Methods for the specification and verification of business processes
MPB (6 cfu, 295AA)

Roberto Bruni
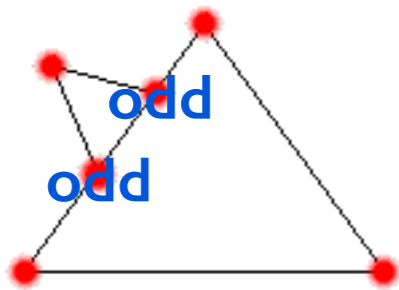
http://www.di.unipi.it/~bruni
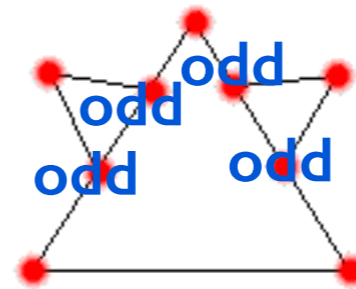
02 - Business processes

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Digression...

Eu path
no Eu circuit
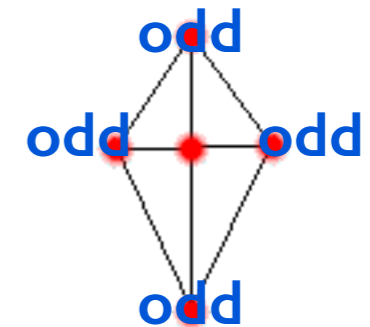
odd
odd

no Eu path
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odd
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Eu path
no Eu circuit

odd odd

no Eu path
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odd
odd odd
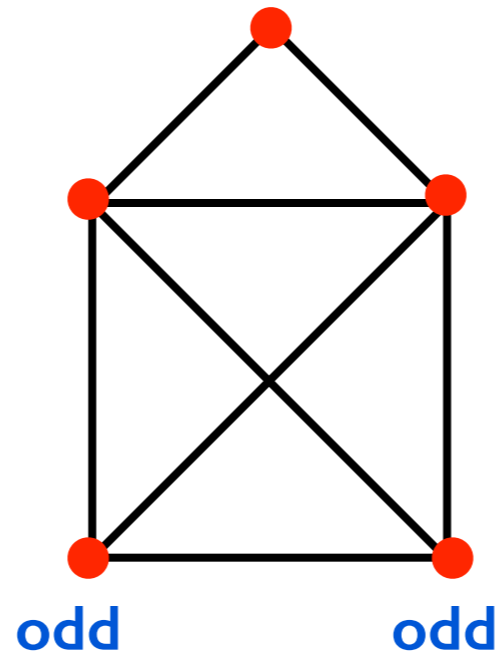odd
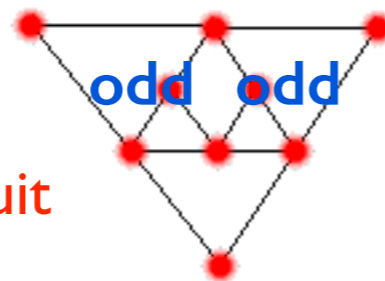
Exercises: find Eulerian path/circuits in the graphs above or prove that they cannot exist.

Digression...

odd   odd

A childish puzzle

Classes

Wednesday: 16:00-18:00, room **A1**

Friday: 14:00-16:00, room **L1**

Today:

Ch.1 of Workflow Management: Models, Methods, and Systems

Ch.1 of Business Process Management: Concepts, Languages, Architectures

Terminology

Generic terms, widely applicable to different working situations and companies

We fix preferred terms when possible, but allow synonyms interchangeably

Issues

☐ **Role of work in the society**

☐ Organizational structures

☐ Principal-contractor relationship

☐ Processes and distribution of work

☐ Process management

Work

People work to live
(or do they live to work?)

We need **products** to live our lives
(food, clothing, house, transportation, fun, health)

We are not capable to produce all we need
(or all we want, or that we are induced to want)
because we cannot be skilled enough

We buy products we cannot make ourselves

Business units

People organize specialized business units

They know how to do some specific product
(limited range of products, highly efficient)

Market

Products are supplied to people via markets
(distribution in exchange of money)

New services

Other work emerge, that would not exist
(trading, banks, advertising, transportation,
regulations, insurance companies, eCommerce)

There are **services** and **products** necessary to
keep the organization operating
(not making a direct contribution to keep us alive)

Complexity

Modern society is too complex for people to see how
their work fits in the overall scheme
(alienation can become a major social problem)

The same scheme applies to large companies:
high degree of work specialization
cause big picture be lost by employees
(why do they have to do the things they are told to do?)

