# Quantitative Process Analysis

Spring 2021 - MAJU

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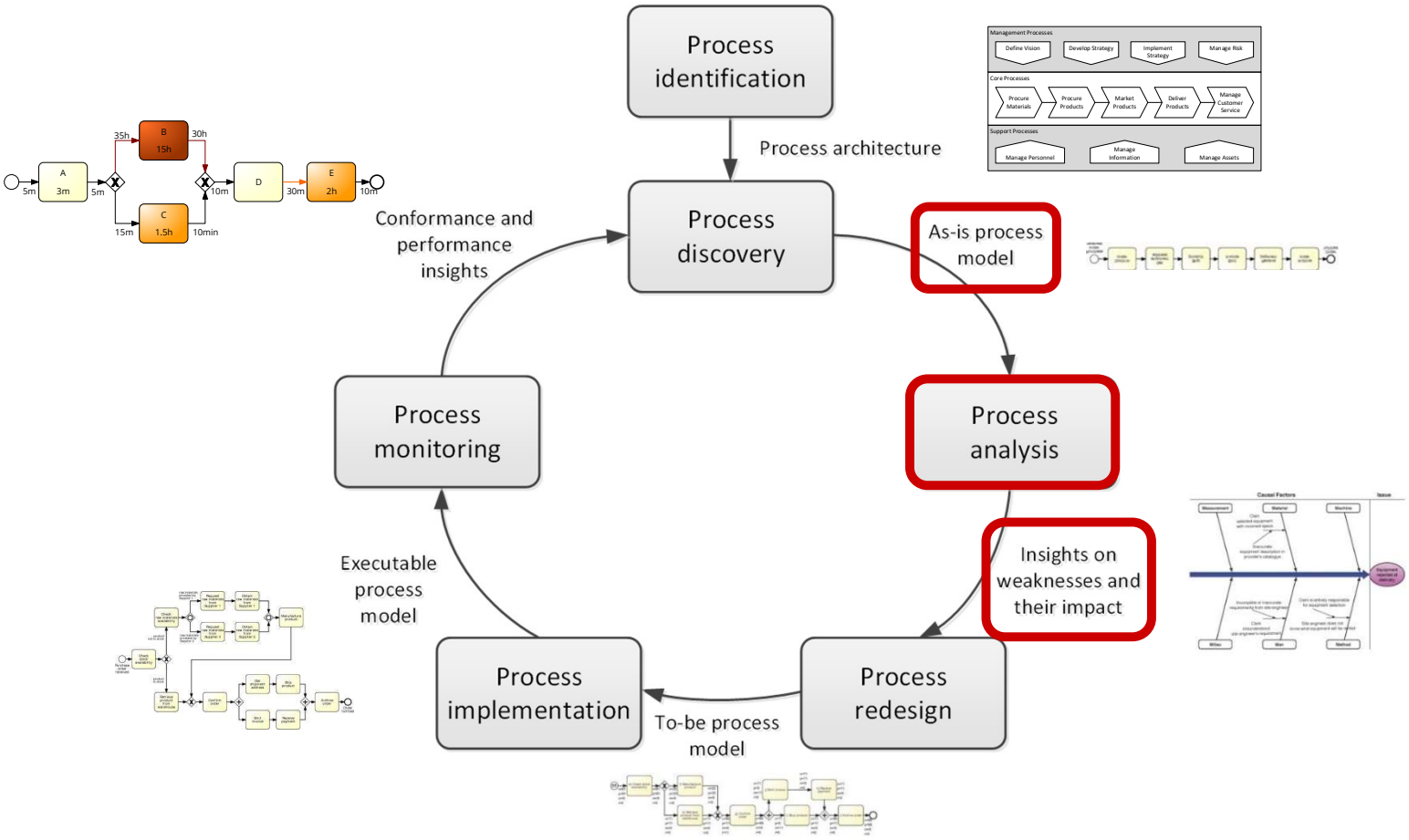
# Process Analysis in the BPM Lifecycle



