KPI/Metrics for the process industry

Charlotta Johnsson

A company is considered a
Business Mover
if it has improved:

a) More than 10% on one or many of the financial metrics

b) More than 1% on over half of the financial metrics

From: MESA survey ”Metrics that Matter”, Oct 2006.

Typical for *Business Movers* is that they:

1) Have well defined KPIs

2) Have informed employees

3) use IT systems to get measurements, calculate Key Performance Indicators (KPIs, Metrics) and display the results.

From: MESA survey ”Metrics that Matter”, Oct 2006

KPI/Metrics for the process industry

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CHALLENGES:

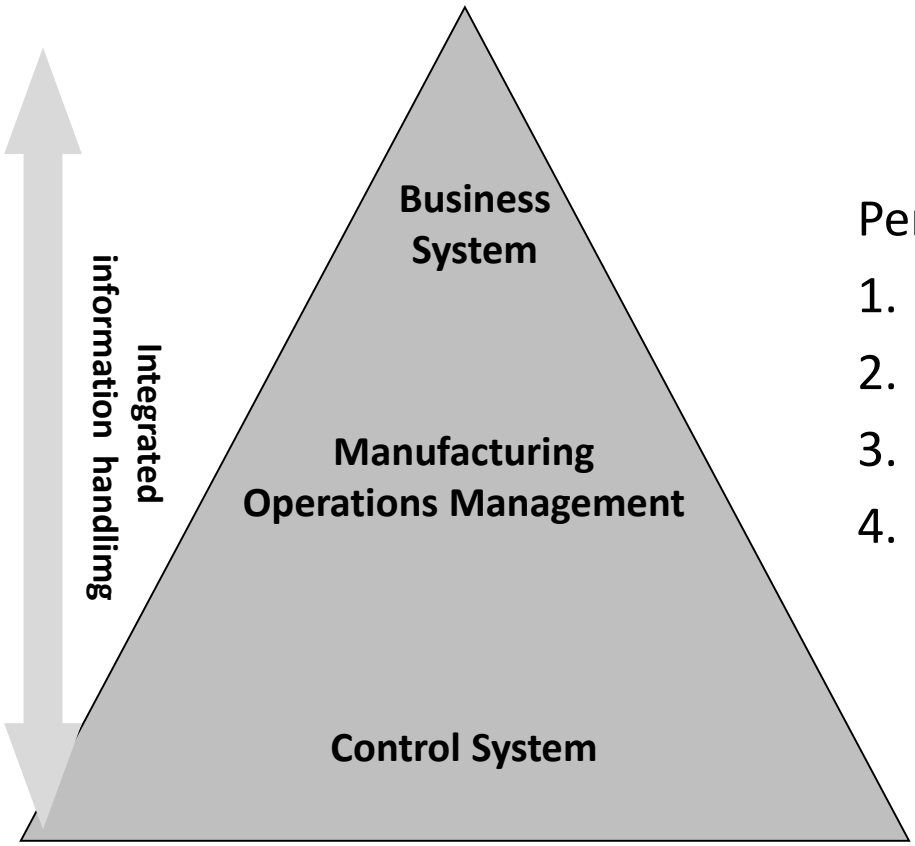
1) What key performance indicators are used in process industry today?
2) Do the key performance indicators differ depending on company characteristics?
3) How can key performance indicators be exchanged between different software-applications?

PROJECT:

- PiiA financed project (jan2015-dec2016) called “PiiA-Metrics”

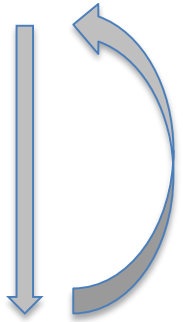
What is a KPI?

Key performance indicators (KPIs) are metrics designed to visualize, assess, and manage the performance of specific operations within enterprises.

