



Performance benchmarking and quality tools

- Performance criteria
- Benchmarking
- General productivity measures
- Cost, time and quality aspects
- The 7 traditional tools
- The 7 new tools



Performance criteria

- Effectiveness
- Efficiency
- Quality
- Productivity
- Quality of work life
- Pace of innovation
- Profitability





Performance: A T Kearney's definition

Using the combined resources of all the participants in the supply chain in the most effective way to provide high quality, cost-effective customer service.



Benchmarking

- Core features
 - Comparison
 - Learning for improvement
- History in CPU and response time benchmarking
- Xerox
 - Means for goal setting
 - Based on best practices



Definition

Structured process

Compare processes not only performance measures

External focus

“Benchmarking is the **process** of continuously measuring and **comparing** an organization against business **leaders** anywhere in the world to get **information** that will help the organization to take action to **improve** its performance.”

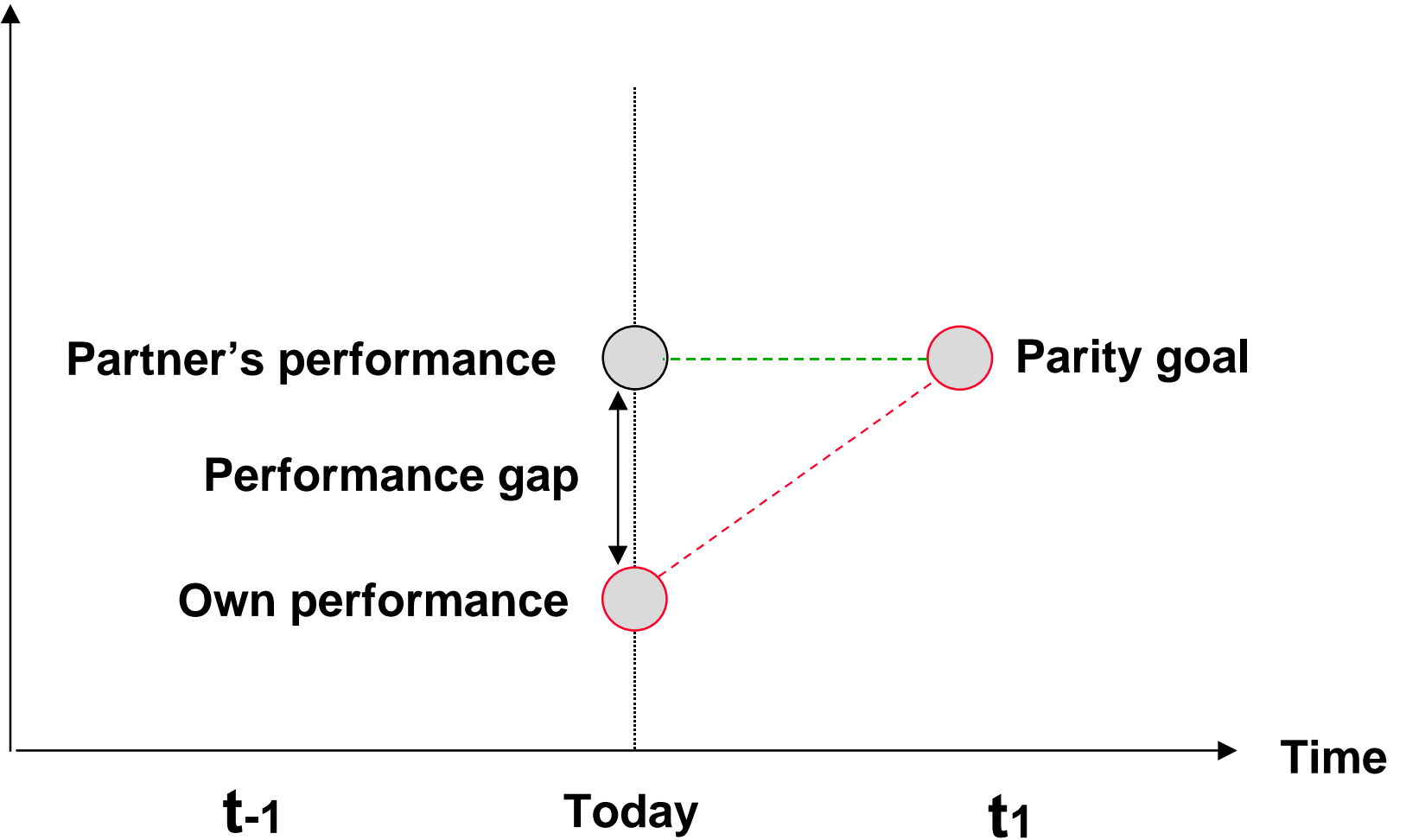
Learning from others

Improve, not only compare and evaluate



On gaps

Performance



Partner's performance

Parity goal

Performance gap

Own performance

Time

$t-1$

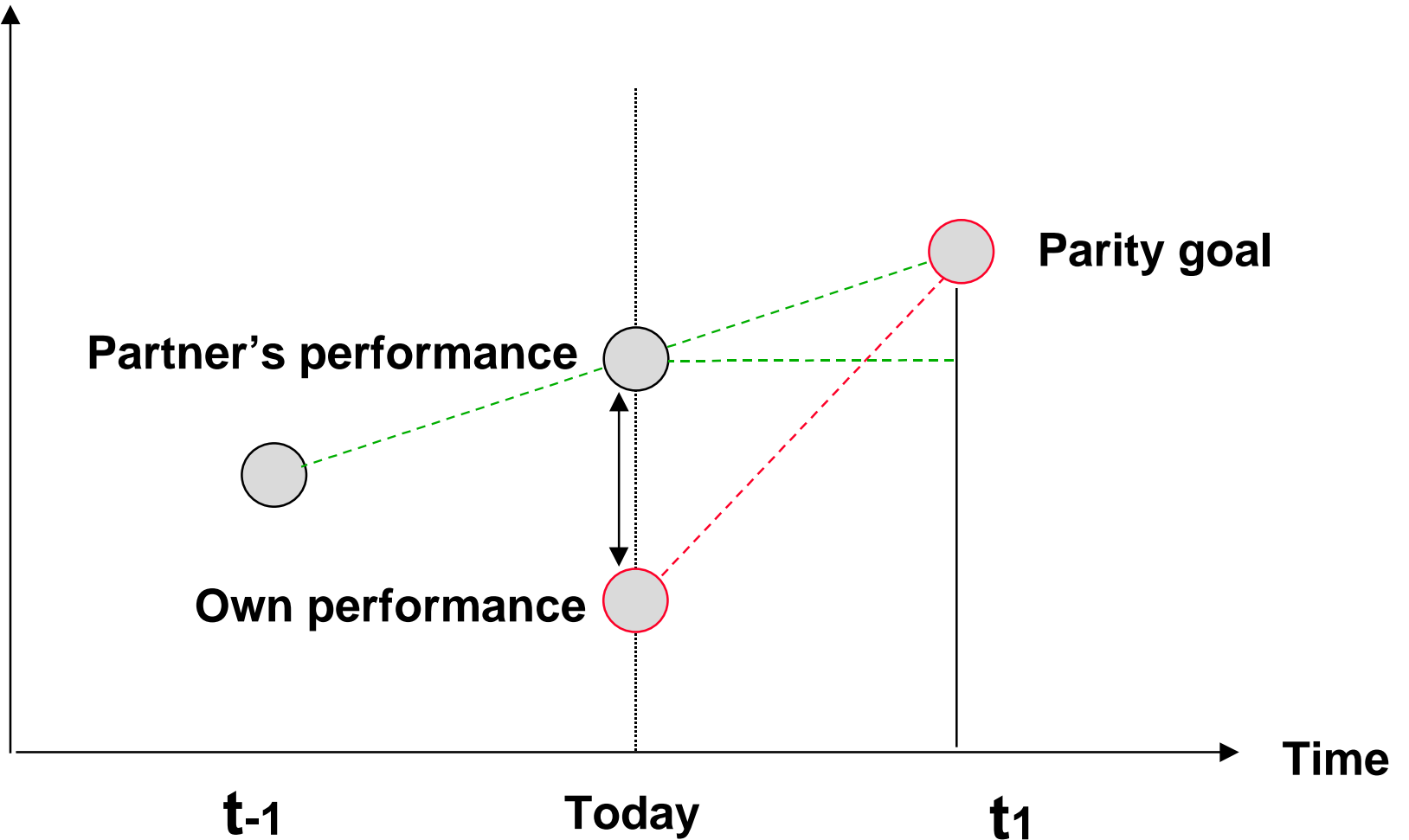
Today

t_1



Achieving real parity

Performance





Types of benchmarking

- Internal benchmarking
 - Departments, plants, subsidiaries
- Competitive benchmarking
 - Direct competitors within same segment
- Generic benchmarking
 - Best practice regardless industry
 - Some processes are generic



Scope of benchmarking

- Strategic benchmarking
 - Practices on strategic level; market behaviour, investment levels, R&D
- Performance benchmarking
 - Economic and operational performance measures
- Process benchmarking
 - Focus on practice; not only how well, but how to get better



Methods & tools

Methods \ Tools	Questionnaire	Interview	Observation
Postal investigation	★		
Telephone	★	★	
Visit	★	★	★