## Process Analysis Techniques

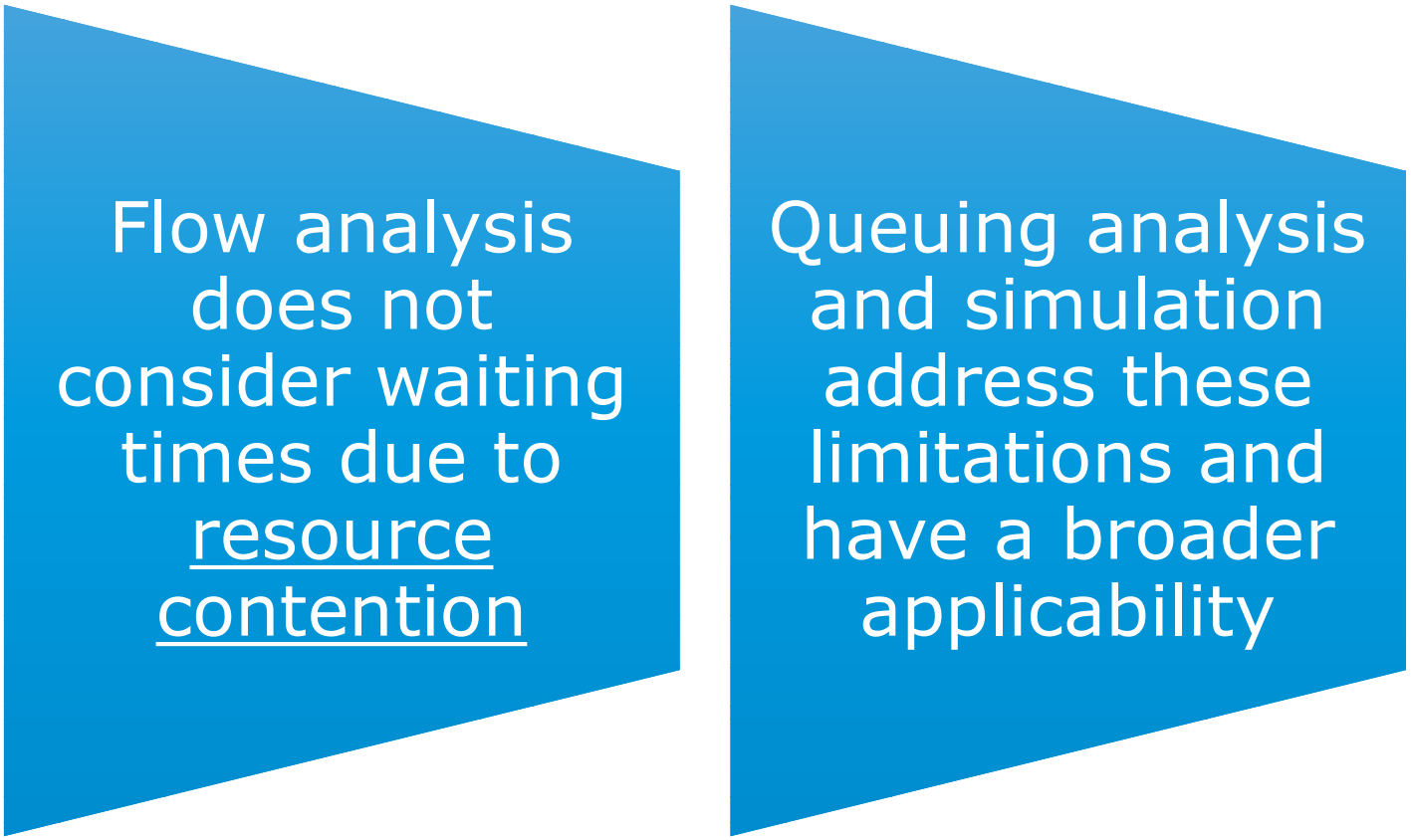
### Qualitative analysis

- Value-Added & Waste Analysis
- Root-Cause Analysis
- Pareto Analysis
- Issue Register

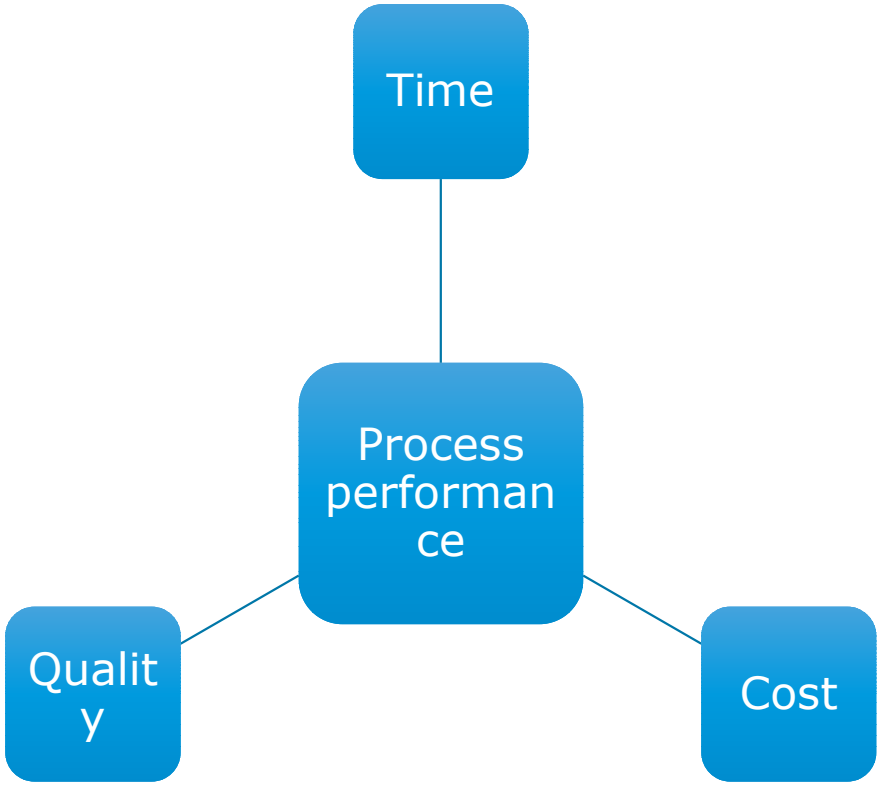
### Quantitative Analysis

- Flow analysis
- Queuing analysis
- Simulation

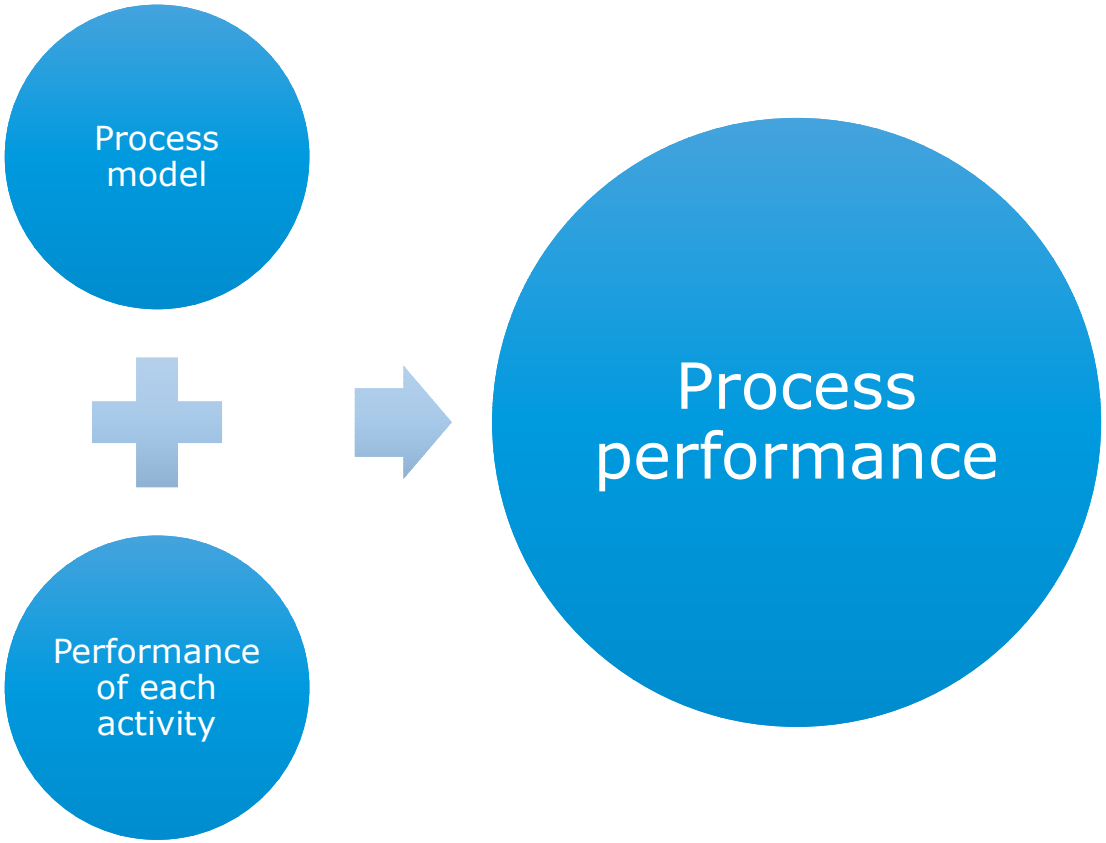
## Why flow analysis is not enough?