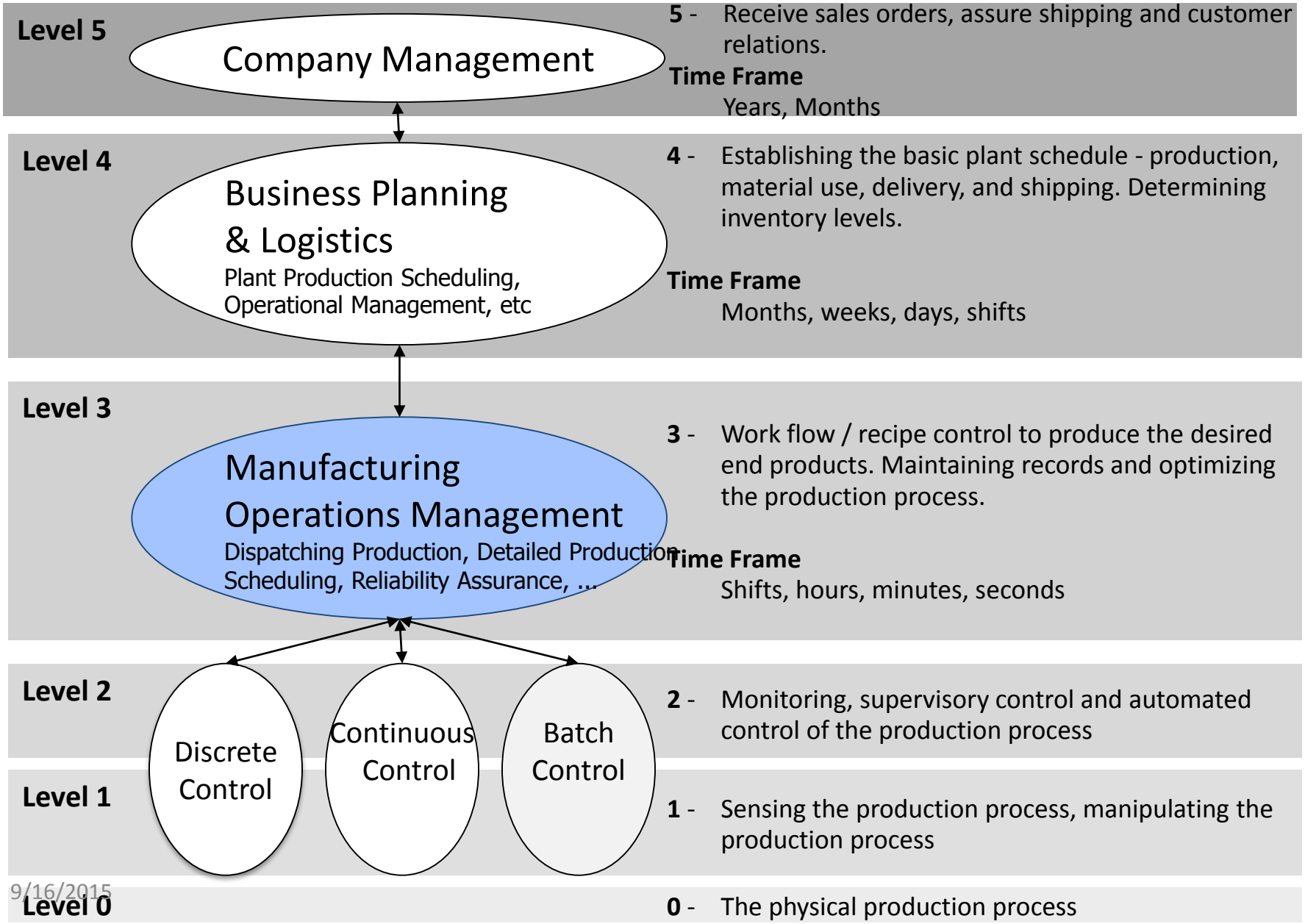


Performance Management:

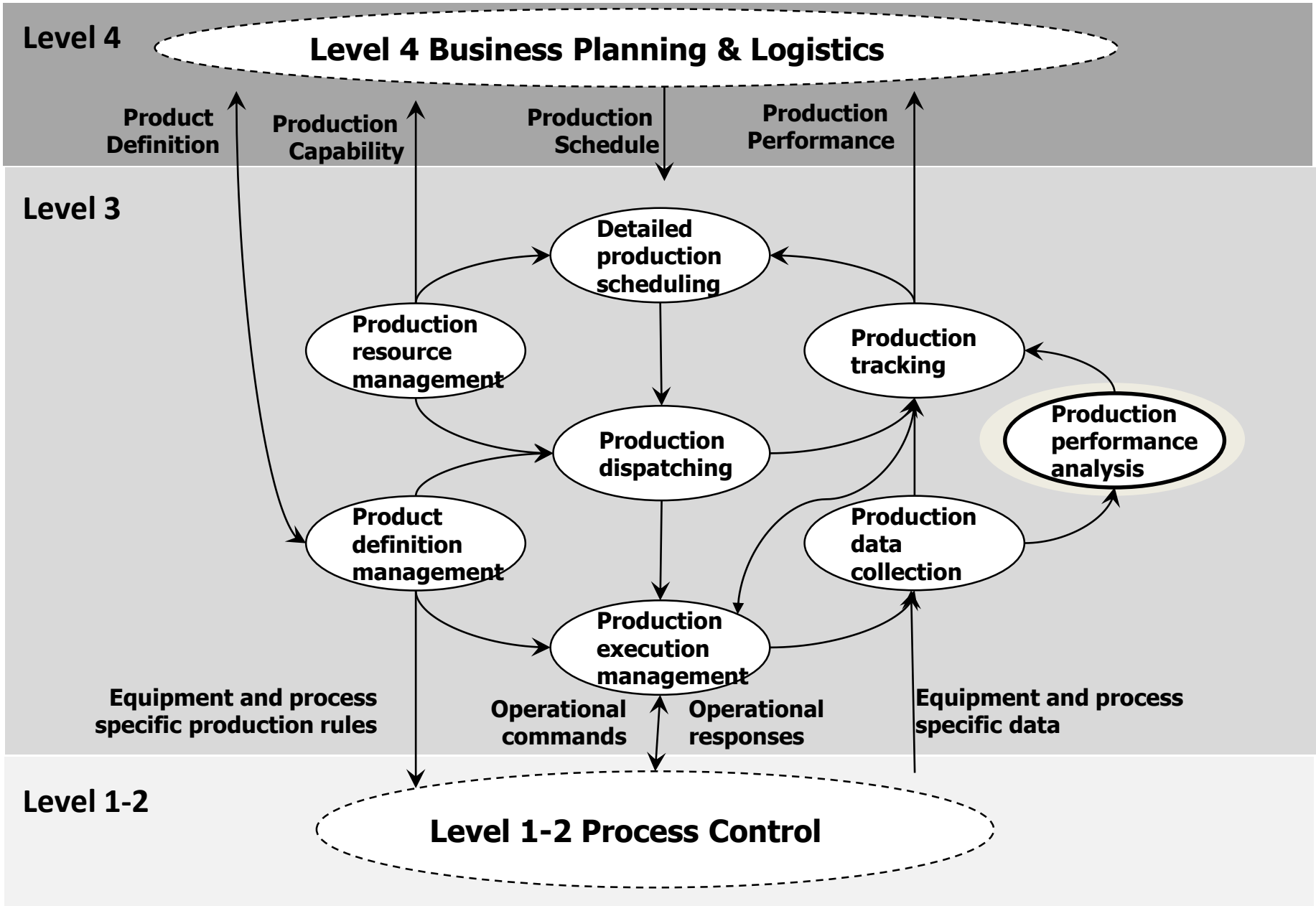
1. Awareness of current situation
2. Clear view of the desired situation
3. Improvement potentials
4. Improvement



Functional Model of an Enterprise (ISA95)



