

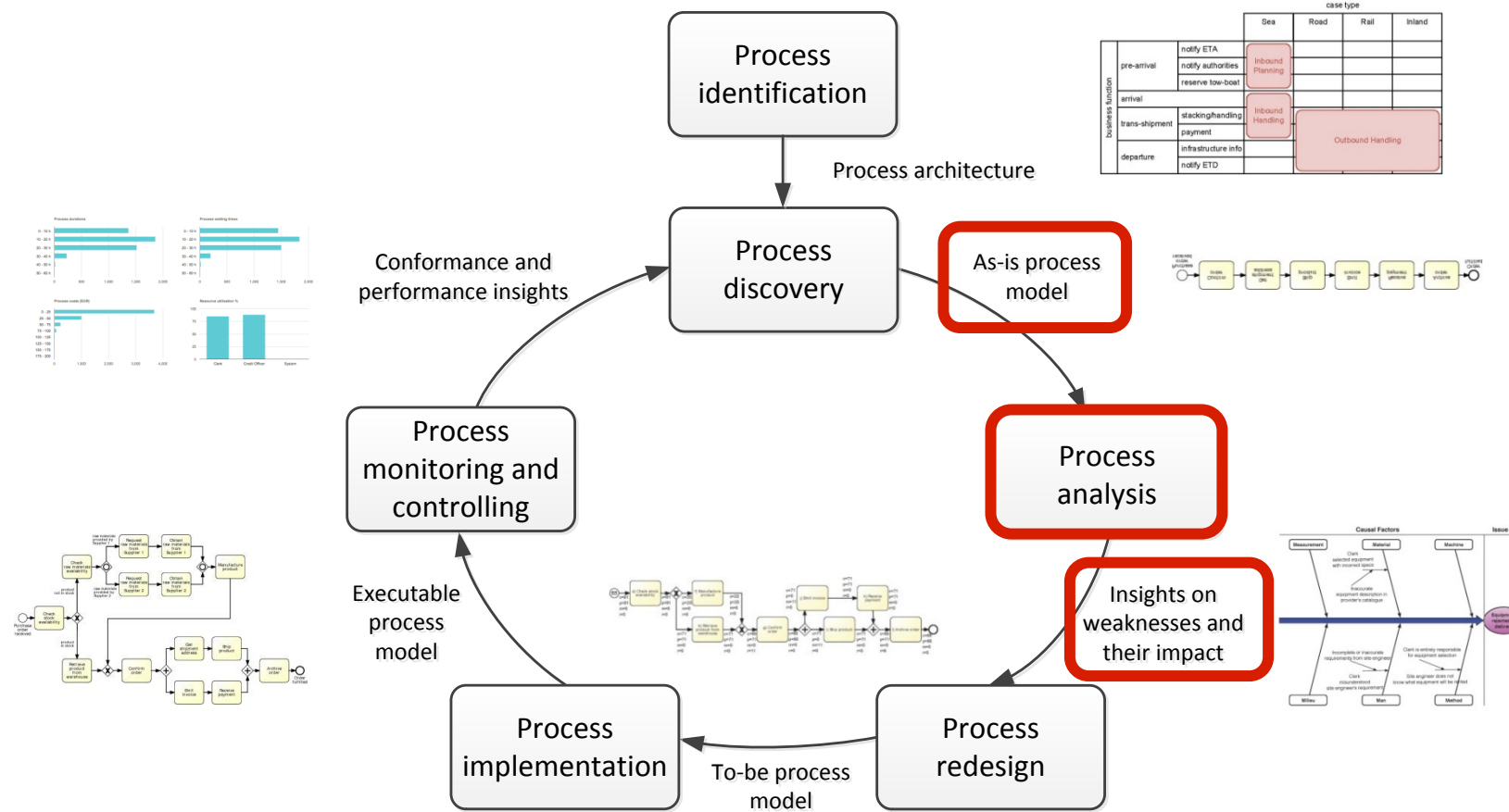
MTAT.03.231  
Business Process Management

