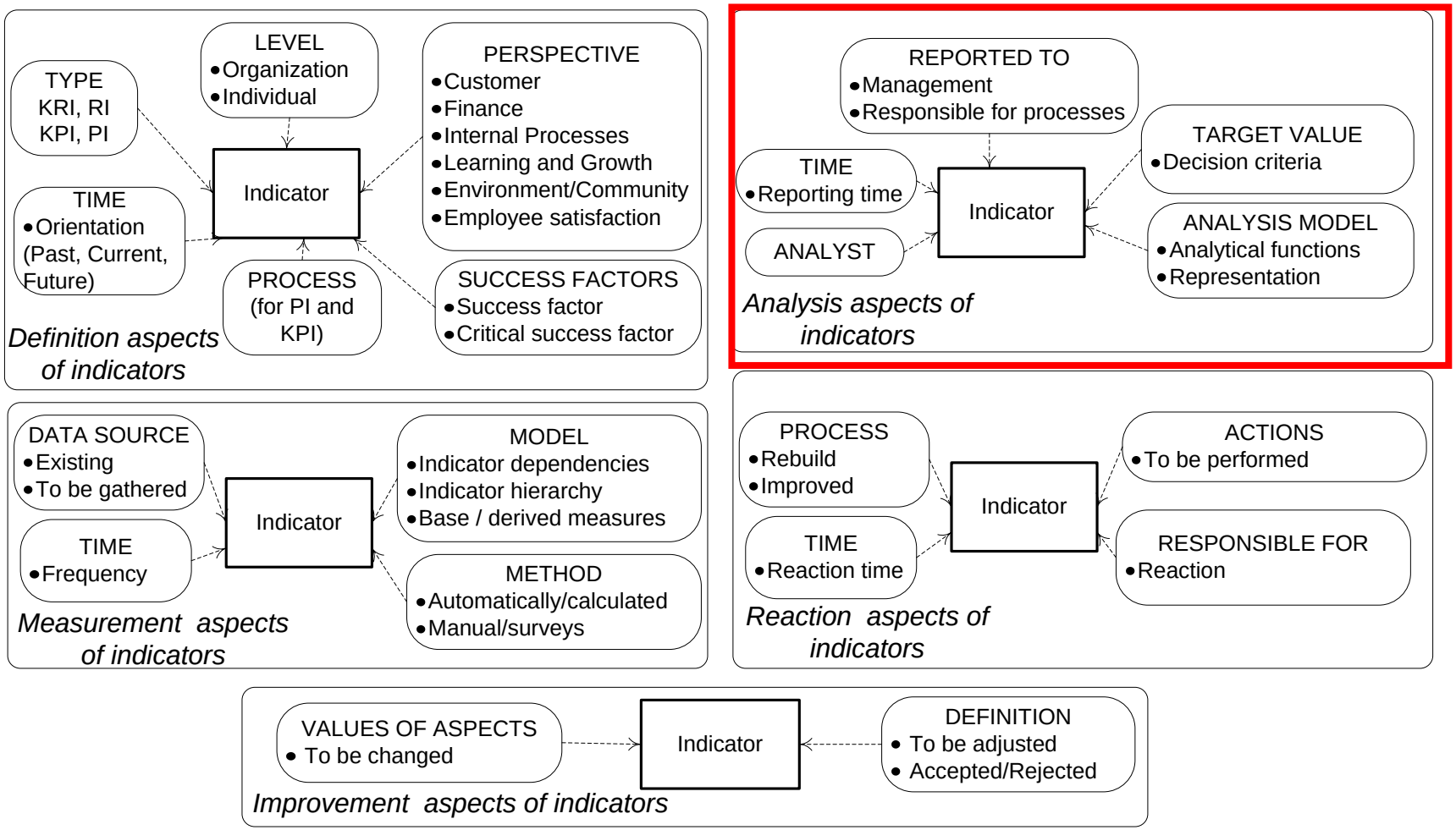
– Measurement

- The measurement step represents the process, when indicators get the values.