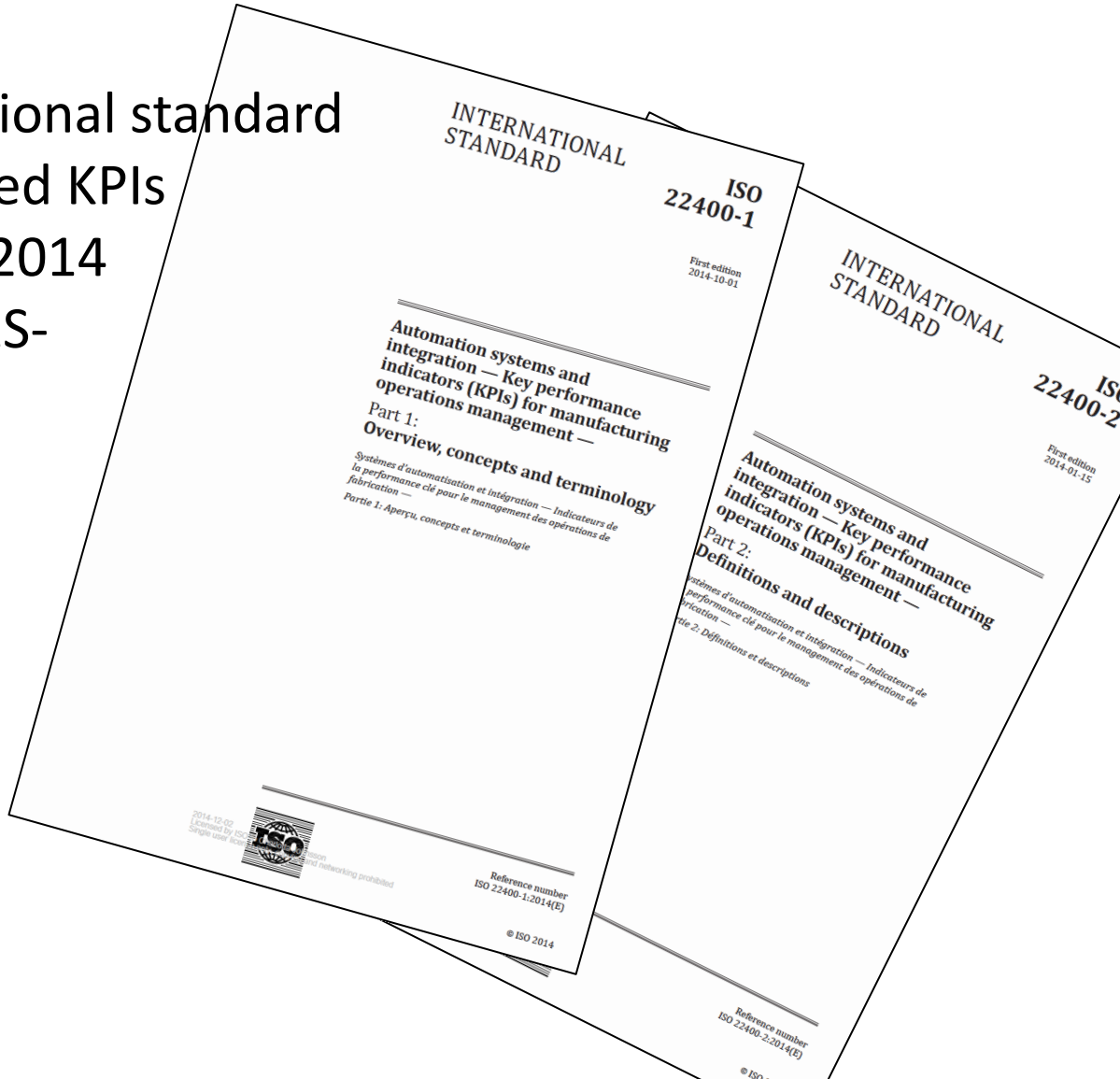
ISA 95 – Activity Model for Production Operations



Earlier work

ISO 22400 is an international standard

- Lists 34 commonly used KPIs
- Standard released in 2014
- Used today in e.g. MES-product development



KPI definition	
Content:	
Name	
ID	
Description	
Scope	
Formula	
Unit of measure	
Range	
Trend	
Context:	
Timing	
Audience	
Production methodology	
Effect model diagram	
Notes	

Source: ISO 22400 – Part1 (2014)

1: What KPIs are used today?

KPI definition	
Content	
Name	Availability
ID	
Description	Availability is a ratio that shows the relation between the actual production time (APT) and the Planned busy time (PBT) for a work unit..
Scope	Work unit, product, time period, product
Formula	Availability = APT / PBT
Unit of measure	%
Range	Min: 0% Max: 100%
Trend	The higher, the better
Context	
Timing	On-demand, periodically
Audience	Supervisor, management
Production methodology	Discrete, batch, continuous
Effect model diagram	See A.10
Notes	Availability indicates how strongly the capacity of a work unit for the production is used in relation to the available capacity. The term availability is also called degree of utilisation or capacity factor.

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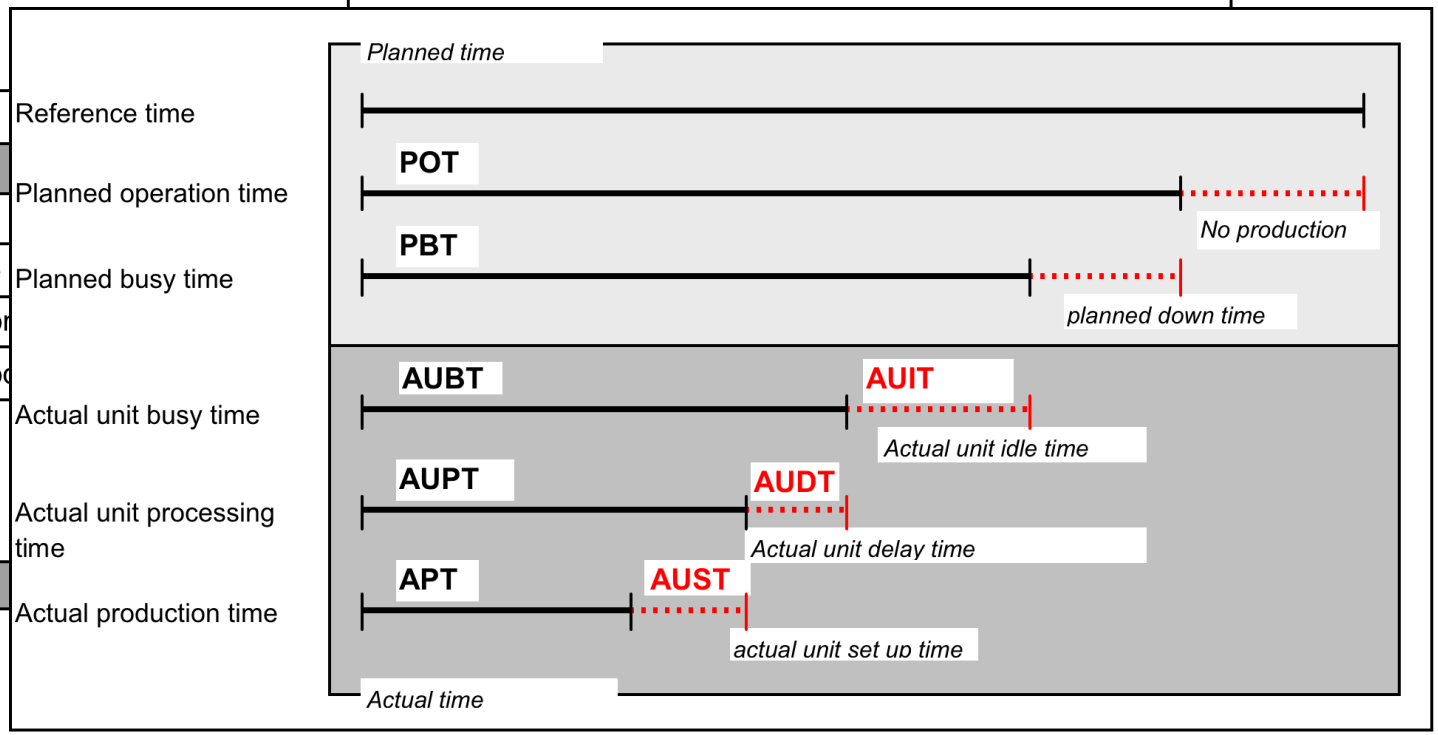