# **Lecture 4 – Qualitative Process Analysis**

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# Process Analysis



# Process Analysis Techniques

## Qualitative analysis

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

## Quantitative Analysis



Fundamentals of

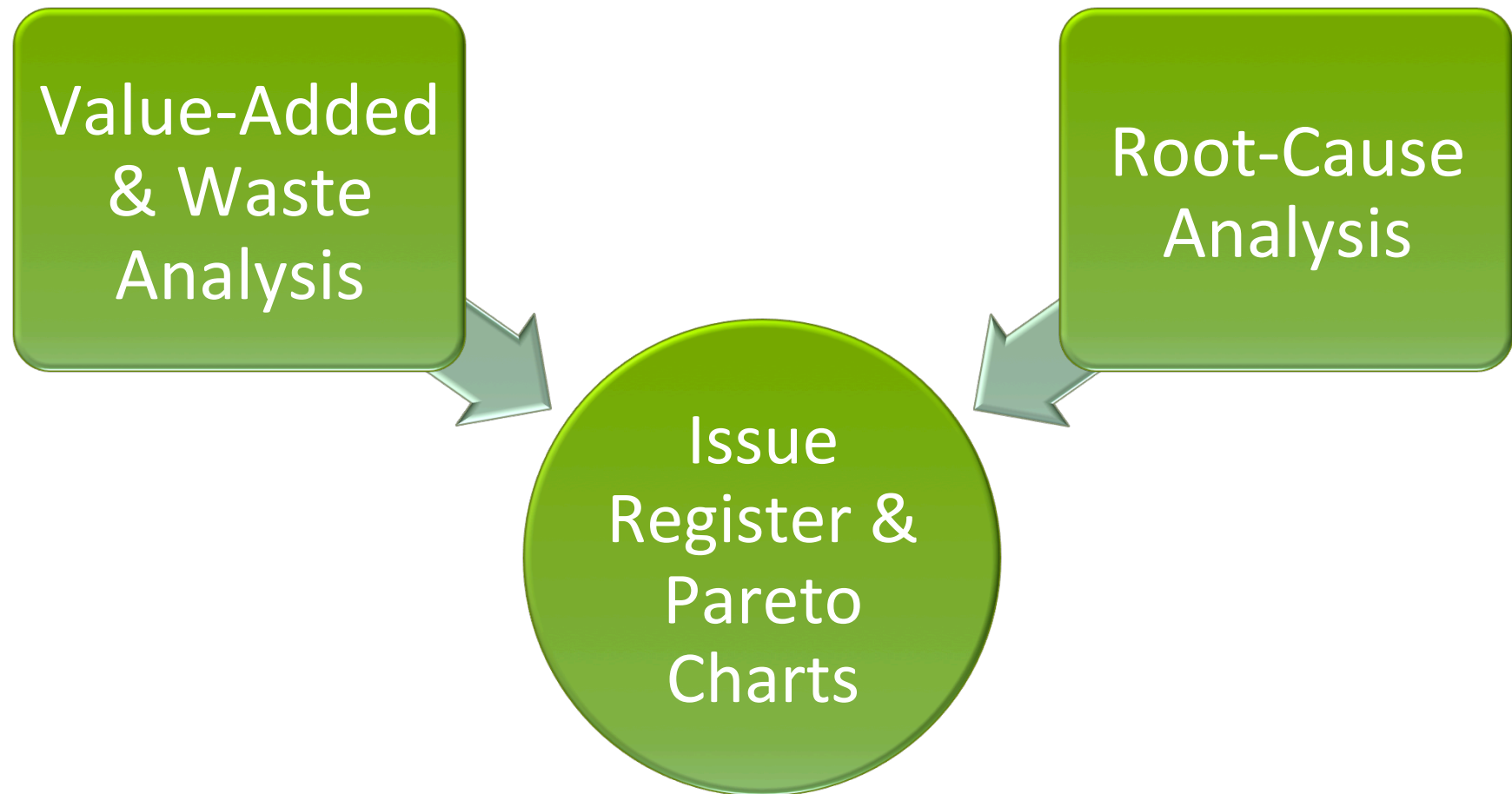
# Business Process Management

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Marcello La Rosa  
Jan Mendling  
Hajo A. Reijers

 Springer

1. Introduction
2. Process Identification
3. Essential Process Modeling
4. Advanced Process Modeling
5. Process Discovery
- 6. Qualitative Process Analysis**
7. Quantitative Process Analysis
8. Process Redesign
9. Process Automation
10. Process Intelligence

## Qualitative analysis



# Value-added analysis

- Decorticate the process into steps
  - Steps performed before a task
  - The task itself, possibly decomposed into smaller steps
  - Steps performed after a task, in preparation for the next task
- Classify each step
  - Value-adding (VA)
  - Business value-adding (BVA)
  - Non-value-adding (NVA)

# Value-adding activities

- Produces value or satisfaction to the customer.
- Criteria:
  - Is the customer willing to pay for this step?
  - Would the customer agree that this step is necessary to achieve their goals?
  - If the step is removed, would the customer perceive that the end product or service is less valuable?
- Examples:
  - Order-to-cash process: Confirm delivery date, Deliver products
  - University admission process: Assess application, Notify admission outcome

# Business value-adding activities

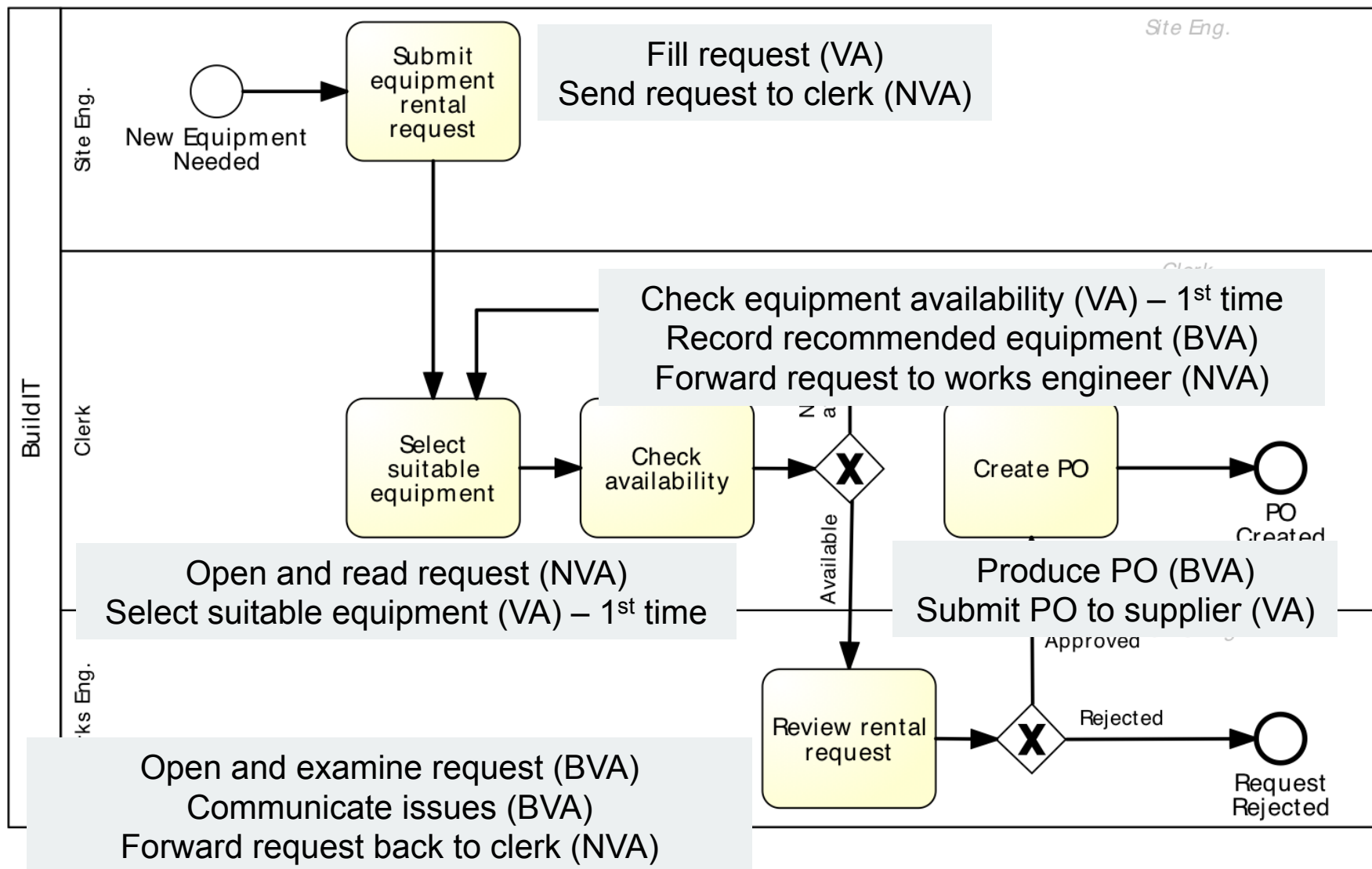
- Necessary or useful for the business to operate.
- Criteria
  - Is this step required in order to collect revenue, to improve or grow the business?
  - Would the business (potentially) suffer in the long-term if this step was removed? Does it reduce risk of business losses?
  - Is this step required in order to comply with regulatory requirements?
- Example
  - Order-to-cash process: Check purchase order, Check customer's credit worthiness, Issue invoice, Collect payment, Collect customer feedback
  - University admission process: Verify completeness of application, Check validity of degrees, Check validity of language test results