Productivity measures

$$\text{Productivity} = \frac{\text{Output}}{\text{Input}}$$

Regional / country level

$$\frac{\text{Gross Production Value}}{\text{Input Goods (value) + Wages}}$$



Company productivity

Total productivity

=

Added value

**(Direct Labor Costs + Social Costs) +
(Indirect Labor Costs + Social Costs) +
Cost of Capital**



Partial productivity

Labour productivity

=

$$\frac{\text{Added value}}{\text{Direct Labor Costs} + \text{Social Costs}}$$

Capital productivity

=

$$\frac{\text{Added value}}{\text{Cost of Capital}}$$



Partial productivity

Organizational productivity

=

Added value

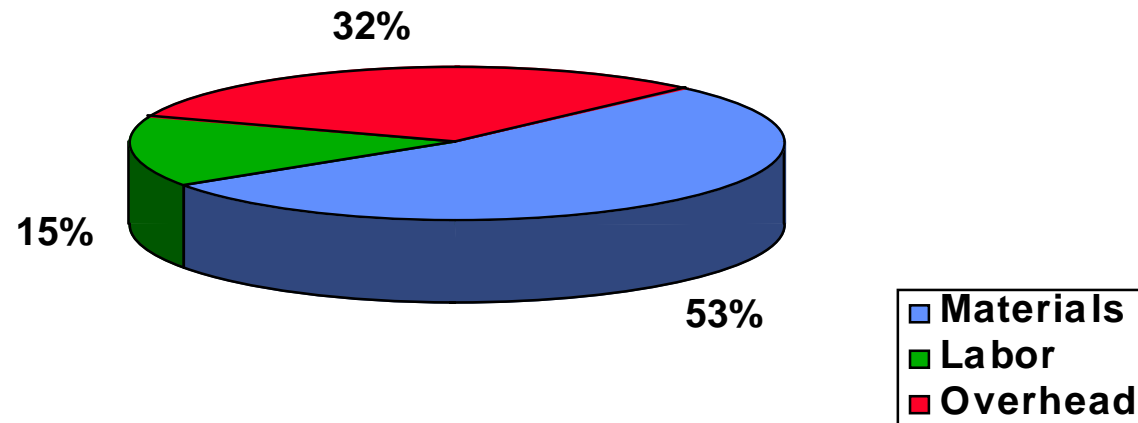
Indirect Labor Costs + Social Costs



Product costs

Direct Materials + Direct Labor + Overhead

Example: Advanced manufacturing





Purchasing costs

Receiving, inspecting handling

Scrap, rework, obsolescence

Schedule disruption

Scheduling delivery

Ordering and purchasing cost

Official purchasing price

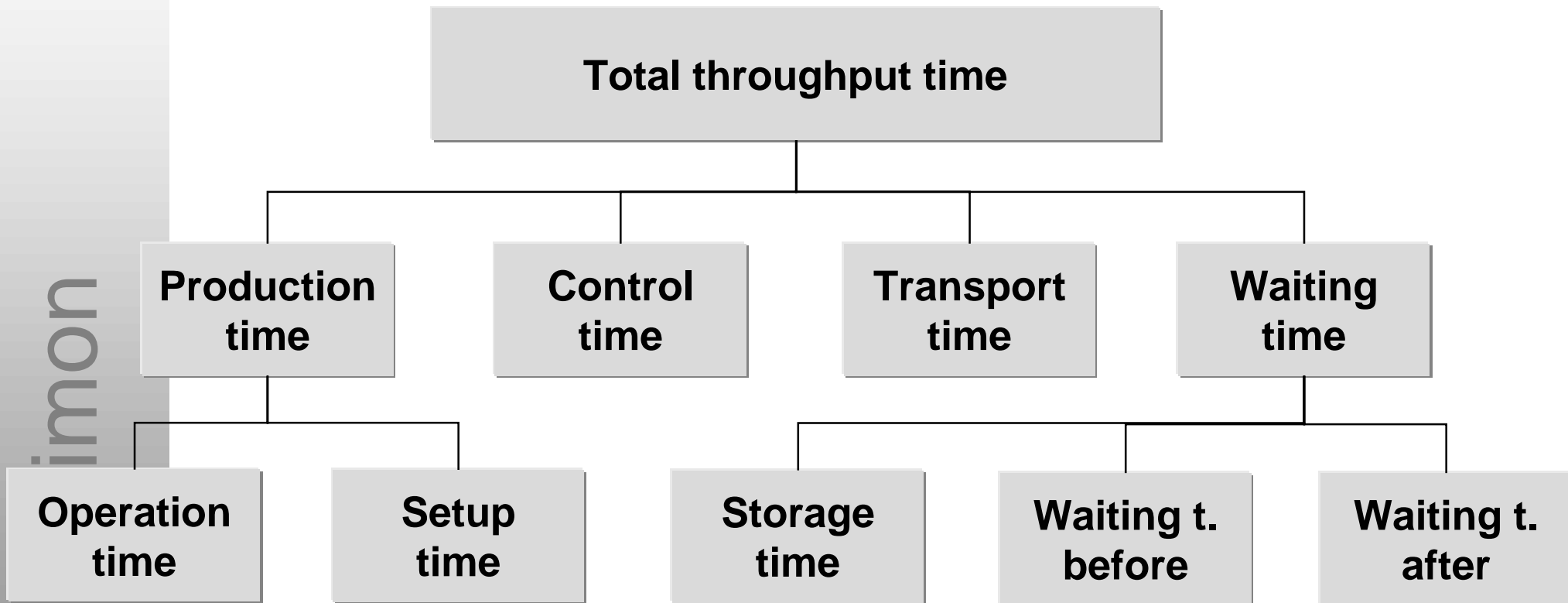


Time

- Time to market
 - From idea to market
- Lead time