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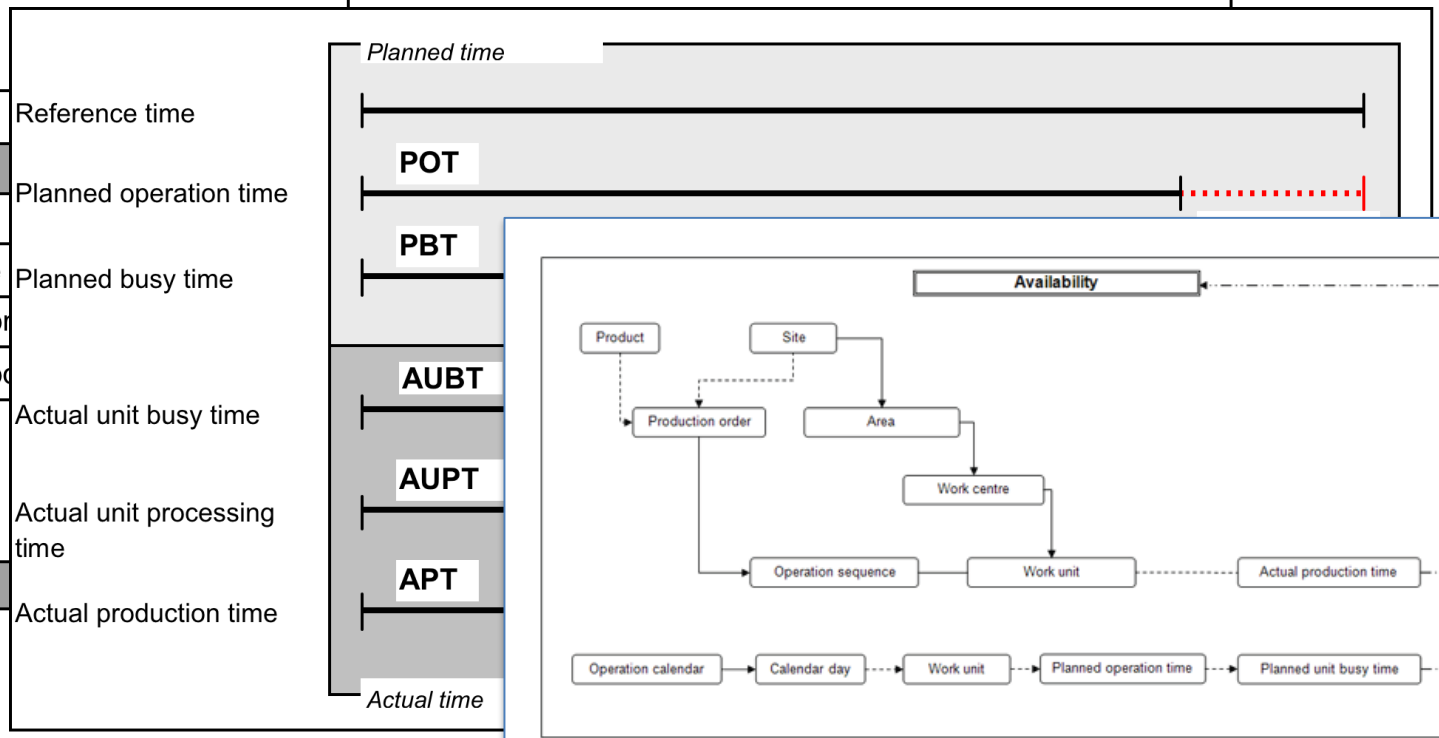

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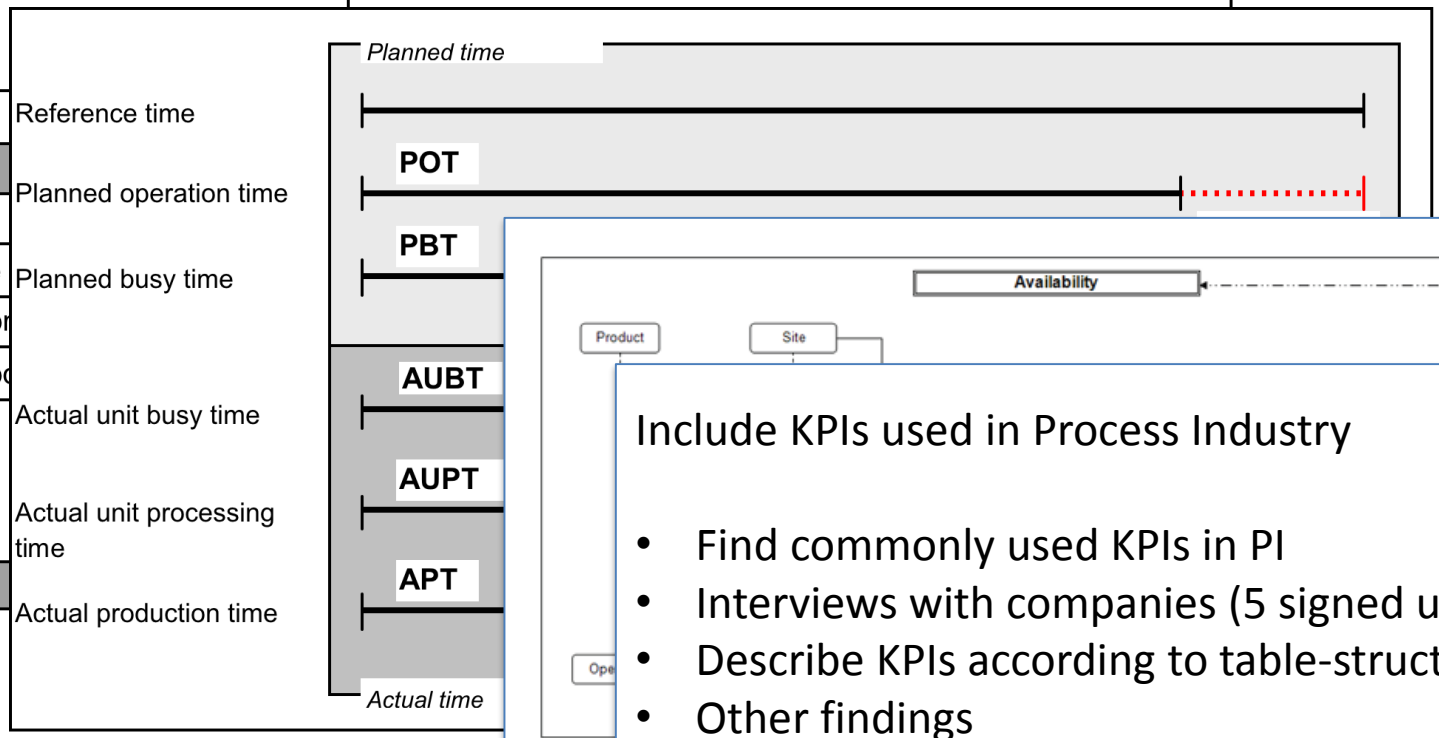