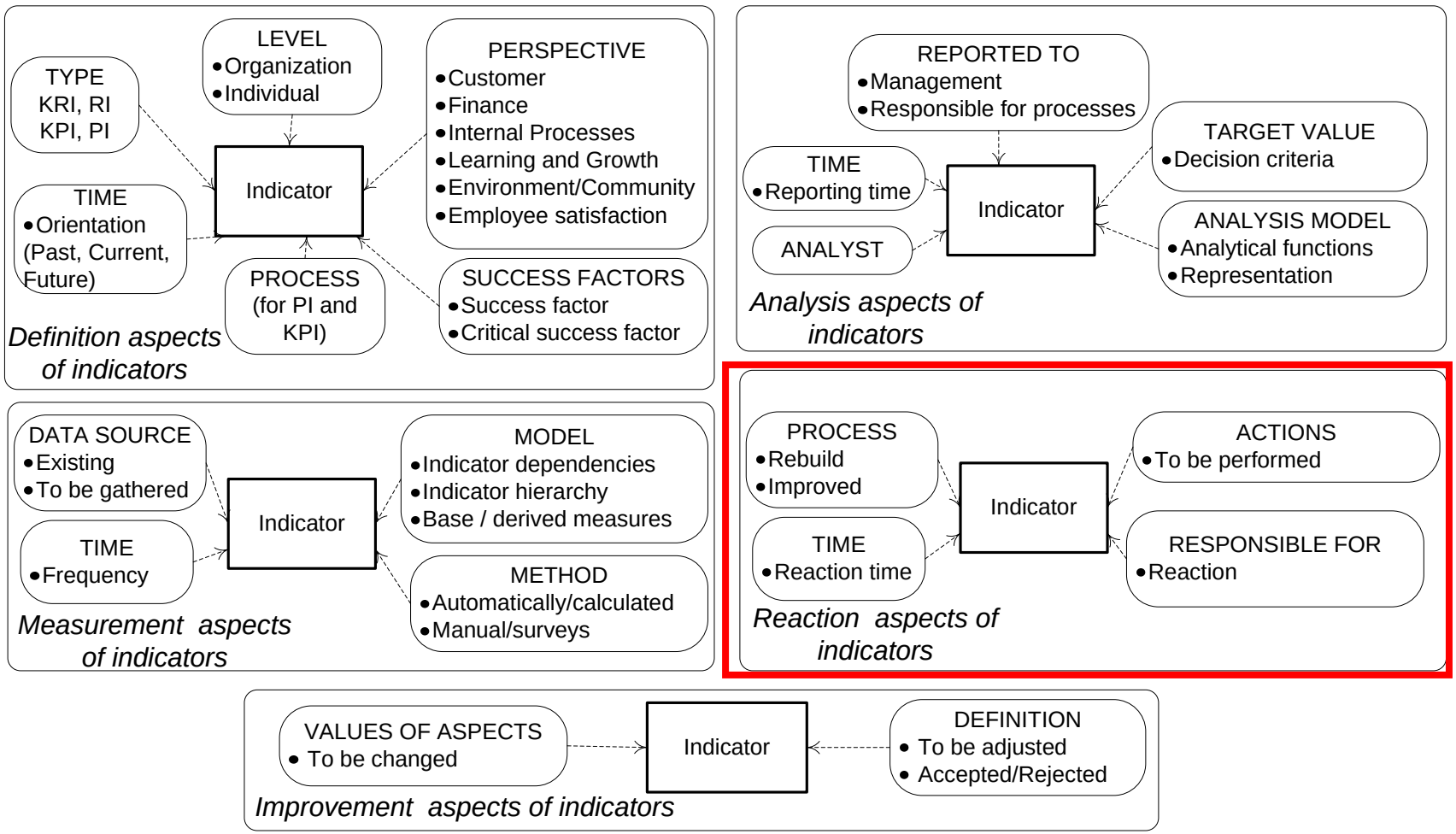
Five-step lifecycle of indicators

- Analysis
  - The analysis step represents the process, when indicators are used to make decisions.