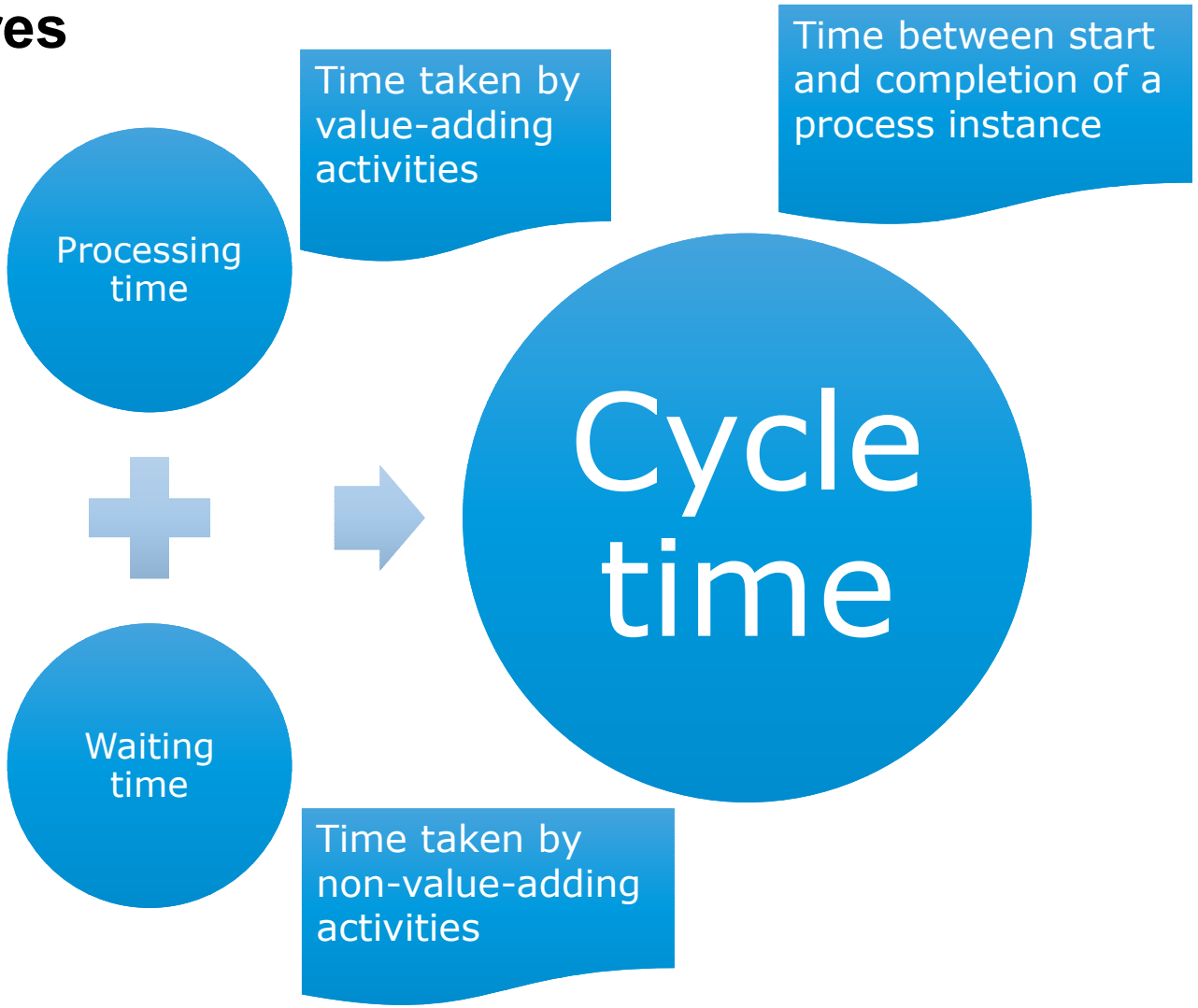
# Process performance



# Flow analysis

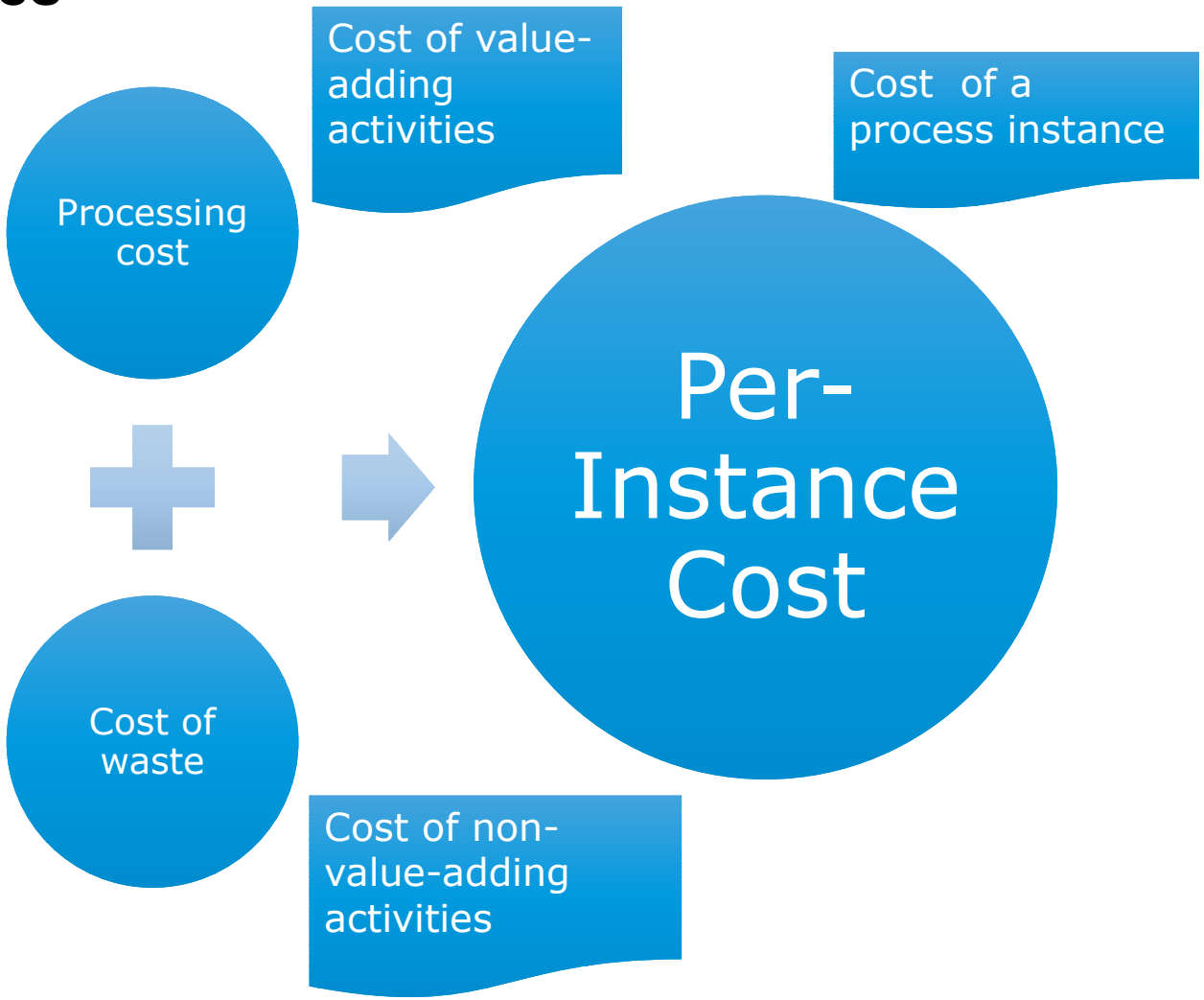


# Time measures



# Cycle time efficiency

# Cost measures



## Typical components of cost

### Material cost

- Cost of tangible or intangible resources used per process instance

### Resource cost

- Cost of person-hours employed per process instance

## Resource utilization


**Resource utilization = 60%**
**➔ on average resources are idle 40% of their allocated time**