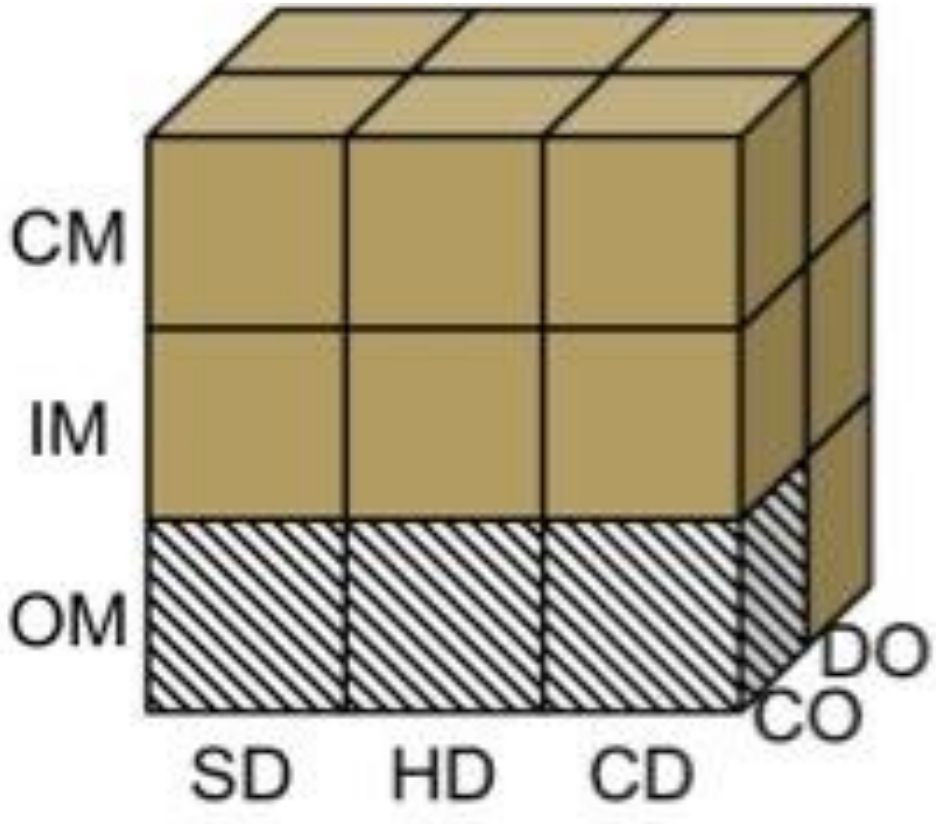
Include KPIs used in Process Industry

- Find commonly used KPIs in PI
- Interviews with companies (5 signed up)
- Describe KPIs according to table-structure
- Other findings

2: Do the KPIs differ depending on company characteristics

Company characteristics:

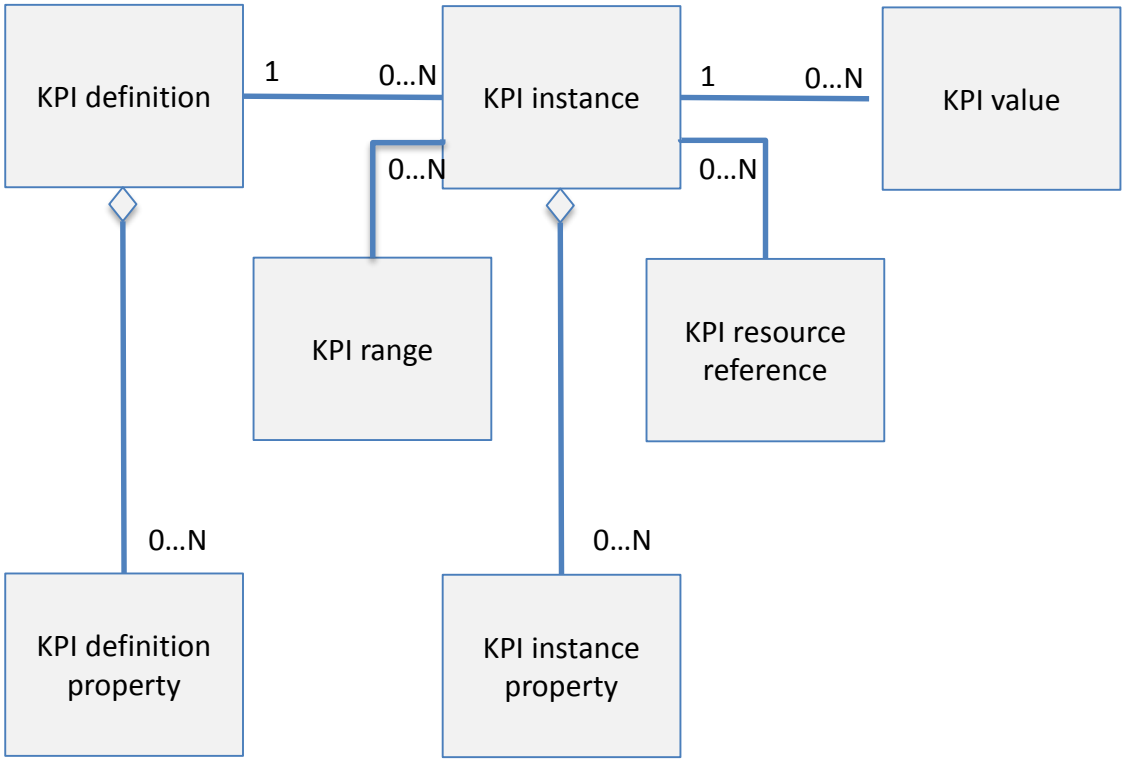
- Continuous (CO) vs Discrete Object (DO)
- Speculation (SD), Hybrid (HD) or Customer-order Driven (CD)
- Continuous (CM), Intermitent (IM) or One-time Mode (OM)



3: How can KPIs be exchanged?