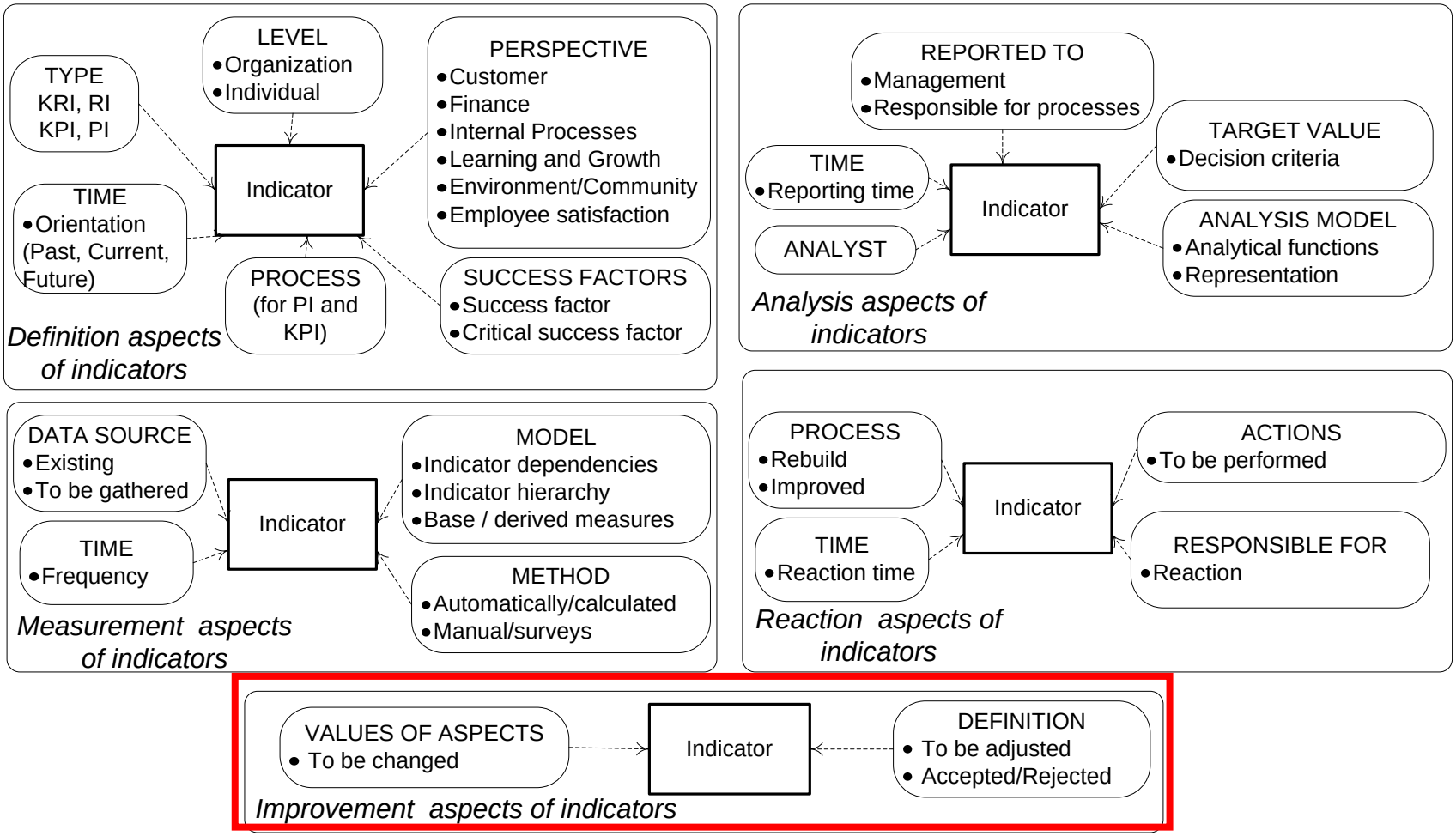
Five-step lifecycle of indicators

- Reaction
  - The reaction step represents the process, when the decisions that are made in the previous step are implemented.



Five-step lifecycle of indicators

- Improvement
  - The improvement step supports the evaluation of indicator definitions and values of aspects.