 - From order to installation at customer site
 - Stock & throughput time



Throughput time





Waste

“Anything other than the minimum amount of equipment, materials, parts, and workers (working time) which are absolutely essential to production.”

Fujio Cho, Toyota

No surplus
No safety stock
No defects



Quality aspects

- SPC - Statistical Process Control
 - Remove sources of faults
 - Reduce variation
- Four steps
 - Define measuring data
 - Data collection
 - Data processing
 - Implementation of change based on statistical results



Taguchi

- Quality = Total loss to the society by the product
- -> The smaller the loss, the higher the quality
- Final manufacturing goals
 - Reduce standard deviation to a minimum
 - Center the nominal value

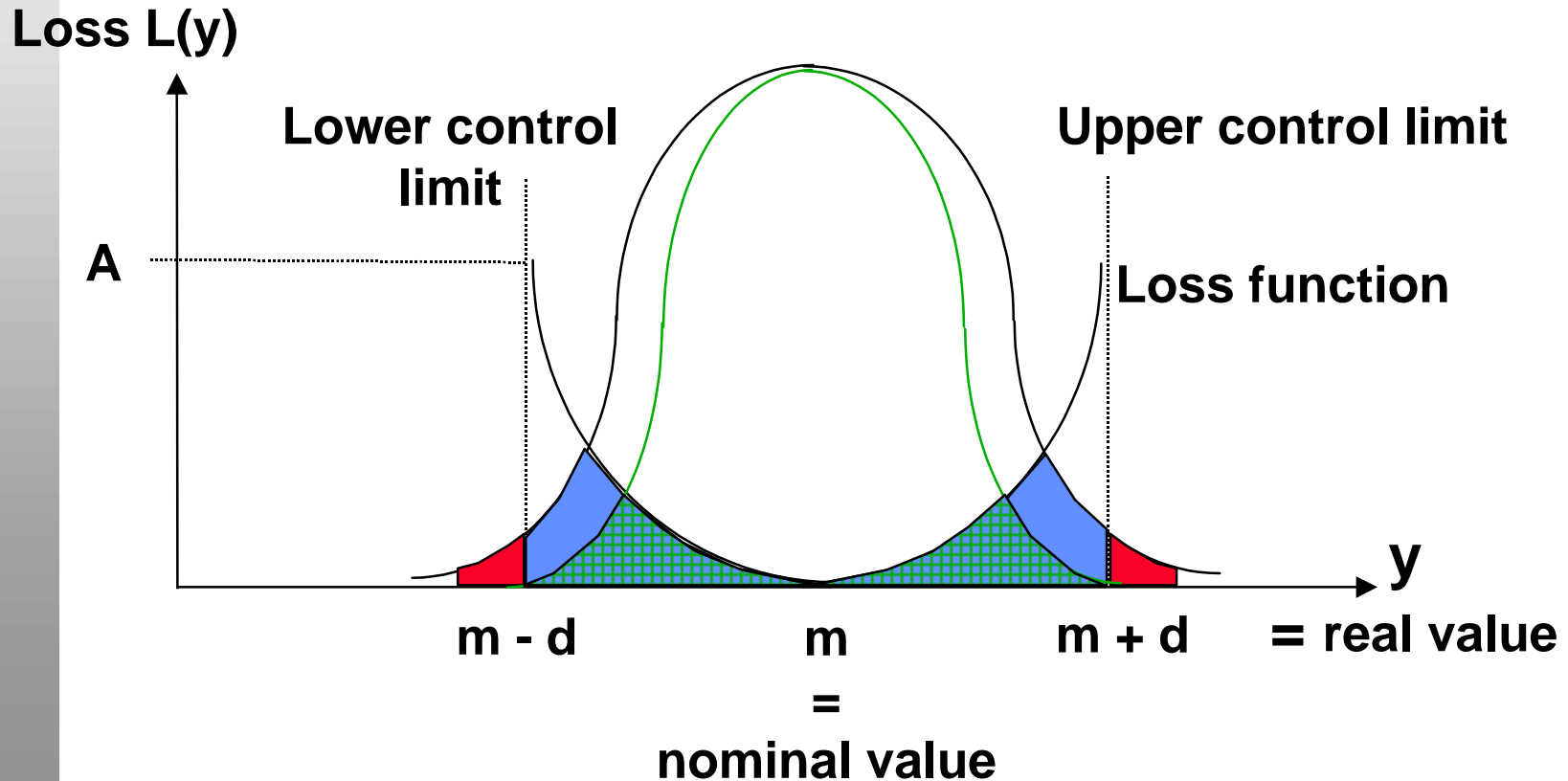


Taguchi's loss function

$A = L(y)$ loss in money due to the limit of tolerance

$d = y - m$

$L(y) = c (y - m)^2$ $c = \text{constant}$





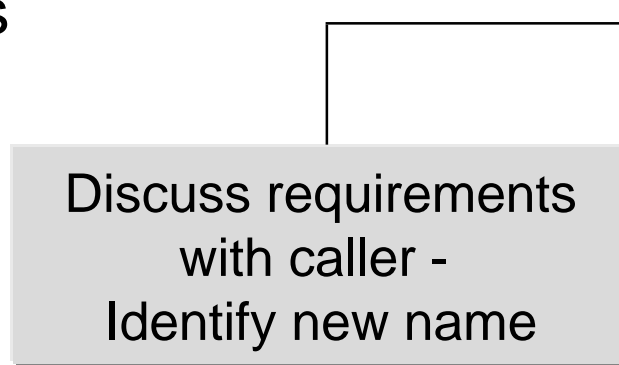
The 7 traditional tools

- Flow chart
- Cause-effect diagram
- Control chart
- Histogram
- Check sheet
- Pareto chart
- Scatter diagram