# Non-value-adding activities

- Everything else besides VA and BVA
- Includes:
  - Handovers, context switches
  - Waiting times, delays
  - Rework or defect correction
- Examples
  - Order-to-cash: Forward PO to warehouse, Re-send confirmation, Receive rejected products
  - University admission: Forward applications to committee, Receive admission results from committee

# Extract of Equipment Rental Process



# Equipment Rental Process – VA Analysis

Step	Performer	Classification
Fill request	Site engineer	VA
Send request to clerk	Site engineer	NVA
Open and read request	Clerk	NVA
Select suitable equipment	Clerk	VA
Check equipment availability	Clerk	VA
Record recommended equipment & supplier	Clerk	BVA
Forward request to works engineer	Clerk	NVA
Open and examine request	Works engineer	BVA
Communicate issues	Works engineer	BVA
Forward request back to clerk	Works engineer	NVA
Produce PO	Clerk	BVA
Send PO to supplier	Clerk	VA

# Waste analysis

*"All we are doing is looking at the time line, from the moment the customer gives us an order to the point when we collect the cash.*

*And we are reducing the time line by reducing the non-value-adding wastes "*

Taiichi Ohno



# Seven sources of waste

## Move

- Unnecessary Transportation
- Motion

## Hold

- Inventory
- Waiting (and idleness)

## Over-do

- Defects
- Over-Processing
- Over-Production

**Move**

# Unnecessary transportation

- Send or receive materials or documents (incl. electronic) taken as input or output by the process

## Example:

- To apply for admission at a University, students fill in an online form. When a student submits the online form, a PDF document is generated. The student is requested to download it, sign it, and send it by post together with the required documents: 1. Certified copies of degree and academic transcripts. 2. Results of language test. 3. CV.

When the documents arrive to the admissions office, an officer checks their completeness. If a document is missing, an e-mail is sent to the student. The student has to send the missing documents by e-mail or post depending on document type.

# Motion

- Motion of resources internally within the process
- Common in manufacturing processes, less common in business processes

## Examples

- Vehicle inspection process, a process worker moves with the inspection forms from one inspection base to another; in some cases inspection equipment also needs to be moved around
- Approval process, a process workers moves around the organization to collect signatures



**Hold**

# Inventory

- Materials inventory
- Work-in-process (WIP)

## Examples

- Vehicle inspection process, when a vehicle does not pass the first inspection, it is sent back for adjustments and left in a pending status. At a given point in time, about 100 vehicles are in the “pending” status across all inspection stations
- University admission process: About 3000 applications are handled concurrently

# Waiting

- Waiting for materials or input data
- Task waiting for a resource
- Resource waiting for work (resource idleness)

## Examples

- Vehicle inspection process: A technician at a base of the inspection station waiting for the next vehicle
- Approval process: Request waiting for approver
- University admission process: Incomplete application waiting for additional documents; batch of applications waiting for committee to meet

**Over-do**

# Defects

- Correcting or compensating for a defect
- Rework loops

## Examples

- Vehicle inspection: A vehicle needs to come back to a station due to an omission
- Travel approval: Request sent back to requestor for revision
- University admission: Application sent back to applicant for modification; request needs to be re-assessed later due to incomplete information

# Over-processing

- Tasks performed unnecessarily given the outcome of the process
- Unnecessary perfectionism

## Examples

- Vehicle inspection: Technicians take time to measure vehicle emissions with higher accuracy than required, only to find that the vehicle clearly does not fulfill the required emission levels
- Travel approval: 10% of approvals are trivially rejected at the end of the process due to lack of budget
- University admission: Officers spend time verifying the authenticity of degrees, transcripts and language test results. In 1% of cases, these verifications uncover issues.  
Verified applications are sent to the admissions committee. The admission committee accepts 20% of the applications it receives