## Resource utilization vs. waiting time


**Typically, when resource utilization > 90%**
**➔ Waiting time increases steeply**

## Quality

### Product quality

- Defect rate

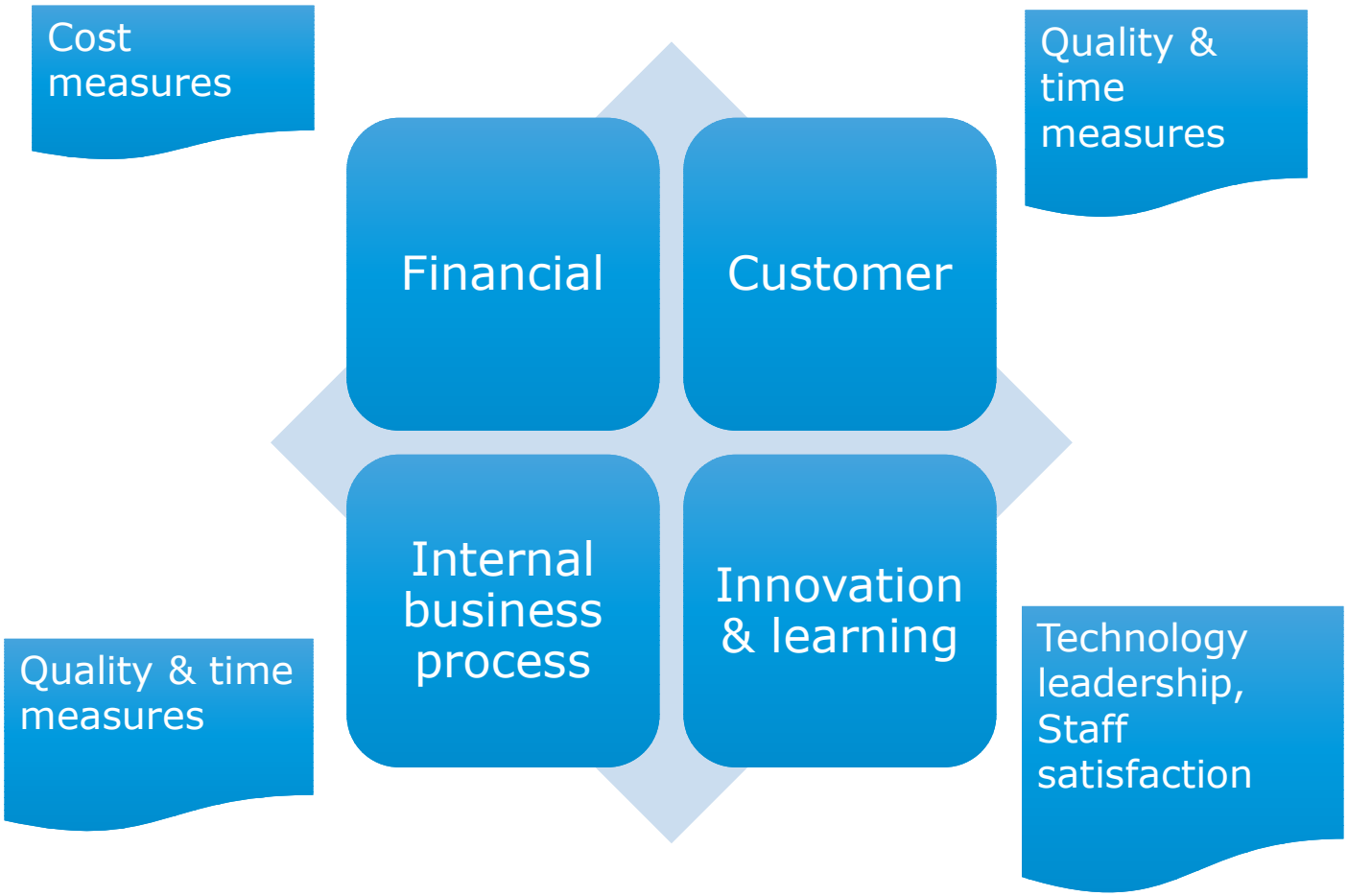
### Delivery quality

- On-time delivery rate
- Cycle time variance

### Customer satisfaction

- Customer feedback score

# Balanced scorecard



# Process performance reference models

## Supply Chain Operations Reference Model (SCOR)

- Performance measures for supply chain management processes