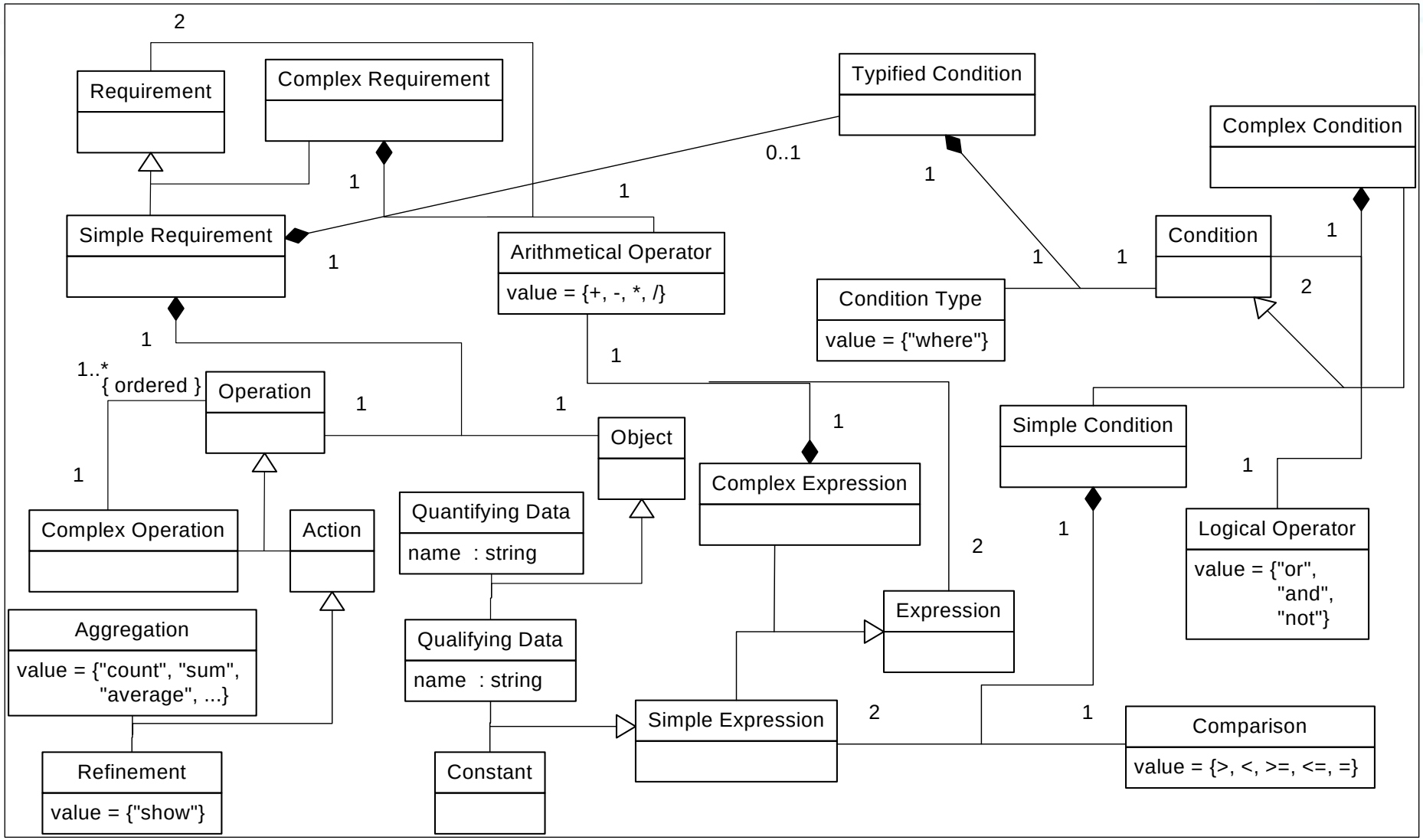
Indicator formal definition

- Indicators are the focus of data analysis in the measurement process
- The sentences that express the performance indicators in natural languages were observed and some patterns were discovered to be formalized
- We based the model for indicator definition on the structure evaluation of the sentences that formulate performance indicators taken from the performance measures database, given in:
  - Parmenter, D.: Key Performance Indicators: Developing, Implementing, and Using Winning KPIs (2010)
- The formal definitions of indicators allow to build an appropriate performance measurement system, e.g. star schema of a data warehouse

Reformulating the indicator sentences

- An indicator component, which is supposed to be measured, is treated as an aggregated number of all occurrences of this component.
  - *calls* →count (call), where *count* is the suitable aggregate function.
- If an indicator sentence contains such components as “listing of”, “list of”, or “instances of”, then in the corresponding requirement the refinement function *show* is applied.
  - *listing of customers* → show customers
- If an indicator contains such component as “number of”, then in the corresponding requirement the aggregate function *count* is applied.
  - *number of visits* → count (visit)
- If an indicator contains such components as “cost of”, “value of”, “expense”, “total expense”, etc., or the name of currency in the beginning if the indicator, then in the corresponding requirement the aggregate function *sum* is applied.
  - *total income* → sum (income)
- If an indicator contains such component as “average”, then in the corresponding requirement the aggregate function *avg* is applied.
  - *average response time* → avg (response time)