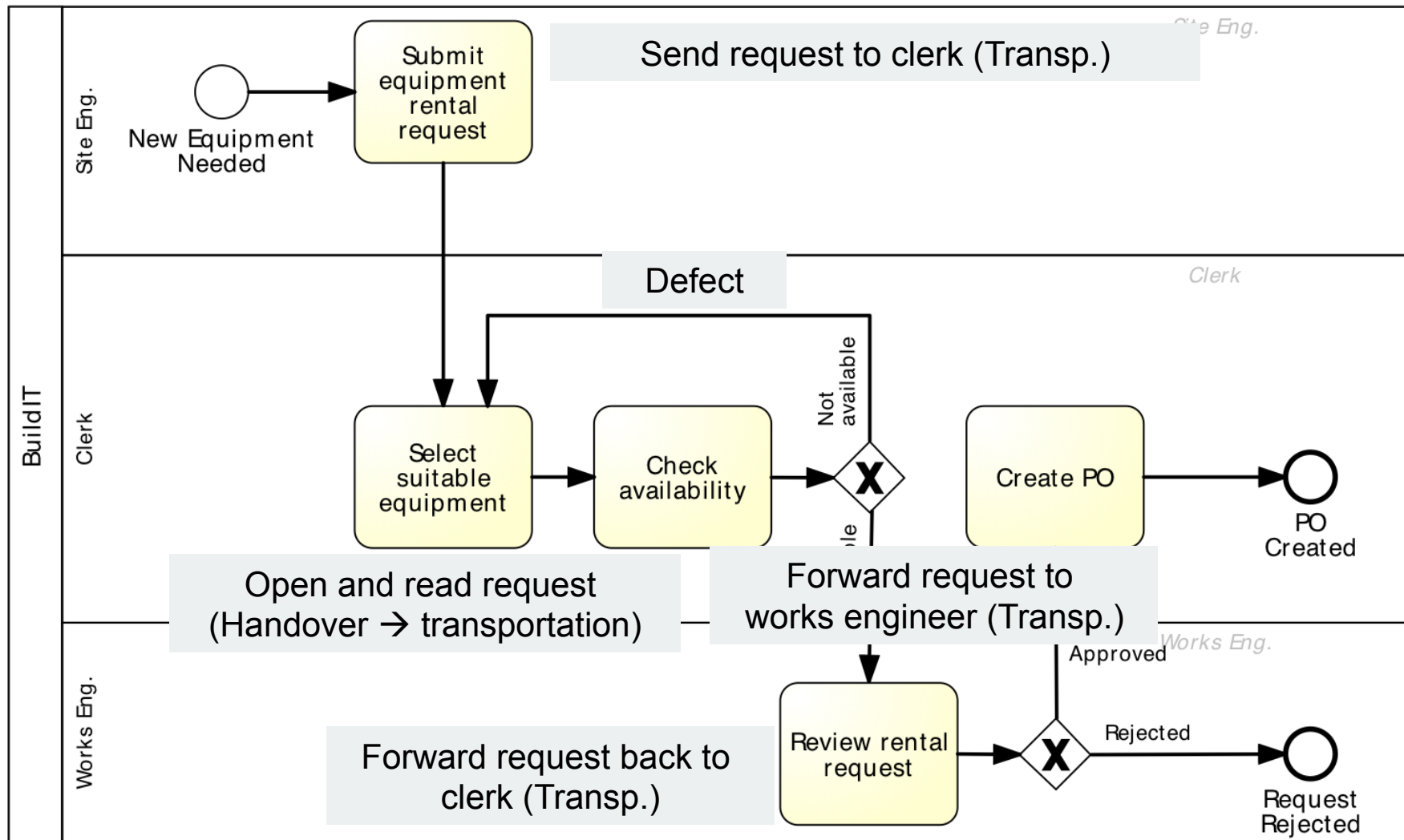
# Over-production

- Unnecessary process instances are performed, producing outcomes that do not add value upon completion

## Examples

- Order-to-cash: In 50% of cases, issued quotes do not lead to an order
- Travel approval: In 5% of cases, travel requests are approved but the travel is cancelled
- University admission: About 3000 applications are submitted, but only 800 are considered eligible after assessment

# Equipment rental process: wastes





# Equipment rental process: wastes

## Transportation

- Site engineer sends request to clerk
- Clerk forwards to works engineer
- Works engineer send back to clerk

## Inventory

- Equipment kept longer than needed

## Waiting

- Waiting for availability of works engineer to approve

# Equipment rental process: wastes

## Defect

- Selected equipment not available, alternative equipment sought
- Incorrect equipment delivered and returned to supplier

## Over-processing

- Clerk finds available equipment and rental request is rejected because equipment not needed
- Rental requests being approved and then canceled by site engineer

## Over-production

- Equipment being rented and not used at all

# Issue register

- Purpose: to maintain, organize and prioritize perceived weaknesses of the process (issues)
- Sources of issues:
  - Input to a process modelling project
  - Collected as part of ongoing process improvement actions
  - Collected during process discovery (modelling)
  - Value-added/waste analysis



# Issue register structure

- Can take the form of a table with:
  - Issue identifier
  - Short name
  - Description
  - Assumptions
  - Impact: Qualitative and Quantitative
  - Possible improvement actions
- Larger process improvement projects may require issue trackers

# Issue example

## Issue name

- Equipment kept longer than needed

## Description

- Site engineers keep rented equipment longer than needed by asking for deadline extensions to the supplier

## Assumptions

- 3000 pieces of equipment rented p.a.  
In 10% of cases, equipment is kept two days more than needed  
Average rental cost is 100 per day