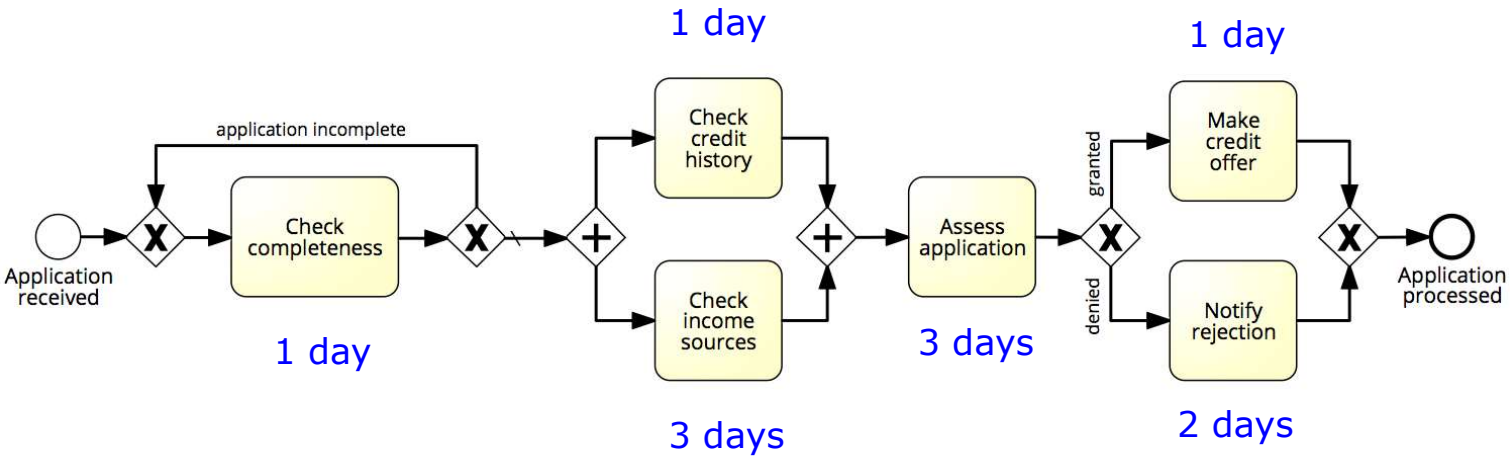
## American Productivity and Quality Council (APQC)

- Performance measures and benchmarks for processes in the Process Classification Framework (PCF)

## IT Infrastructure Library (ITIL)

- Performance measures for IT service management processes

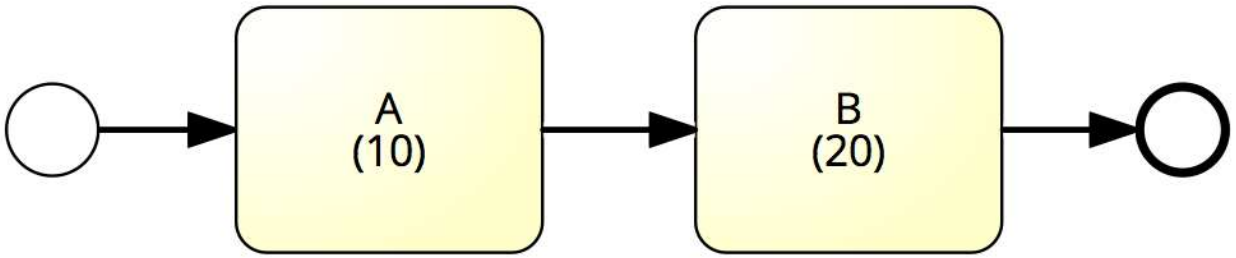
# Flow analysis of cycle time




Cycle time = X days

## Sequence – Example

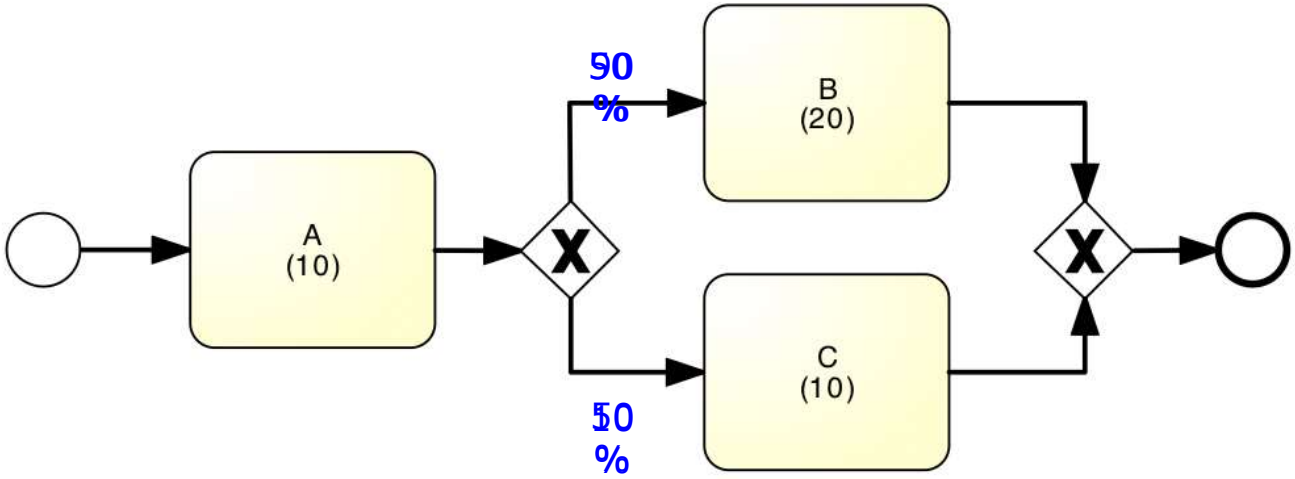
- What is the average cycle time?