UML models are used to define the structure of a KPI

UML is an implementation independent specification format.



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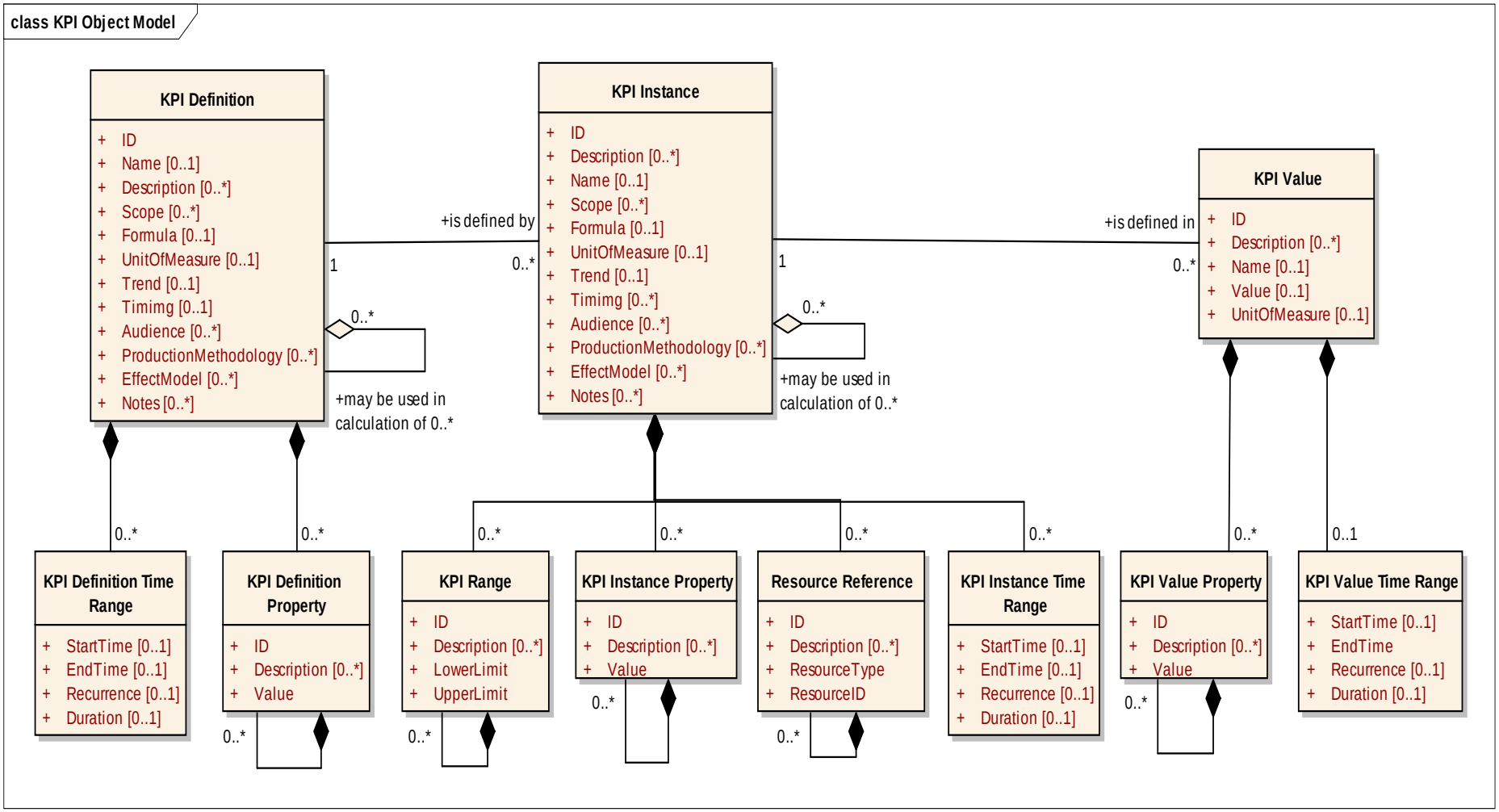

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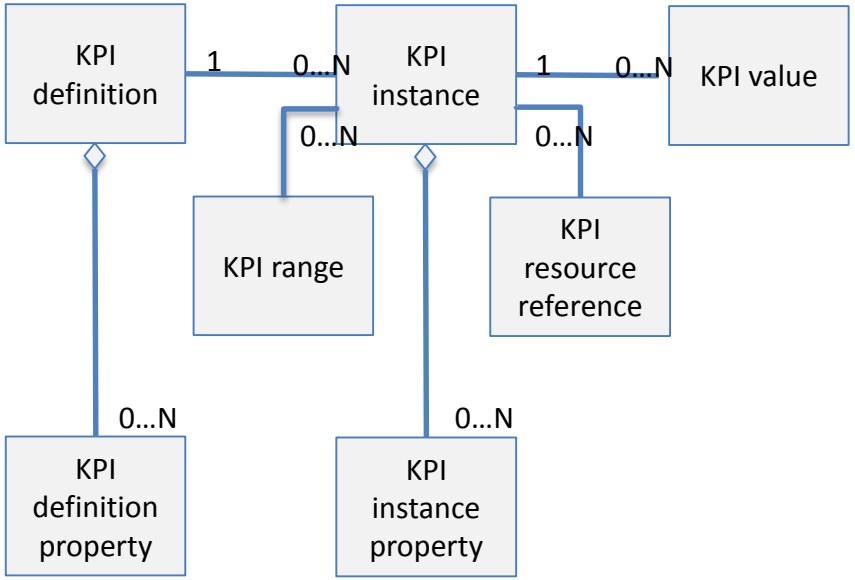
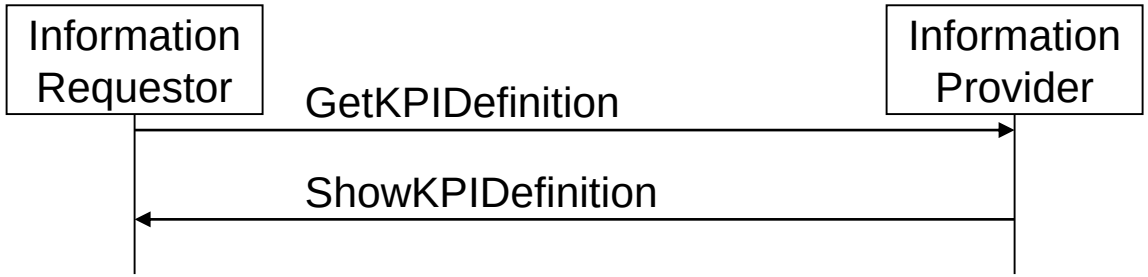
UML models define the KPI structure