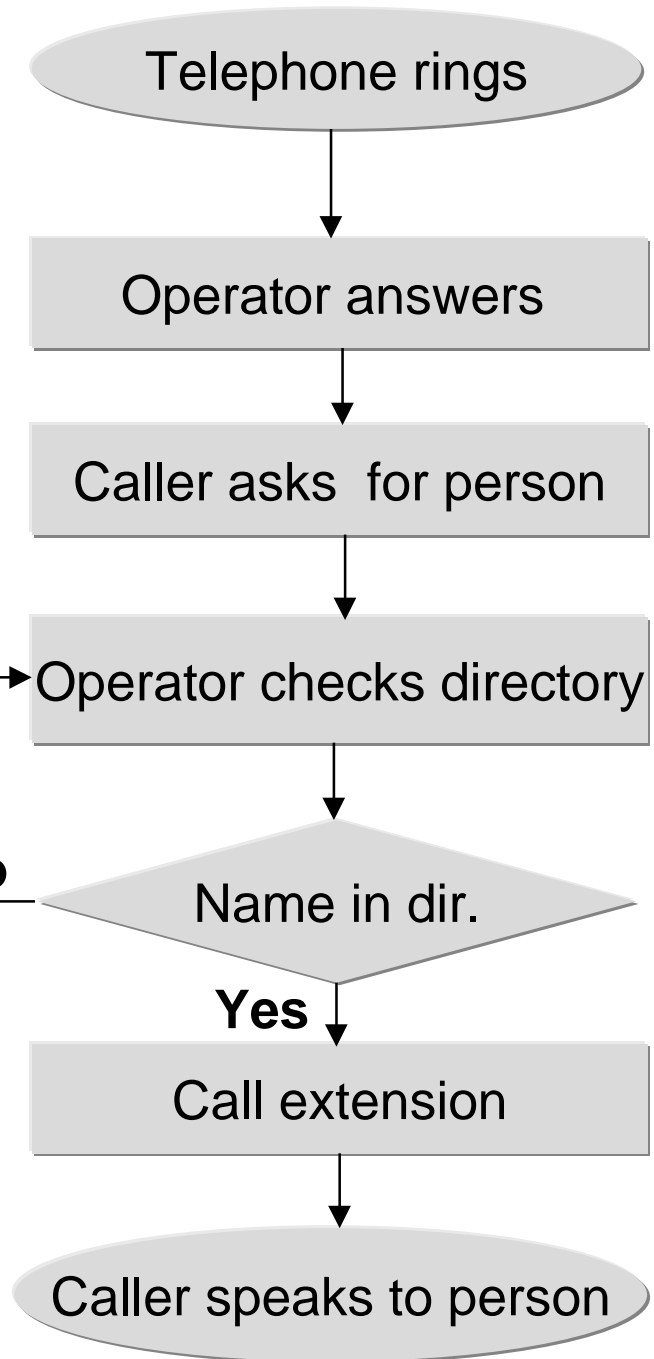


Flowchart

- Understand processes
 - Identification of improvements through visualization
- Understanding of overall process