Cycle time = 10 + 20 = 30

## Example: Alternative Paths

- What is the average cycle time?

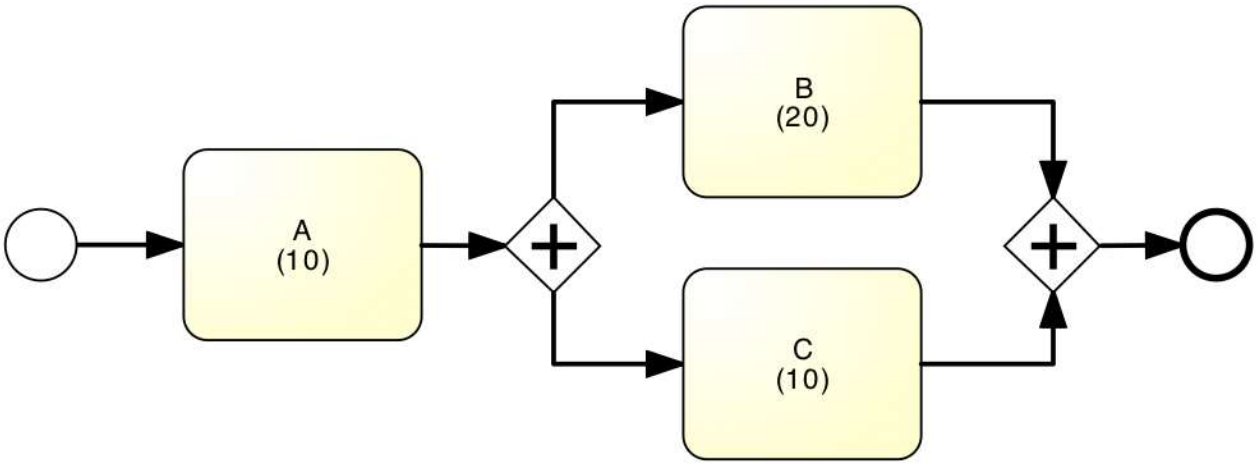



Cycle time = 10 + (20+10)/2 = 25

Cycle time = 10 + 0.9*20+0.1*10 = 29

## Example: Parallel paths

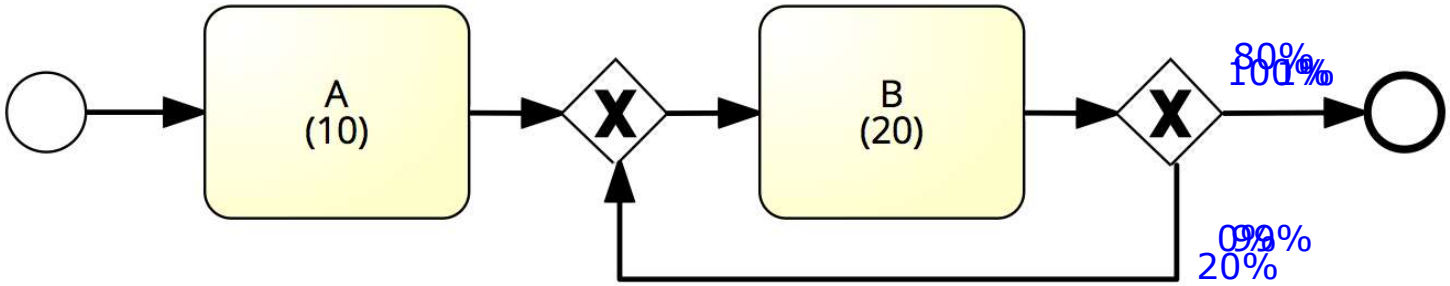
- What is the average cycle time?




Cycle time = 10 + 20 = 30

## Example: Rework loop

- What is the average cycle time?

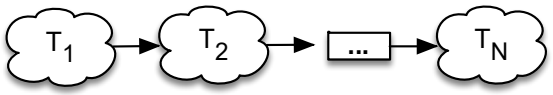



Cycle time = 10 + 20 = 30

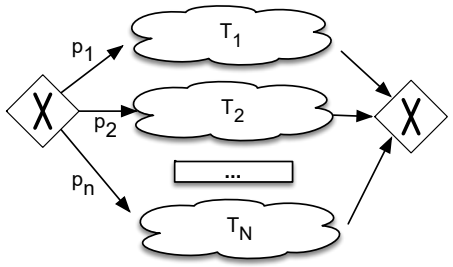
Cycle time = 10 + 20/0.01 = 2010

Cycle time = 10 + 20/0.8 = 35

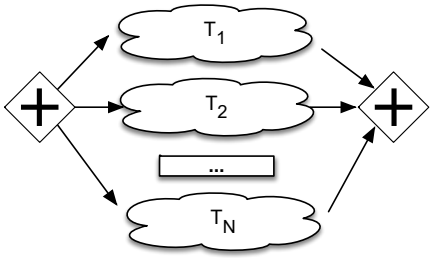
# Flow analysis equations for cycle time



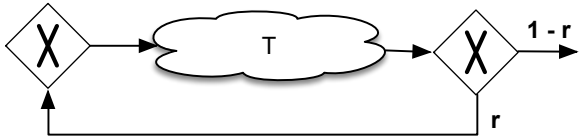

$$CT = T_1 + T_2 + \ldots + T_N$$




$$CT = p_1 * T_1 + p_2 * T_2 + \ldots + p_n * T_N$$




$$CT = \max(T_1, T_2, \ldots, T_N)$$




$$CT = T / (1-r)$$

# Example 7.1

Let us consider the credit application process model in Figure 7.6 and the task cycle times given in Table 7.1. Let us also assume that in 60% of the cases the credit is granted.