Paradigm shift

Alienation from work can have negative effects on
(human life and) productivity

Companies can allow employees to know
they are working for a particular customer
(increase motivation, self-esteem, productivity)

Shift:

from supply-driven economy (scarce means of production)
to **demand-driven** economy (customers are scarce)

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Organizational structure

An **organizational structure** establishes how the work, authorities and responsibilities are divided up amongst its staff
(roles and functions)

A single person can fulfill several roles,
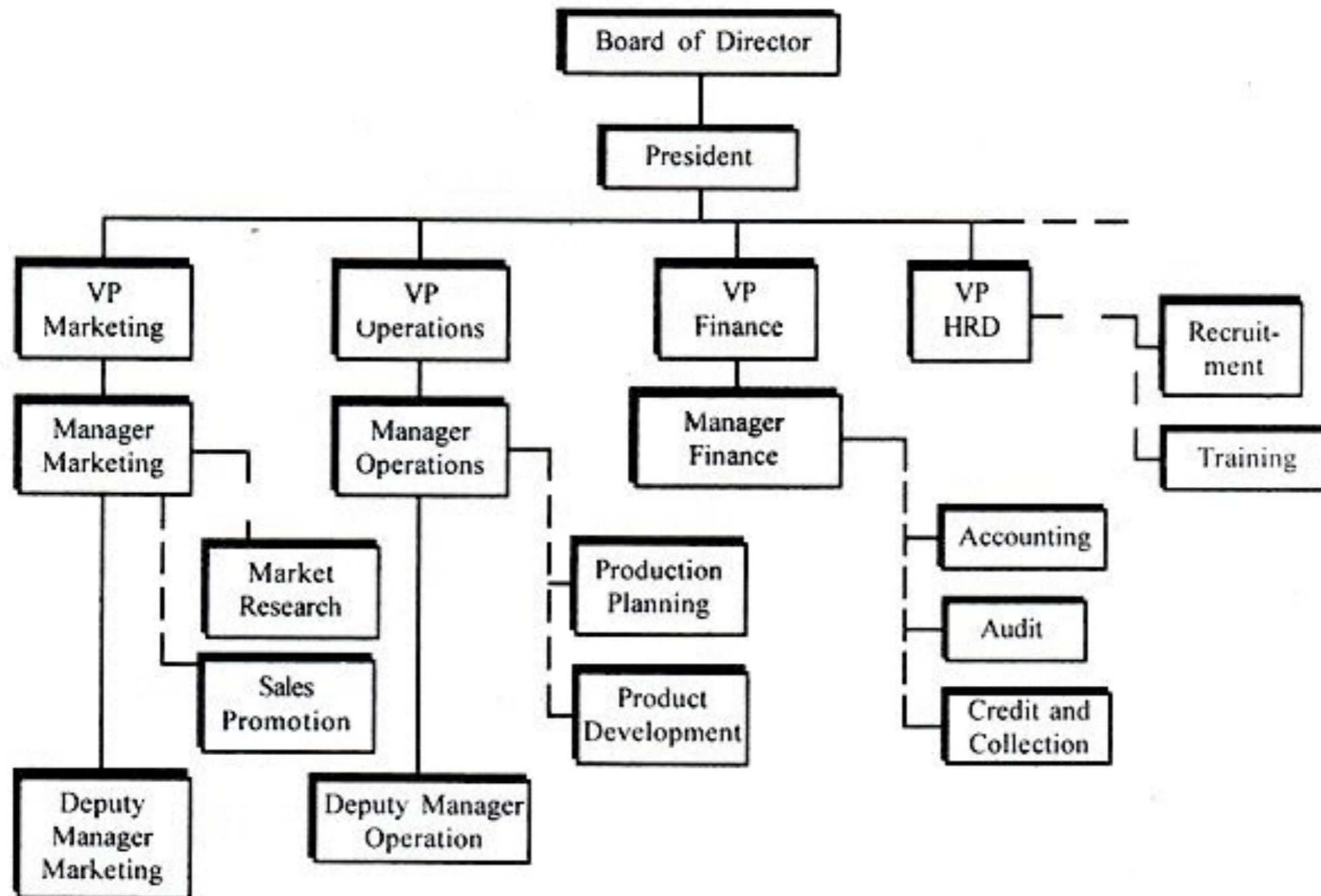at the same time or at different times

Task force to reduce bureaucracy

Most relevant forms of organizational structure

Hierarchical:
structured as a tree,
internal nodes are individual roles or functions,
leaves are staff or departments,
branches are authority relationships
(independent of cases)