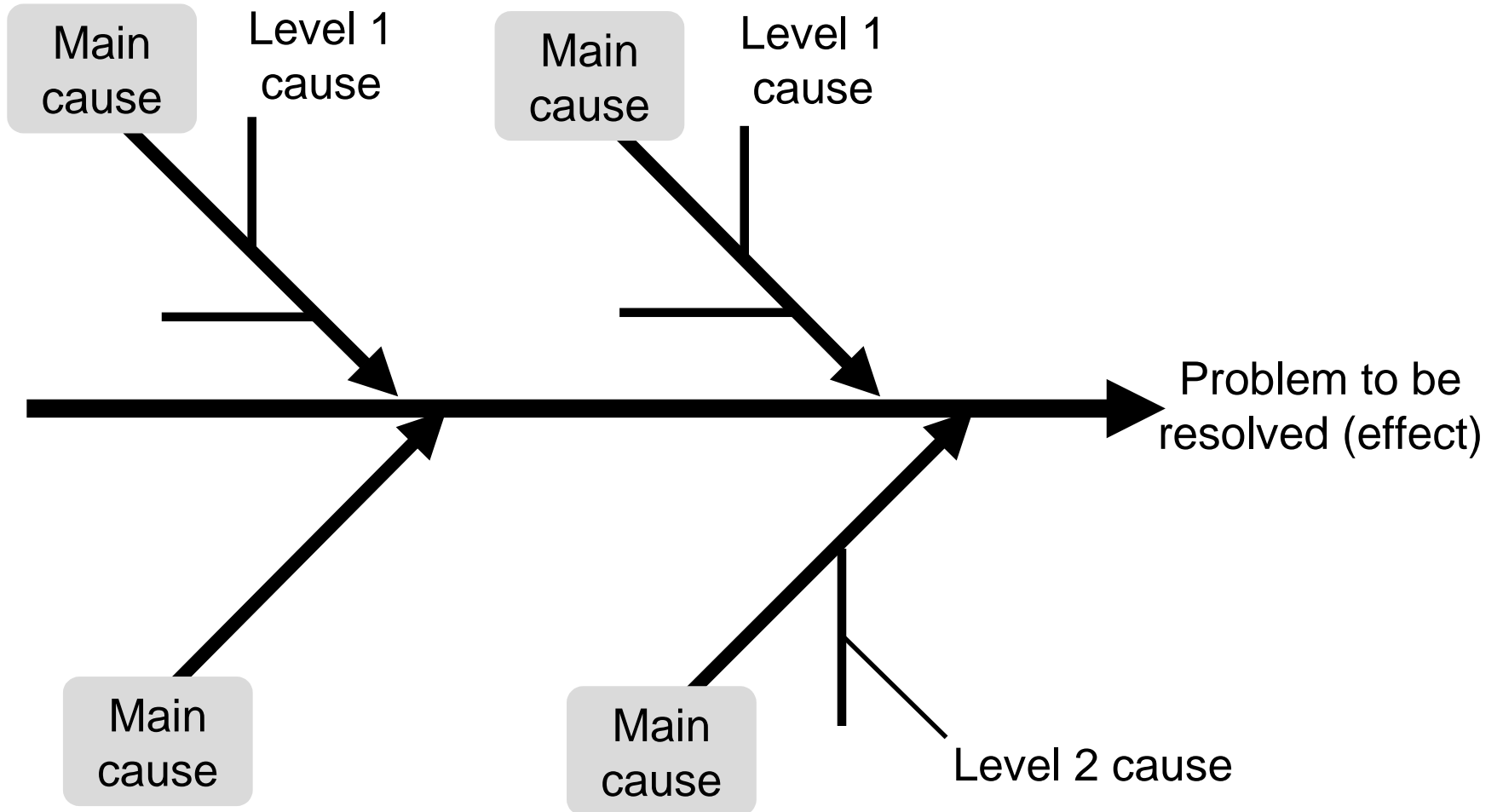


- Identification of suppliers and customers





Cause effect diagrams



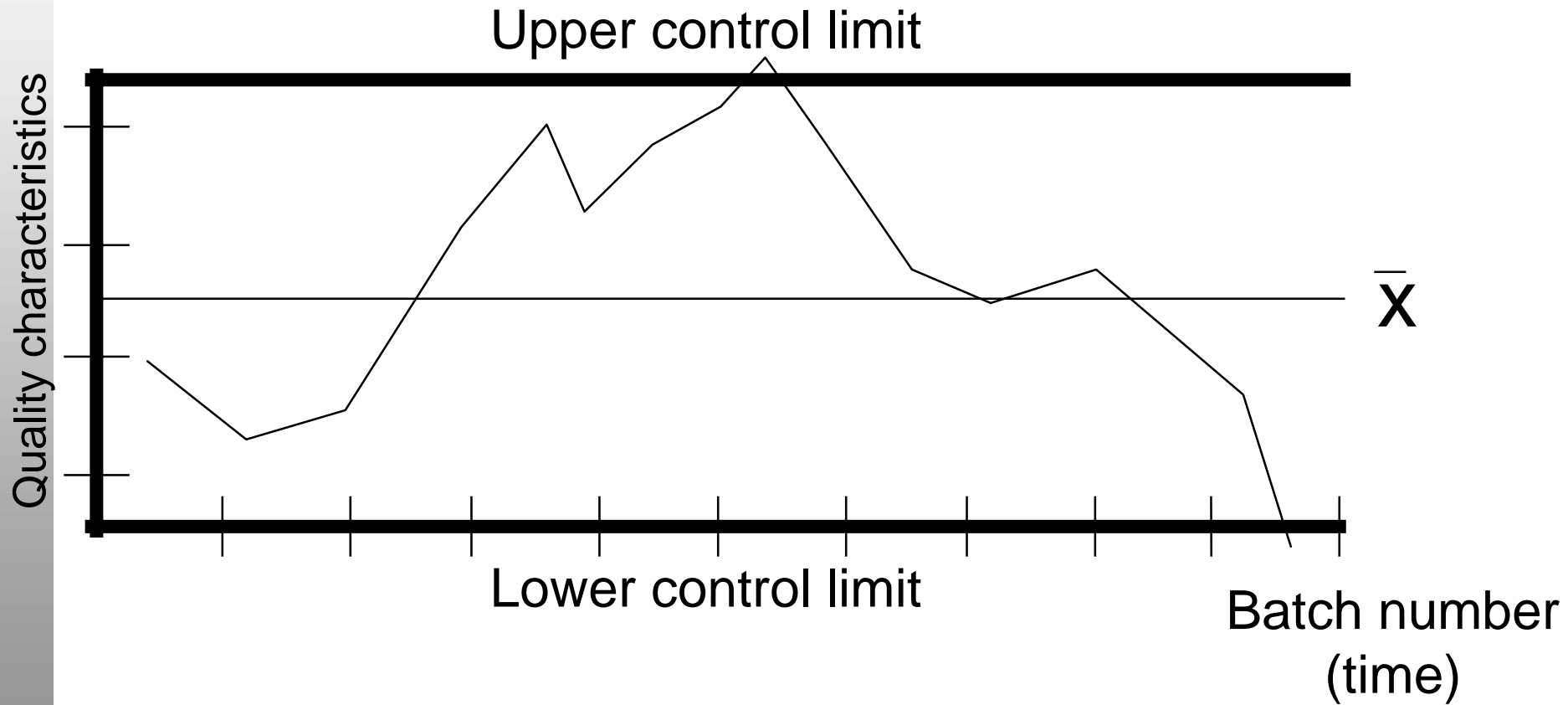


Types

- Dispersion analysis
 - Search causes of undesired effect
- Cause enumeration
 - List all causes for grouping and communication
- Process classification
 - Process step = branch, quality influencing factors are identified for each step
- Use “fishbone” for further work, i.e. Pareto charts



Control charts



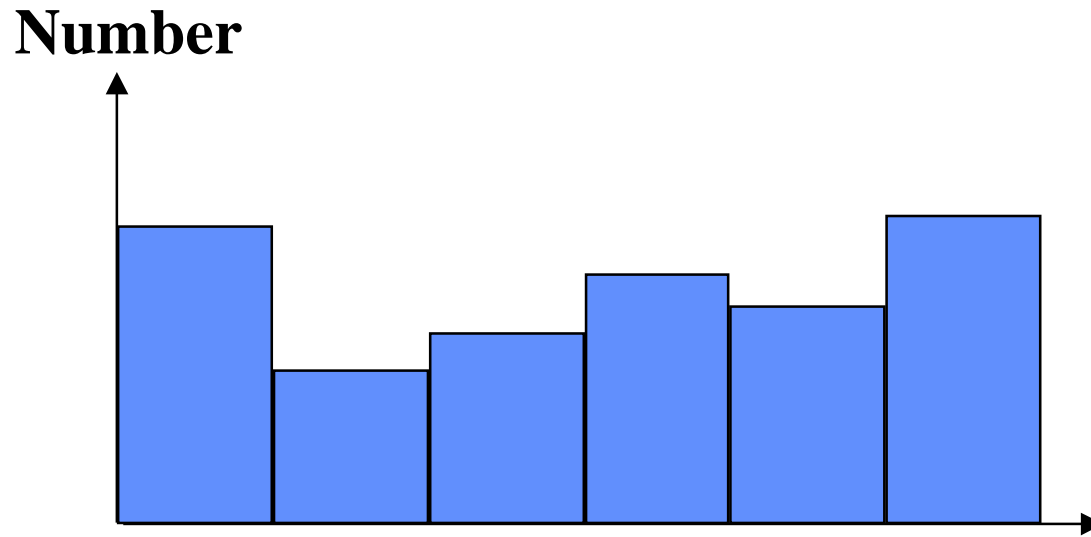


Use of control charts

- Used for predict process bahavior for improvement
- Displays deviations in the process
- Shows common causes to avoid blaming operators for them
- Avoid adjustment of stable processes
- Avoid tampering
- Outside control area (3σ) means out of control



Histogram



- Histogram displays
 - Frequency of events
 - Distribution of frequencies
- Pitfalls
 - Correctness of data
 - No small samples
 - Does NOT show sequence, i.e. no trend indicator



Check sheets

Date: (Date:) Machine: (Activity:) Operator: (Performer:)		
Parameter	Check	Number