**The total cycle time is then: 1 + 3 + 3 + 1.4 = 8.4 days.**

| Task | Cycle time |
|---|---|
| Check completeness | 1 day |
| Check credit history | 1 day |
| Check income sources | 3 days |
| Assess application | 3 days |
| Make credit offer | 1 day |
| Notify rejection | 2 days |

**Table 7.1** Cycle times for credit application process

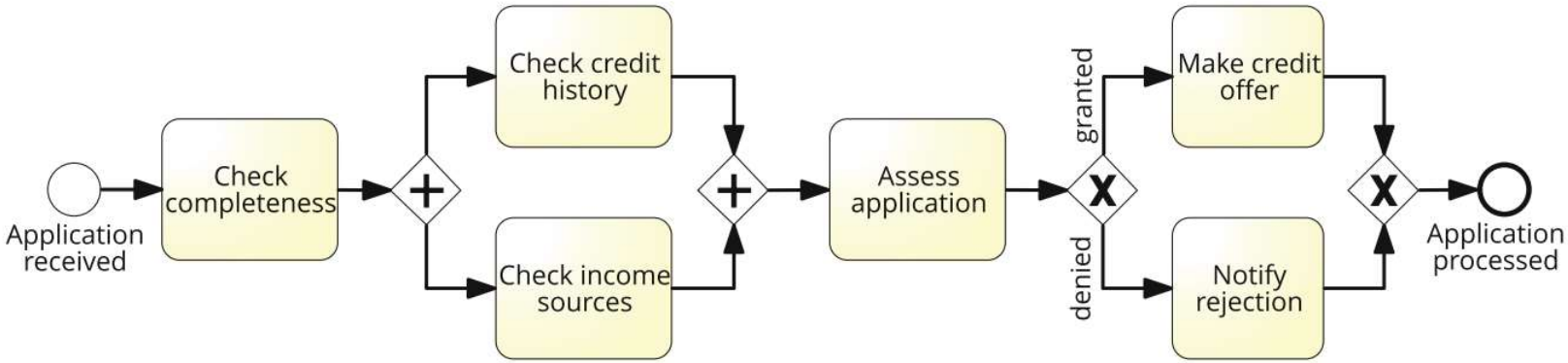
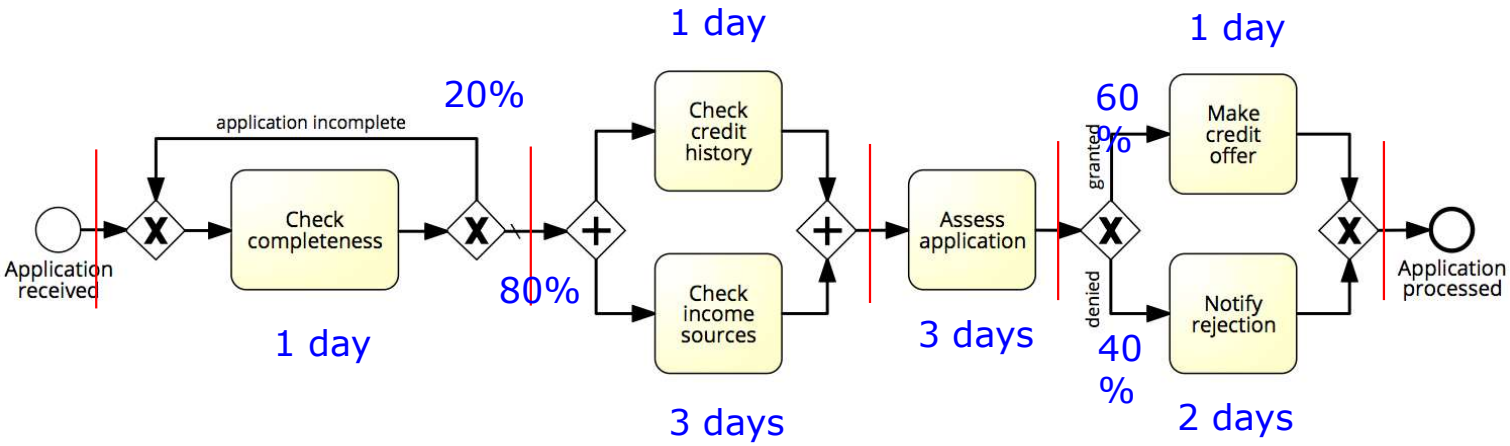



**Fig. 7.6** Credit application process

# Flow Analysis Of Cycle Time




Cycle time = 1.25 + 3 + 3 + 1.4 =
8.65 days

# Example 7.2

- Let us consider the credit application process model in Figure 7.10 and the cycle times previously given in Table 7.1. Let us assume that after each execution of “Check completeness”, in 20% of the cases the application is incomplete. And let us also assume that in 60% of the cases the credit is granted.