Model of Indicator definition



Example

- We used performance indicator definitions formulated in natural language from a performance measures database:
  - Parmenter, D.: Key Performance Indicators: Developing, Implementing, and Using Winning KPIs (2010)
  - This database contains a comprehensive list of performance measures from six measurement perspectives, e.g. customer, finance, etc. ~ 300 indicators
  - We have chosen indicators from different perspectives with different structure of the sentences in a natural language
  - “Average number of contacts with key customers”

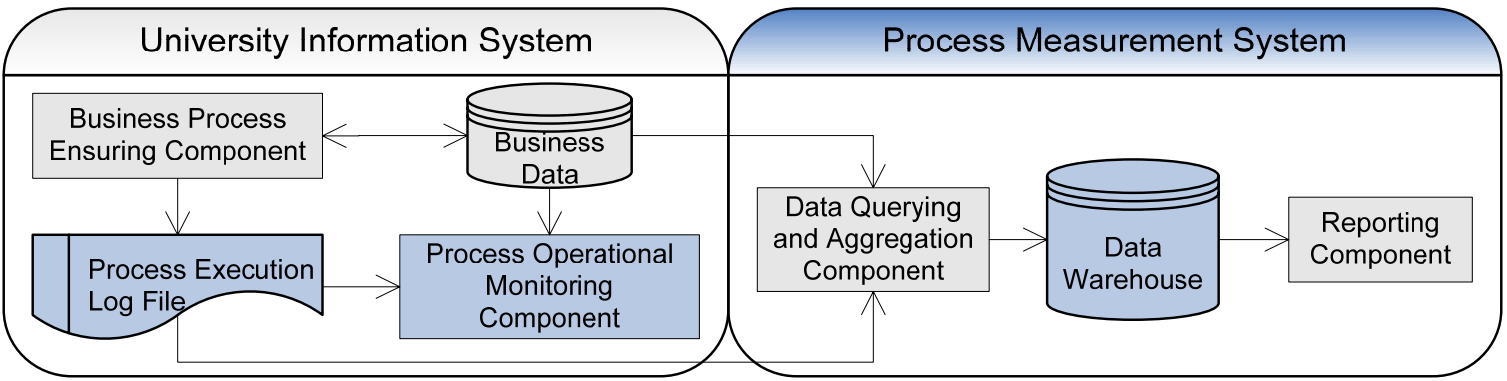
<table>
<tr><td>show</td><td>Refinement</td><td>Action</td><td colspan="2">Operation</td><td rowspan="10">Simple Requirement</td></tr>
<tr><td>month</td><td>Qualifiyng Data</td><td colspan="3">Object</td></tr>
<tr><td>AVG</td><td>Aggregation</td><td>Action</td><td colspan="2">Operation</td></tr>
<tr><td>contacts ocurrance</td><td>Quantifying Data</td><td colspan="3">Object</td></tr>
<tr><td>where</td><td colspan="3">Condition Type</td><td rowspan="4">Typified Condition</td></tr>
<tr><td>customer type</td><td>Qualifiyng Data</td><td>Simple Expression</td><td rowspan="3">Simple Condition</td></tr>
<tr><td>=</td><td colspan="2">Comparison</td></tr>
<tr><td>'key customer'</td><td>Constant</td><td>Simple Expression</td></tr>
</table>

Performance Measurement Systems

- *Different new data sources*
  - E.g. workflow logs are integrated with other data sources..
- *Specific data analysis approaches*
  - different data analysis goals, e.g. technical or business goals
  - different time periods – e.g. short term analysis of processes, which presumes monitoring of process execution at the time of the analysis, and long term analysis
- A data warehouse as a solution for a process measurement system is appropriate:
  - when mostly the long term analysis is performed,
  - when integration of all possible data sources is needed and one part of necessary data already exists within a data warehouse of a company,
  - when analysis is performed at the level of an organization.

Implementation of the Process Monitoring and Measurement

- Process monitoring
  - Process execution log file
  - Process Operational Monitoring Component
- Process Measurement System
  - based on the data warehouse model



Conclusions and Future work

- Our PMS is successfully implemented according the formal indicator definitions.
- a data warehouse that already exists in an organization could be effectively used also for performance measurement purposes
- We will complement the existing PMS, according to the proposed framework – 5 step indicators lifecycle.
- The future work will be done in two directions:
  - more practical case studies and evaluations of ease of use of formal patterns
  - the development of a new method for semi-automated construction of data warehouse schemas based on the formal definitions of indicators, according to the model given in this paper.

Thank you!