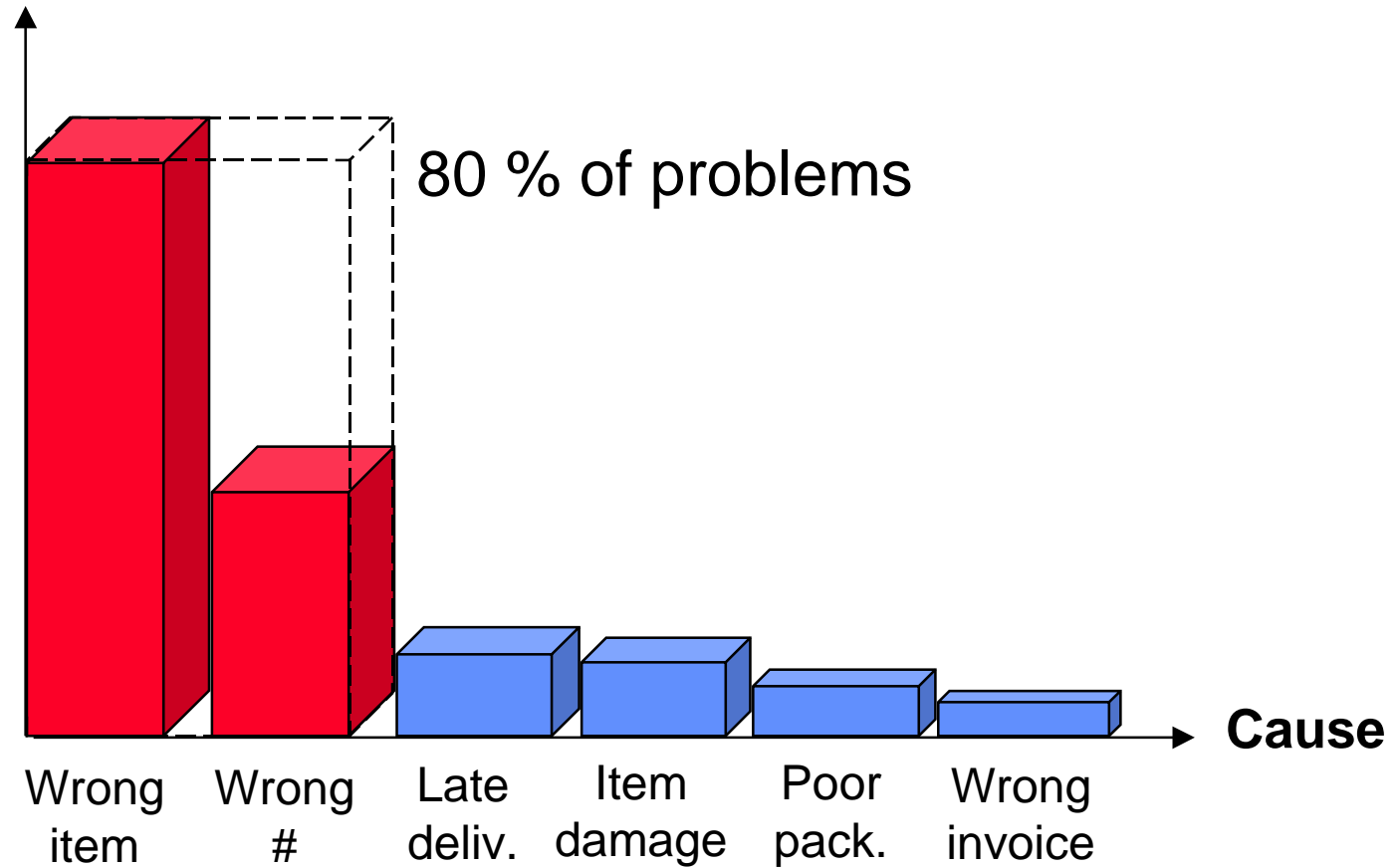
Check sheet use

- Systematic data collection
- No specific areas of application or forms
- Pitfalls
 - Exclusion bias, “wrong” places, “wrong” time, “wrong” condition
 - Interaction bias, process performance influences data collection
 - Estimation bias, formula and methods



Pareto chart

Number of complaints



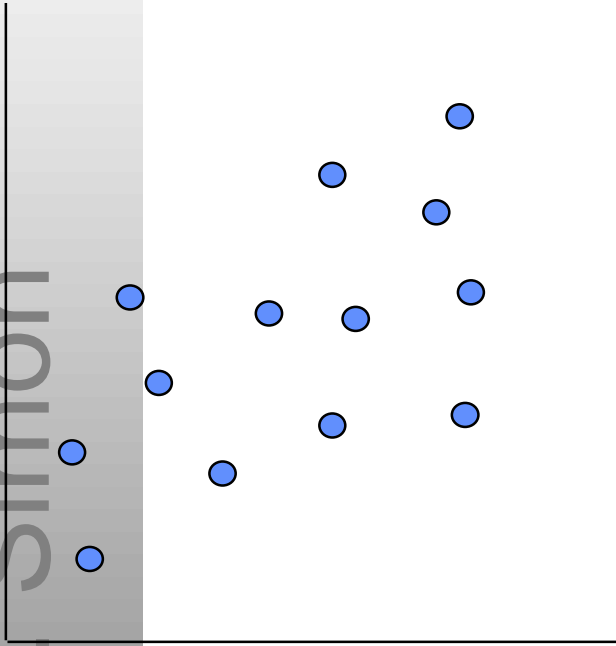


Pareto chart characteristics

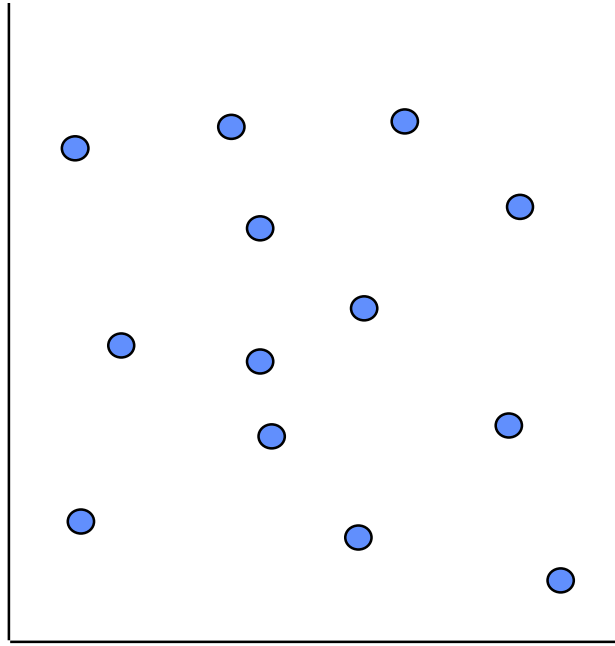
- Most effects come from few causes
- 80:20 rule (The **Pareto-principle**)
 - 80% of problems caused by 20% of staff
 - 80% of non-quality cost caused by 20% of possible causes
- Start working with the “vital few”
- Don’t forget the “useful many”



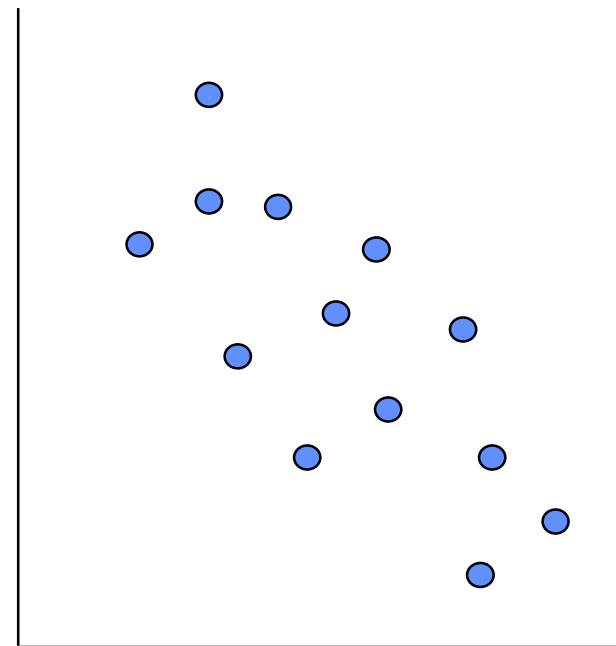
Scatter diagram



Positive correl.