## Quantitative impact

- $0.1 \times 3000 \times 2 \times 100 = 60,000$  p.a

# Issue Register Example

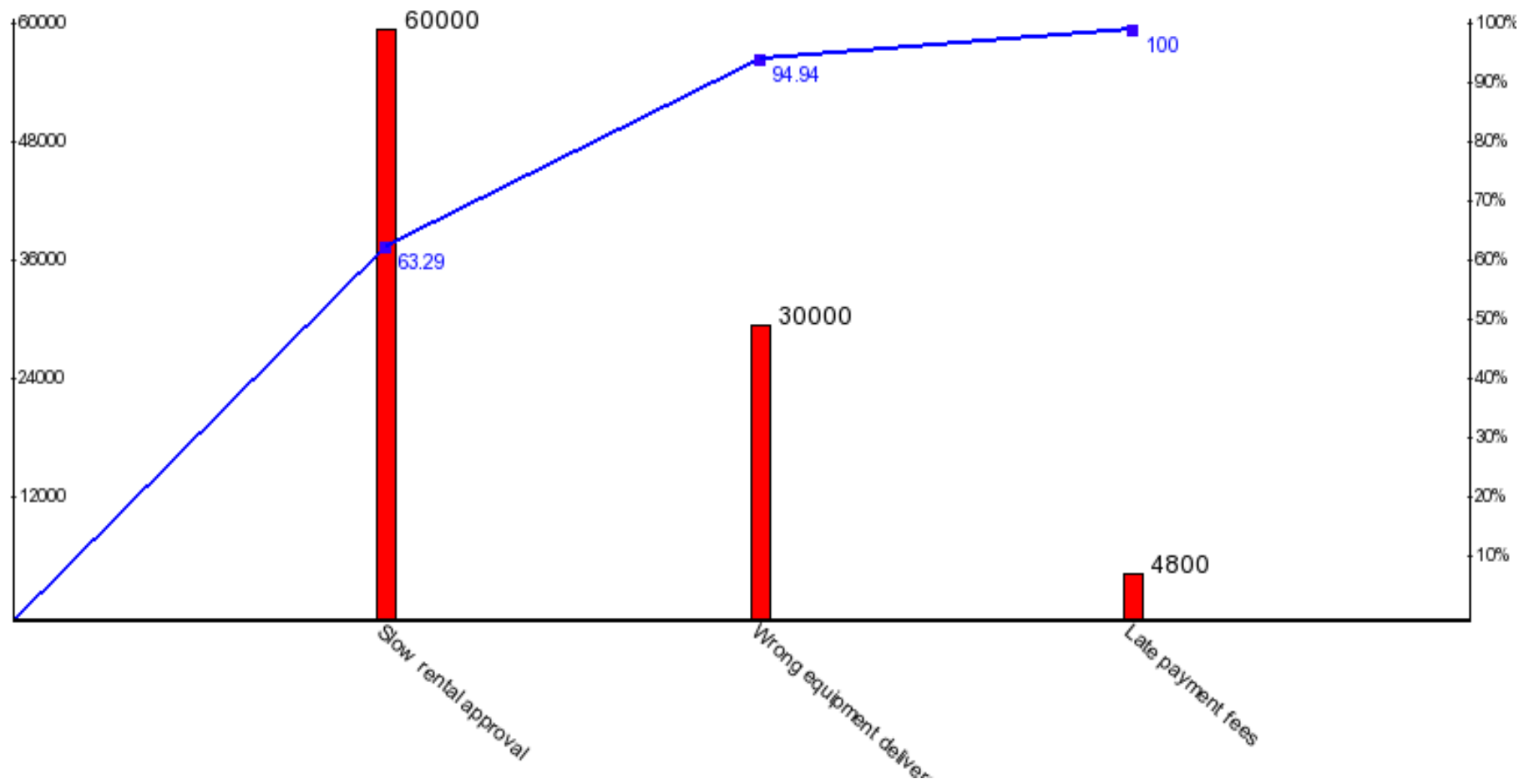
Name	Explanation	Assumptions	Qualitative Impact	Quantitative Impact
Equipment kept longer than needed	Site engineers keep equipment longer than needed via deadline extensions	3000 pieces of equipment rented p.a. In 10% of cases, equipment kept two days longer than needed. Rental cost is 100 per day		$0.1 \times 3000 \times 2 \times 100 = 60,000$ p.a.
Rejected equipment	Site engineers reject delivered equipment due to non-conformance to their specifications	3000 pieces of equipment rented p.a. 5% of them are rejected due to an internal mistake For each equipment rejected due to an internal mistake, BuildIT is billed 100.	Disrupted schedules. Employee stress and frustration	$3000 \times 0.05 \times 100 = 15,000$ p.a.
Late payment fees	Late payment fees incurred because invoices are not paid by their due date	3000 pieces of equipment rented p.a. Average rental time is 4 days Rental cost is 100 per day. Each rental leads to one invoice. About 10% of invoices are paid late. Penalty for late payment is 2%.	Poor reputation with suppliers	$0.1 \times 3000 \times 4 \times 100 \times 0.02 = 2400$ p.a.

# Pareto chart

- Useful to prioritize a collection of issues
- Bar chart where the height of the bar denotes the impact of each issue
- Bars sorted by impact
- Superposed curve of cumulative percentage impact