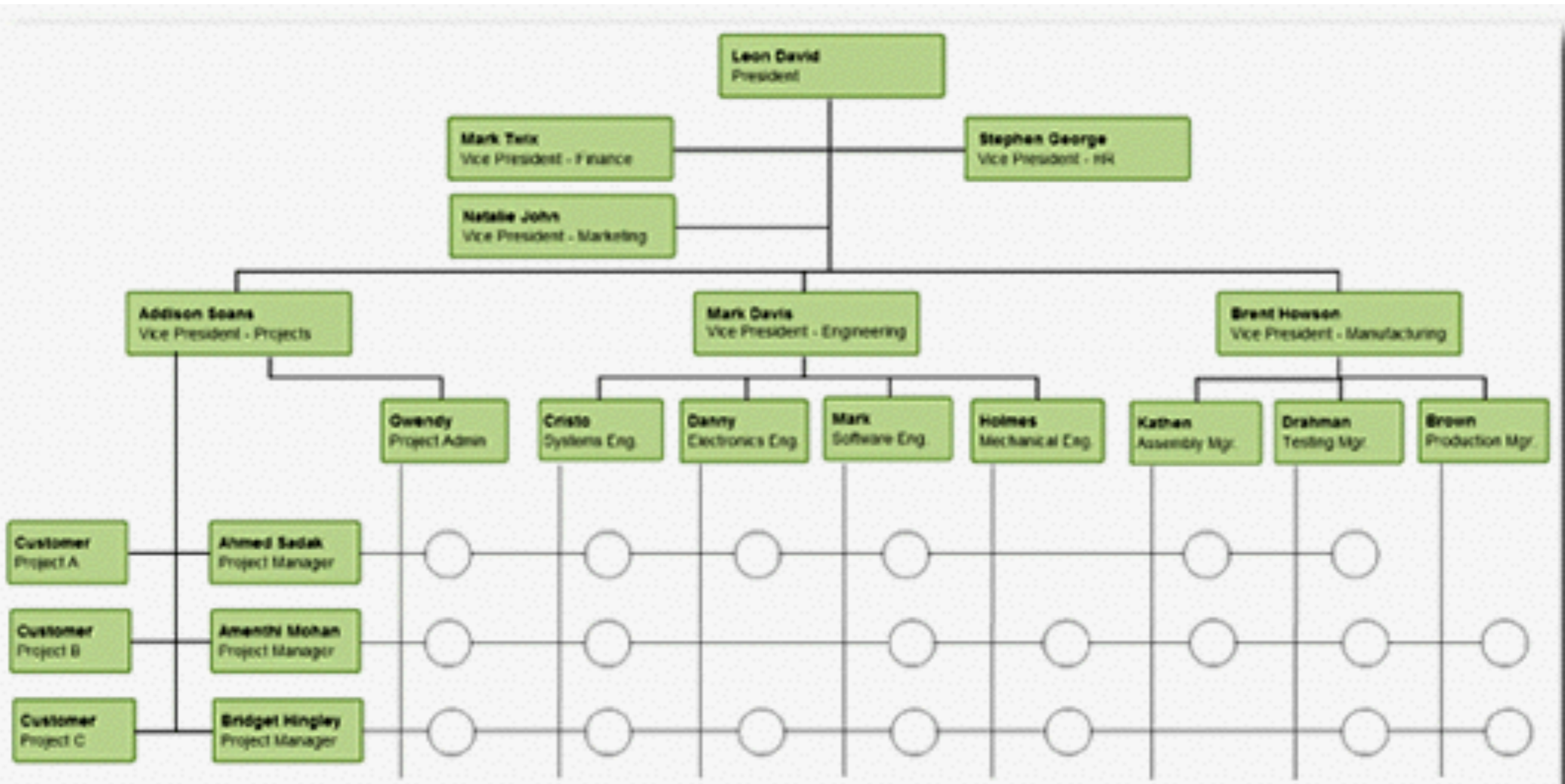# Hierarchical structure

Legend : — Line Authority
-- Staff Relationship

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Most relevant forms of organizational structure

Matrix:
add (dynamic) functional dimension
(each person can have one or more
functional bosses, known as project leaders)