UML models are translated to XML schemas
XML schemas can be exchanged between various systems



3: How can KPIs be exchanged?

```
<?xml version="1.0" encoding="UTF-8"?>
<!--Sample XML file generated by XMLSpy v2010 rel. 3 sp1 (http://www.altova.com)-->
<KPIDefinition xsi:schemaLocation="http://www.mesa.org/xml/KPI-ML-V01RC03 KPI-ML-
V01RC03.xsd" xmlns="http://www.mesa.org/xml/KPI-ML-V01RC02"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
      <ID>OLR100</ID>
      <Description> The other loss ratio is the relationship of the
          quantity of loss not related to production, storage or
           transportation (QL) to the quantity of consumed material (CM).
      </Description>
      <Name>Other Loss Ration</Name>
      <Scope> Work unit </Scope>
      <Scope> defect type </Scope>
      <Formula>QL / CM</Formula>
      <UnitOfMeasure>%</UnitOfMeasure>
      <Range>
            <ID>Natural</ID>
            <Description>Natural Range</Description>
            <LowerLimit>0</LowerLimit>
            <UpperLimit>100</UpperLimit>
      </Range>
      <Trend>Lower-is-better</Trend>
      <Timing>On-demand</Timing>
      <Timing>Periodically</Timing>
      <Timing>real-time</Timing>
      <Audience>Operator</Audience>
      <Audience>supervisor</Audience>
      <Audience>management</Audience>
      <ProductionMethodology>Batch</ProductionMethodology>
      <ProductionMethodology>Continuous</ProductionMethodology>
      <Notes>" The other loss ratio evaluates losses that have not occurred
             during production, storage, or transportation.
             See also production loss ratio"
      </Notes>
</KPIDefinition>
```