No correl.



Negative correl.



Scatter characteristics

- Relationship between two variables or characteristics
- Powerful, but ...
- Use with care (Nonsense correlation)
 - Dow Jones Index - Lake Superior, 1925-65
 - Too small samples
 - Measurement errors



7 old vs 7 new tools

- “Old” tools mainly used to analyze gathered data
- “New” tools used for attacking the problem
- No replacement, but a complement

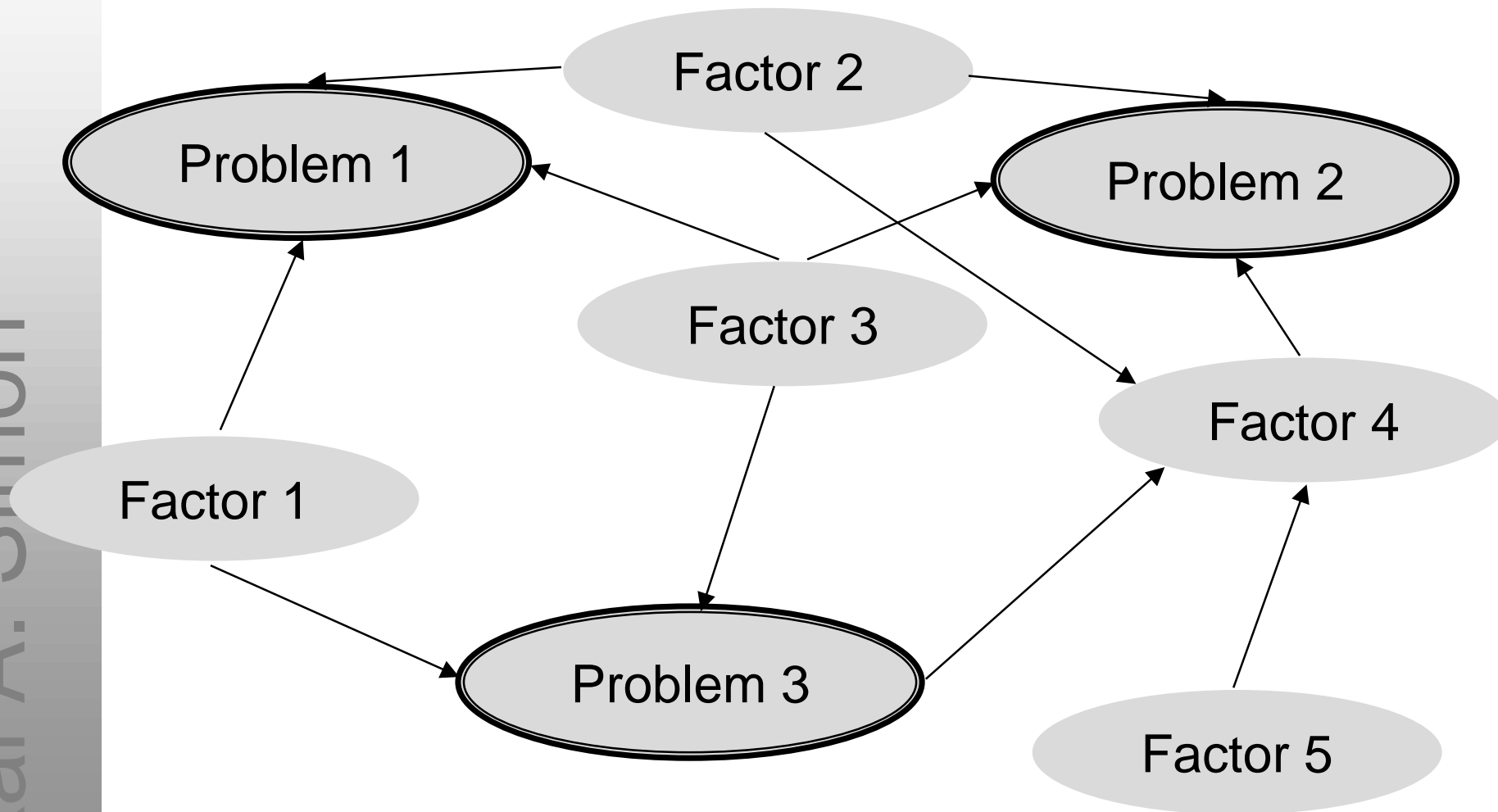


The 7 new tools

- Relations diagram method
- KJ method
- Systematic diagram method
- Matrix diagram
- Matrix data analysis
- PDPC method
- Arrow diagram



Relations diagram





Rel. diagram characteristics

- Identification of intertwined causal relationships
- Complex problems situations or simulations
- Problem solving procedure
 - Isolating all factors
 - Expressing the factors freely and concisely
 - Logical identification of cause-effect relations, depict identified relations in diagram
 - Production of complete picture
 - Extraction of key factors