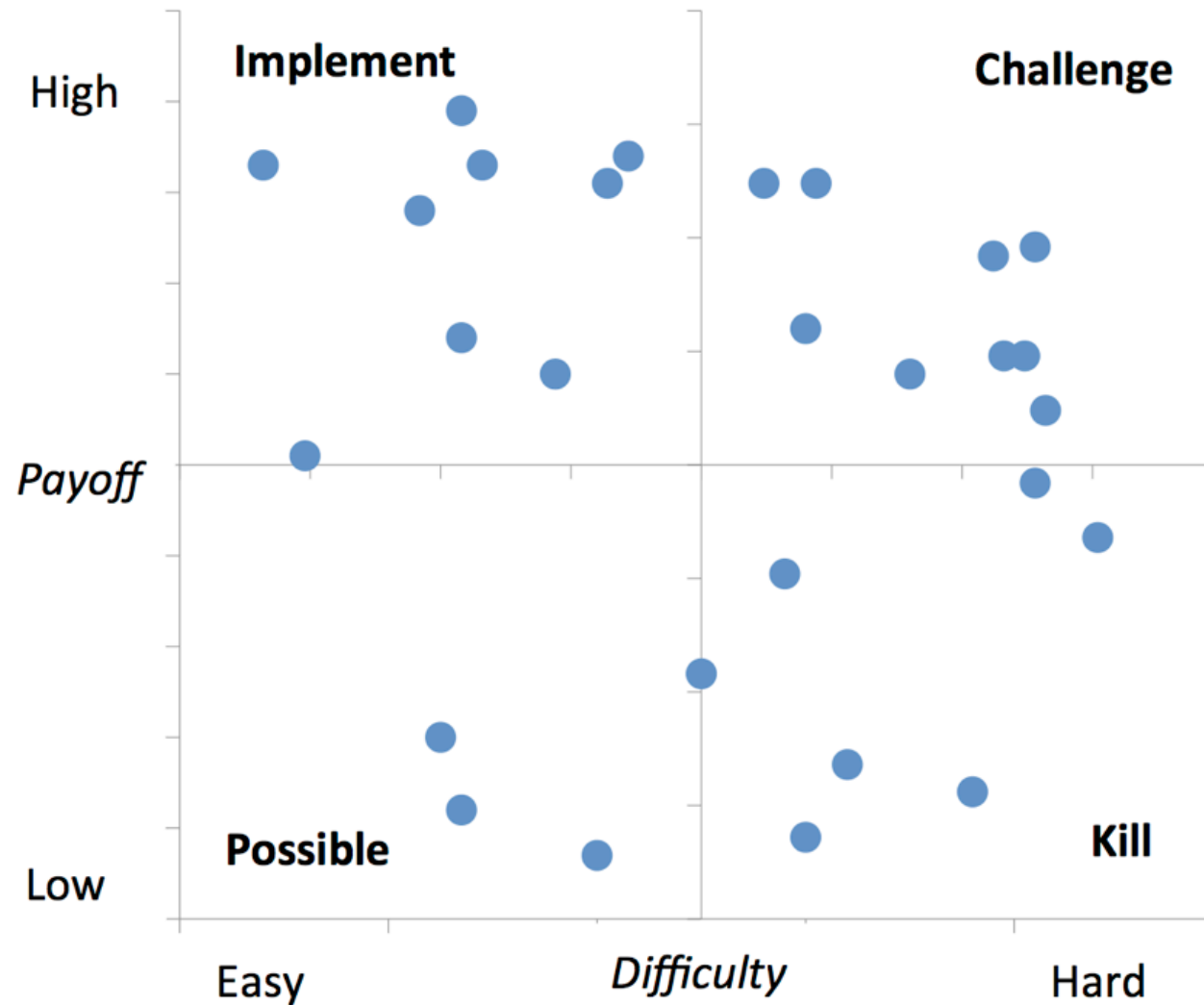


# Pareto chart example

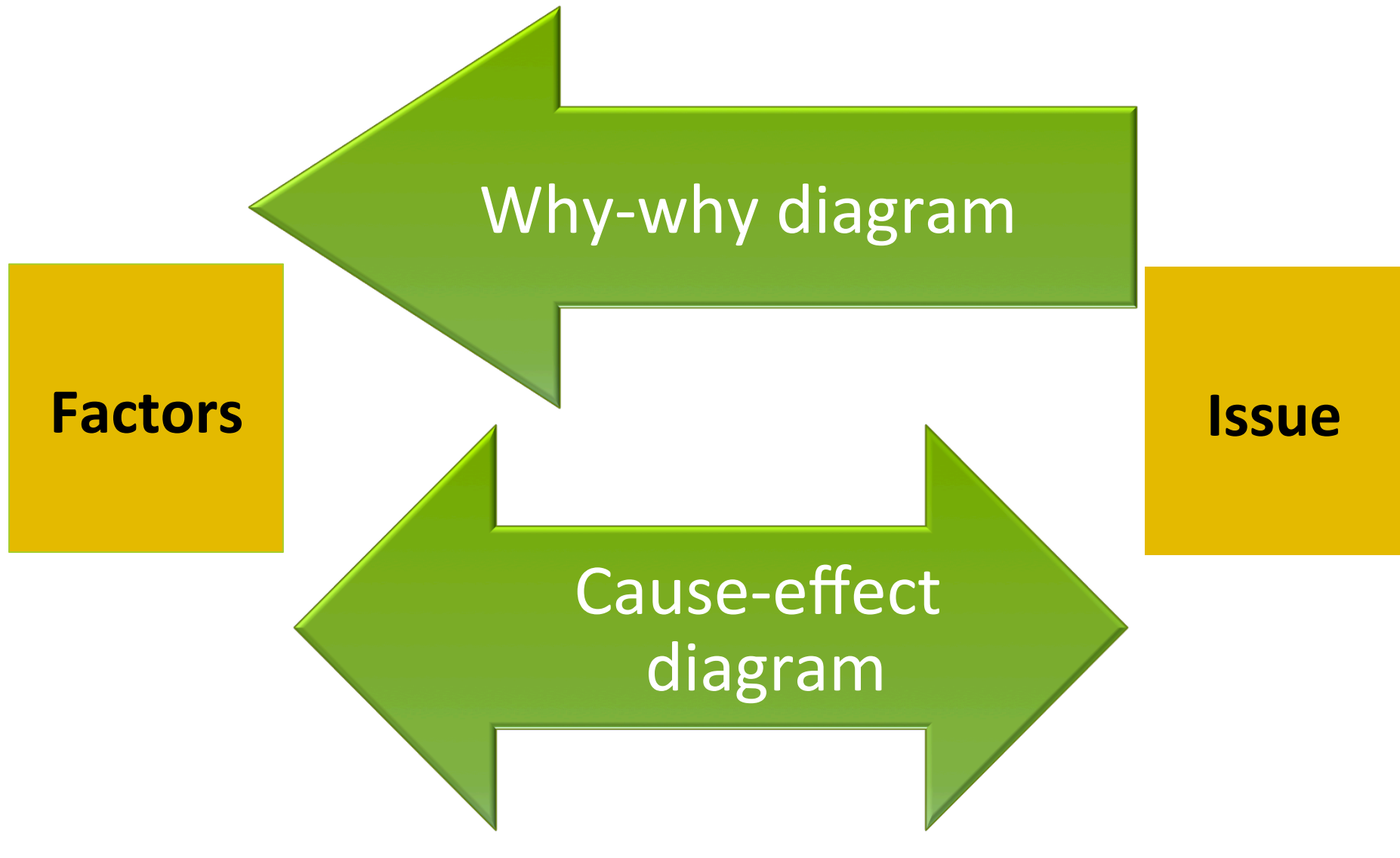




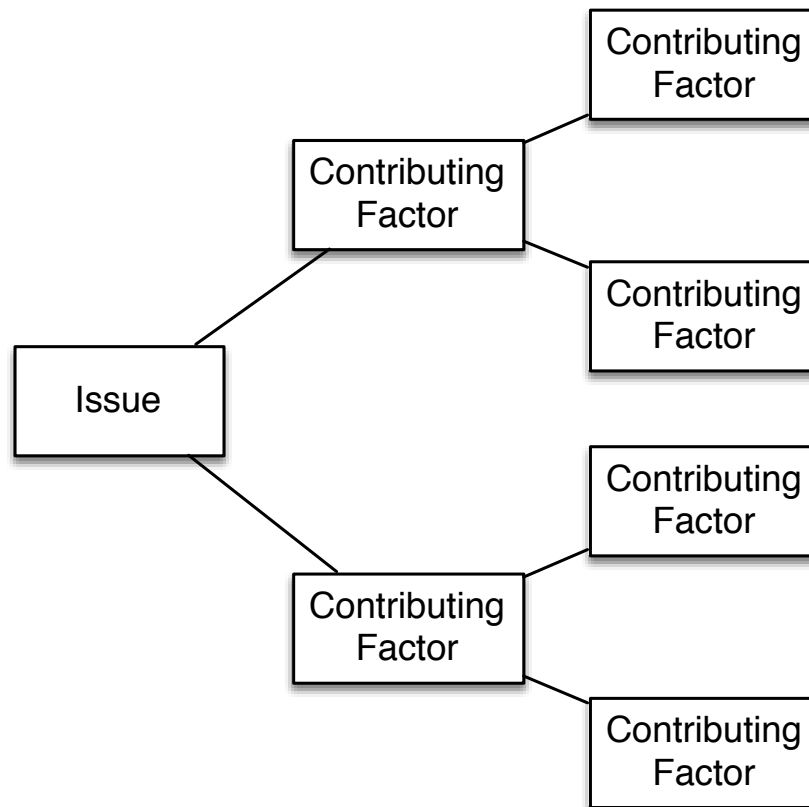
# Two-Dimensional Prioritization: PICK Chart



# Root-cause analysis



# Why-why