Exchanging KPIs

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<KPIDefinition>
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        <Description>   </Description>
        <Name>            </Name>
       <Scope>            </Scope>
        <Formula>         </Formula>
        <UnitOfMeasure> </UnitOfMeasure>
        <Range>
                <ID>  </ID>
                <Description>  </Description>
                <LowerLimit>   </LowerLimit>
                <UpperLimit>   </UpperLimit>
        </Range>
        <Trend>         </Trend>
        <Timing>       </Timing>
        <Audience>  </Audience>
        <ProductionMeth.>  </ProductionMeth.>
       <Notes>       </Notes>”
</KPIDefinition>
```

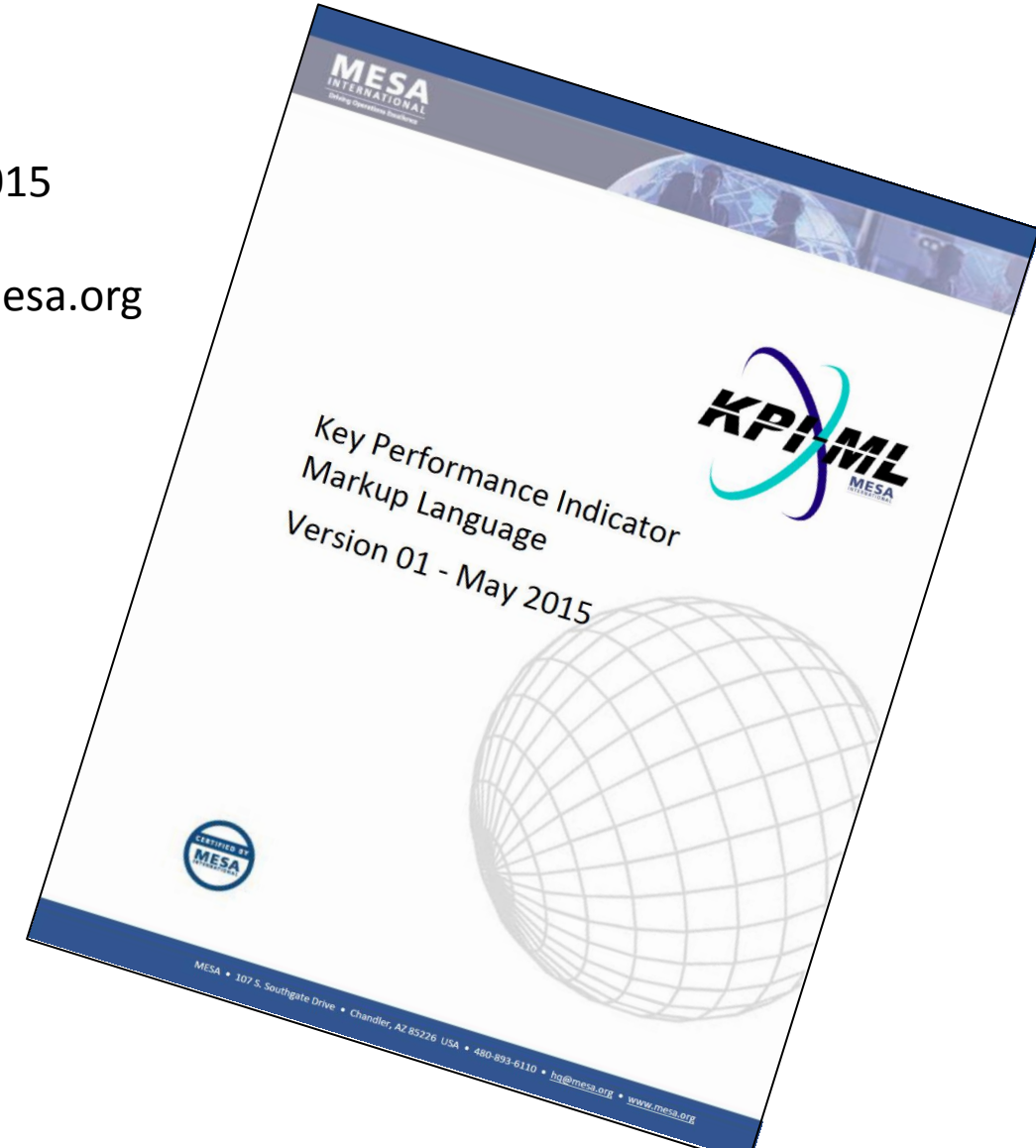
XML schemas for KPIs, an implementation proposal for the information to be exchanged

3: How can KPIs be exchanged?

XML schemas are refered to as KPI-ML

KPI-ML was released by MESA, May 2015

Available at MESAs homepage www.mesa.org



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1) What KPIs are used in process industry today?
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OTHER topics: navigation among KPIs, finding target-values to the KPIs, KPI lifecycle management.
RELATED TO: active participation in ISO22400 and MESA

PROJECT:

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THANK YOU!

KPIs defined

The following 34 KPIs are defined in ISO 22400 – Part 2

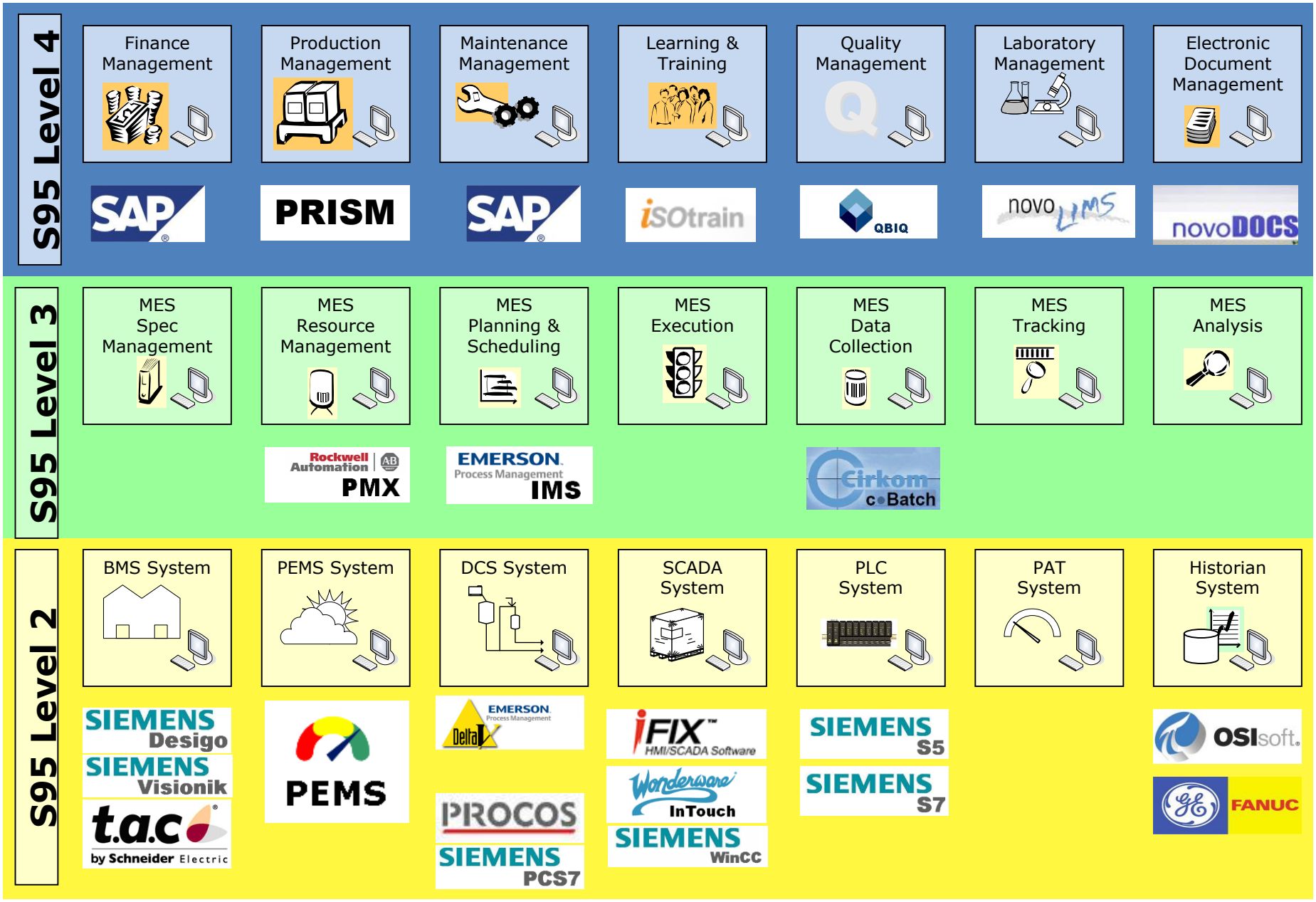
6.1 Worker Efficiency
6.2. Allocation Ratio
6.3. Throughput rate
6.4. Allocation efficiency
6.5 Utilization efficiency
6.6. Overall equipment effectiveness index
6.7 Net equipment effectiveness index
6.8 Availability
6.9 Effectiveness
6.10 Quality Ratio
6.11 Setup Rate
6.12 Technical efficiency
6.13 Production process ratio
6.14 Actual to planned scrap ratio
6.15 First pass yield
6.16 Scrap ratio
6.17 Rework ratio

KPIs defined

The following 34 KPIs are defined in ISO 22400 – Part 2

6.18 Fall off ratio
6.19. Machine capability index
6.20 Critical machine capability index
6.21 Process capability index
6.22 Critical process capability index
6.23 Comprehensive energy consumption
6.24 Inventory turns
6.25 Finished goods ratio
6.26 Integrated goods ratio
6.27 Production loss ratio
6.28 Storage and transportation loss ratio
6.29 Other loss ratio
6.30 Equipment load ratio
6.31 Mean operating time between failures
6.32 Mean time to failure
6.33 Mean time to restoration
6.34 Corrective maintenance ratio

Functional Model – NNE Example



Process Industry

- Pulp & paper
- Chemicals and plastics
- Petroleum
- Pharmaceutical
- Mining
- Iron and Steel
- Food

Source: IVA 2006