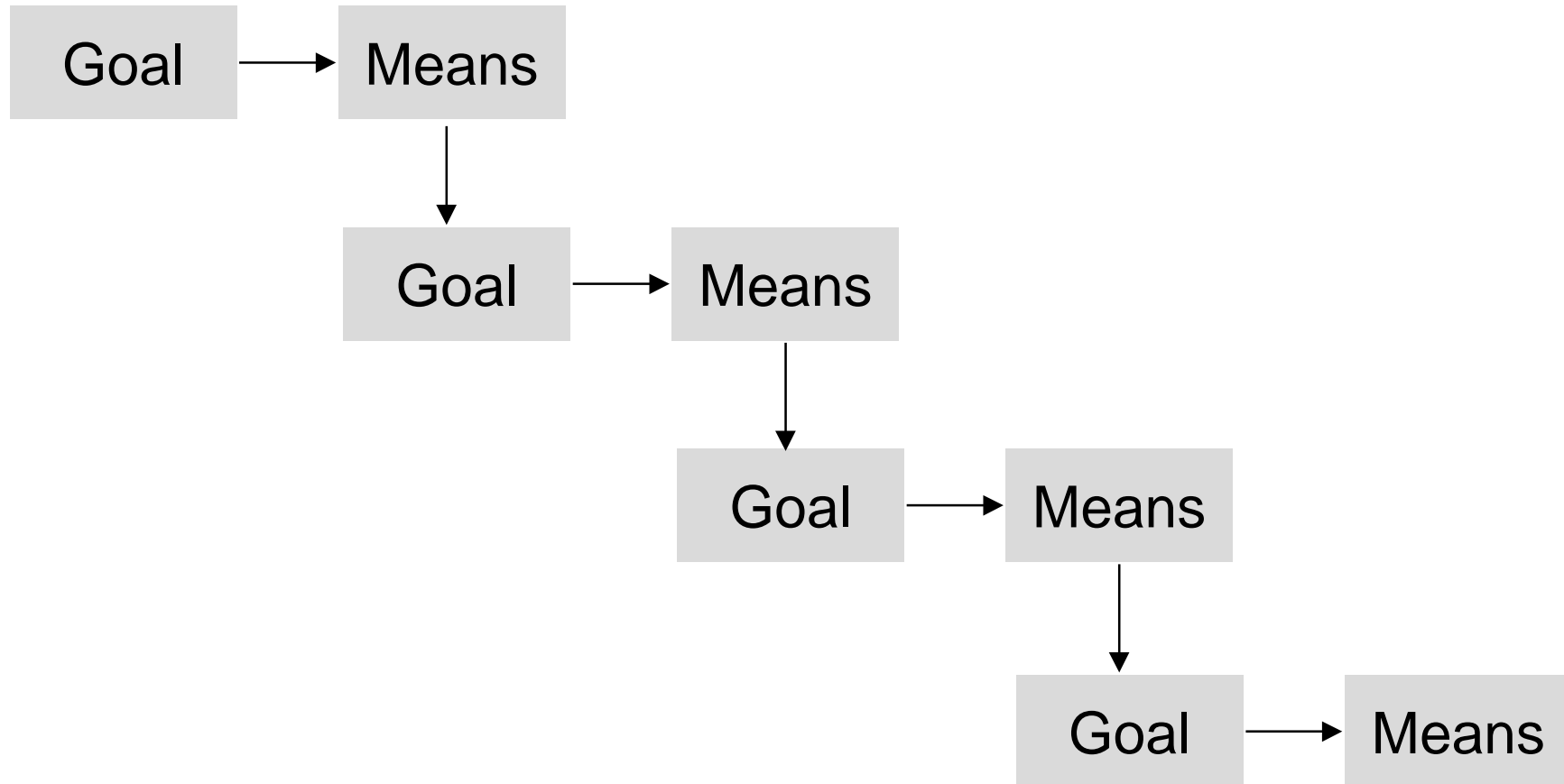


KJ method

- Narrative approach to clarify important but unresolved problems
- Performed in groups
- Affinity diagram for relations and similarities
 - Selecting theme
 - Collecting narrative data
 - Transferring data onto cards
 - Sorting the cards
 - Labeling cards
 - Drawing diagram



Systematic diagram





System. diagram characteristics

- Given set of objectives, search for best accomplishments
- Representation of events as tree and its branches
- Clarifies important aspects, enables an overview
- Makes subject visible and searches for suitable means



Matrix diagrams

		C					
		c1	c2	c3			cn
R	r1						
	r2			●			
	rm						



Matrix diagram characteristics

- Identify corresponding elements of problems
- Presence or absence of relationships
- Intersectings as starting points for multi-dimensional problem approach
- Start consideration with questions
 - Is there any relation?
 - What kind of relation is there?
 - Is there a dependency?
 - Must it be resolved?



Matrix data analysis

		Market					
		1	2	3	4	i	n
1	7	3				8	
2							
3	4						
4							
i						5	
m		6				7	7



Matrix data analysis charact.

- Large array of numbers is represented
- Displays correlations with numbers or symbols
- Natural overlooking of blank cells, filled in cells catch attention
- Patterns of relationships can be identified

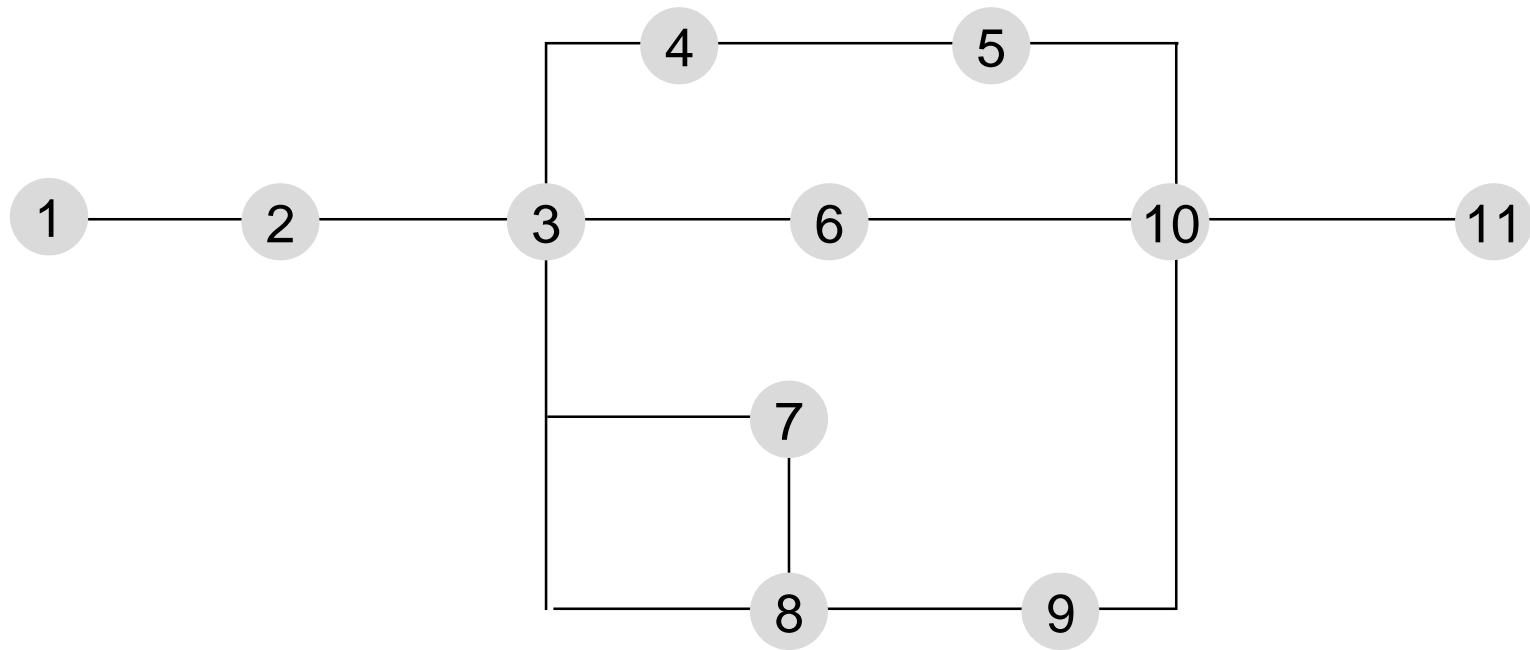


PDPC method

- Process Decision Program Chart
- Determine which processes to use for desired results
- Evaluates progress of events and variety of conceivable outcomes
- Anticipation of undesirable potential events or outcomes



Arrow diagrams





Arrow diagrams

- Form of network planning technique
- Based on PERT or CPM
 - PERT - Program Evaluation and Review Technique
 - CPM - Critical Path Method
- Diagram connects all activities related to plan execution
- Effects of deviations are depicted