diagram



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...

**Five levels  
of nesting**

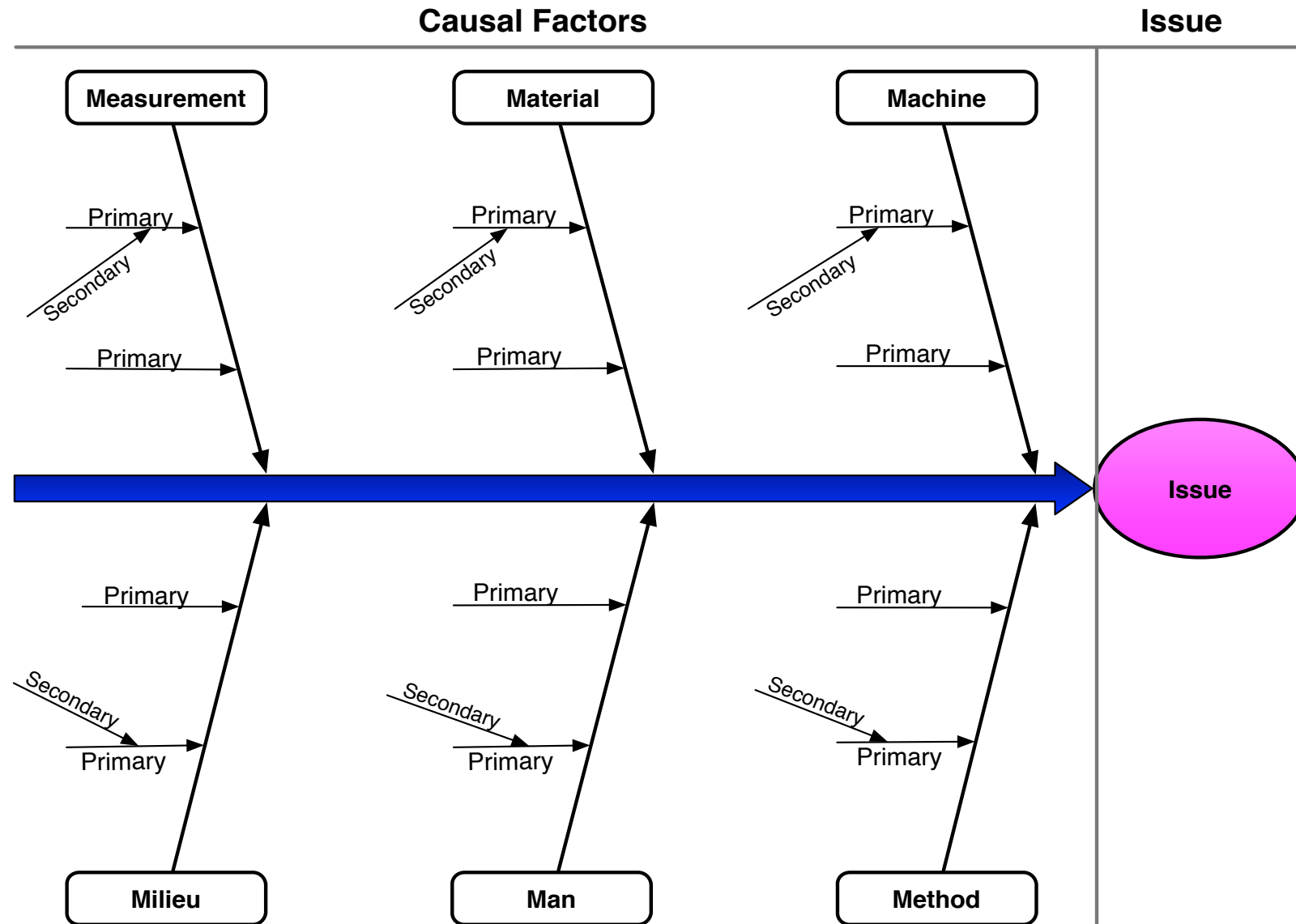
**“Five  
Why’s”**

## Why-why diagram example

Site engineers keep equipment longer, why?