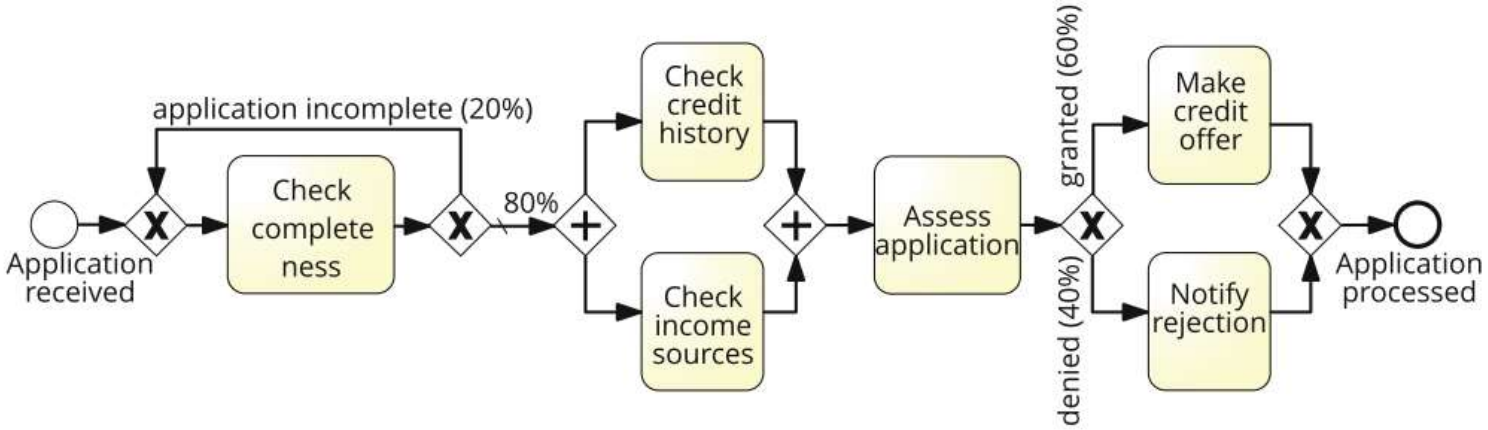
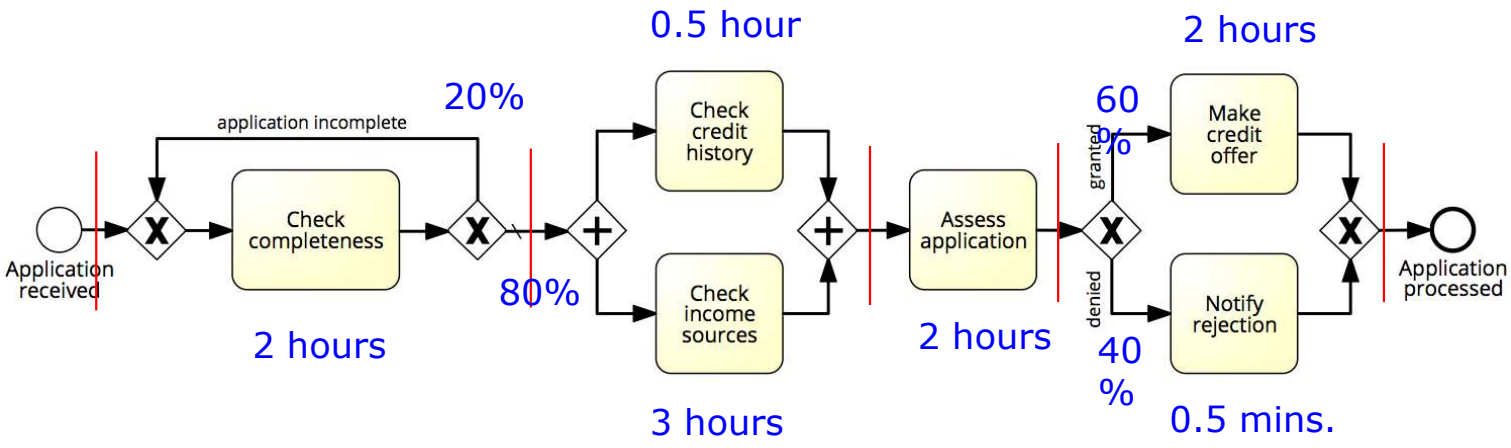



**Fig. 7.10** Credit application process with rework

# Flow Analysis of Processing Time




Processing time = 2.5 + 3 + 2 + 1.4 = 8.9 hours

Cycle time efficiency = 8.9 hours / 8.65 days = 12.9%

# Cycle Time Efficiency

- Cycle time efficiency = processing time / cycle time
- Cycle time efficiency = 8.9 hours / 8.65 days
- 8 Working hours per day translates 8.65 days into 69.2 hours
- **Cycle time efficiency = 8.9 hours / 69.2 hours = 12.9%**

# Exercise 7.1

Consider the process model given in Figure 3.8 (page 86). Calculate the cycle time under the following assumptions:

- Each task in the process takes 1 h on average.
- In 40% of the cases the order contains only Amsterdam products.
- In 40% of the cases the order contains only Hamburg products.
- In 20% of the cases the order contains products from both warehouses.

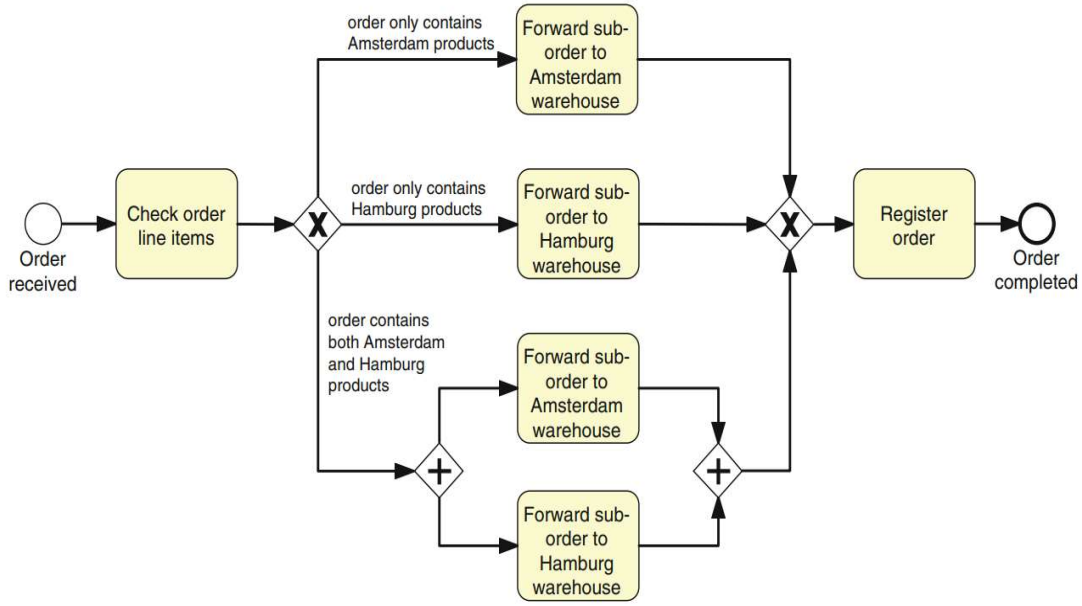



**Fig. 3.8** Modeling an inclusive decision: first trial