- Site engineer fears that equipment will not be available later when needed, why?
  - time between request and delivery too long, why?
    - excessive time spent in finding suitable equipment and approving the request, why?
      - time spent by clerk contacting possibly multiple suppliers sequentially;
      - time spent waiting for works engineer to check the requests;

# Cause-effect (Fishbone) diagram



# Categories of causes: Six Ms

1. **Machine:** factors stemming from technology used
  - Lack of suitable functionality in the supporting software applications
  - Poor User Interface (UI) design
  - Lack of integration between systems
2. **Method:** factors stemming from the way the process is designed, understood or performed
  - Unclear assignments of responsibilities
  - Unclear instructions
  - Insufficient training
  - Lack of timely communication
3. **Material:** factors stemming from input materials or data
  - Missing, incorrect or outdated data

# Categories of causes: Six Ms

4. **Man:** factors stemming from wrong assessments or incorrect performance of steps attributable to:

- Lack of training and clear instructions
- Lack of motivation
- Too high demands towards process workers

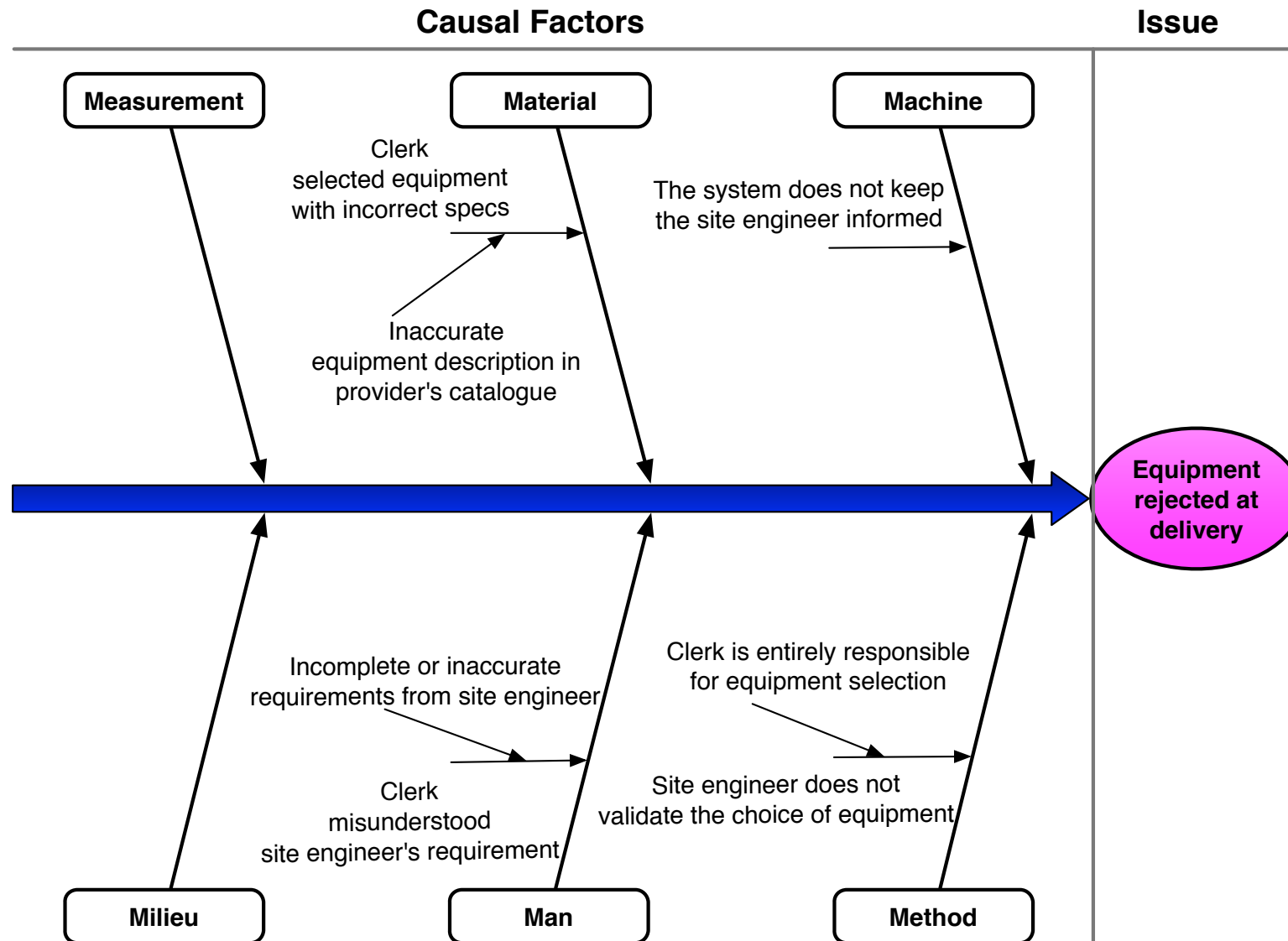
5. **Measurement:** factors stemming from reliance on:

- Inaccurate estimations
- Miscalculations

6. **Milieu:** factors outside the scope of the process

- Delays caused because of unresponsive external actors
- Sudden increases of workload due to special circumstances

# Cause-effect diagram example





# Summary

1. Segregate value-adding, business value-adding and non-value-adding steps
2. Identify waste
3. Collect and systematically organize issues, assess their impact
4. Analyze root causes of issues