Matrix structure

Most relevant forms of organizational structure

Network:
autonomous actors collaborate
to supply products or services

Network structure
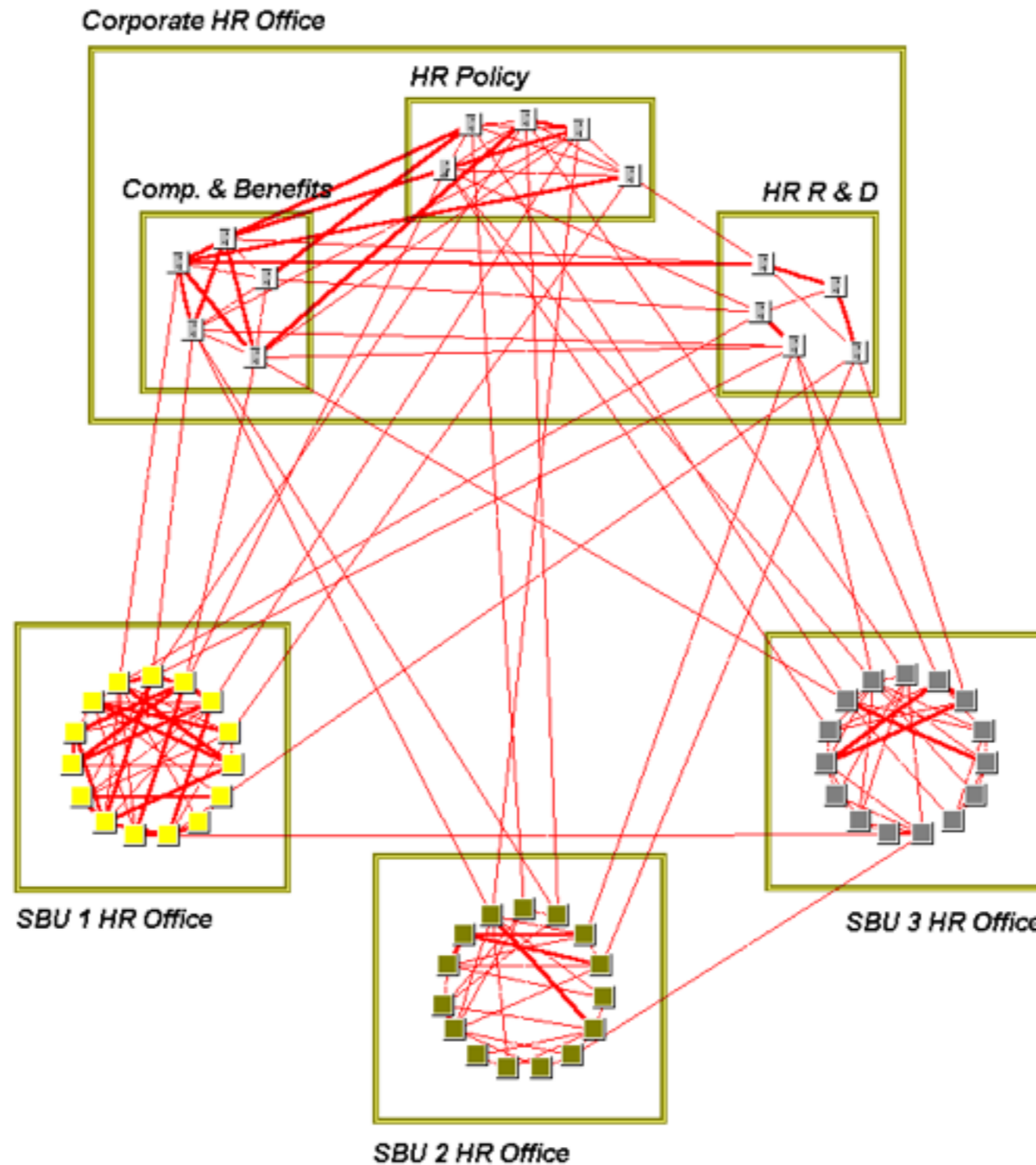
Corporate HR Office

HR Policy

Comp. & Benefits

HR R & D

SBU 1 HR Office

SBU 2 HR Office

SBU 3 HR Office

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Issues

☑ Role of work in the society

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☐ Process management

Principal

Most people's work is assigned or outsourced to
them by other people: their **principals**
(they can be company departments or firms)

We can divide principals in two forms:
boss and **customer**

Assignments ordered by bosses
are often related to work for customers

Contractors

A person who is assigned a task is called
contractor, or also **resource**
(assignments can be carried out by machines
and computer applications as well as people)

Actors

An **actor** can be a principal or a contractor, or play both roles at the same time
(contractors may redirect work to third parties)

Contract

A **contract** exists between a principal and a contractor about the case to be performed (deadline for completion, price to be paid)

A **communication** protocol can be established between a principal and a contractor to exchange information

Protocol example
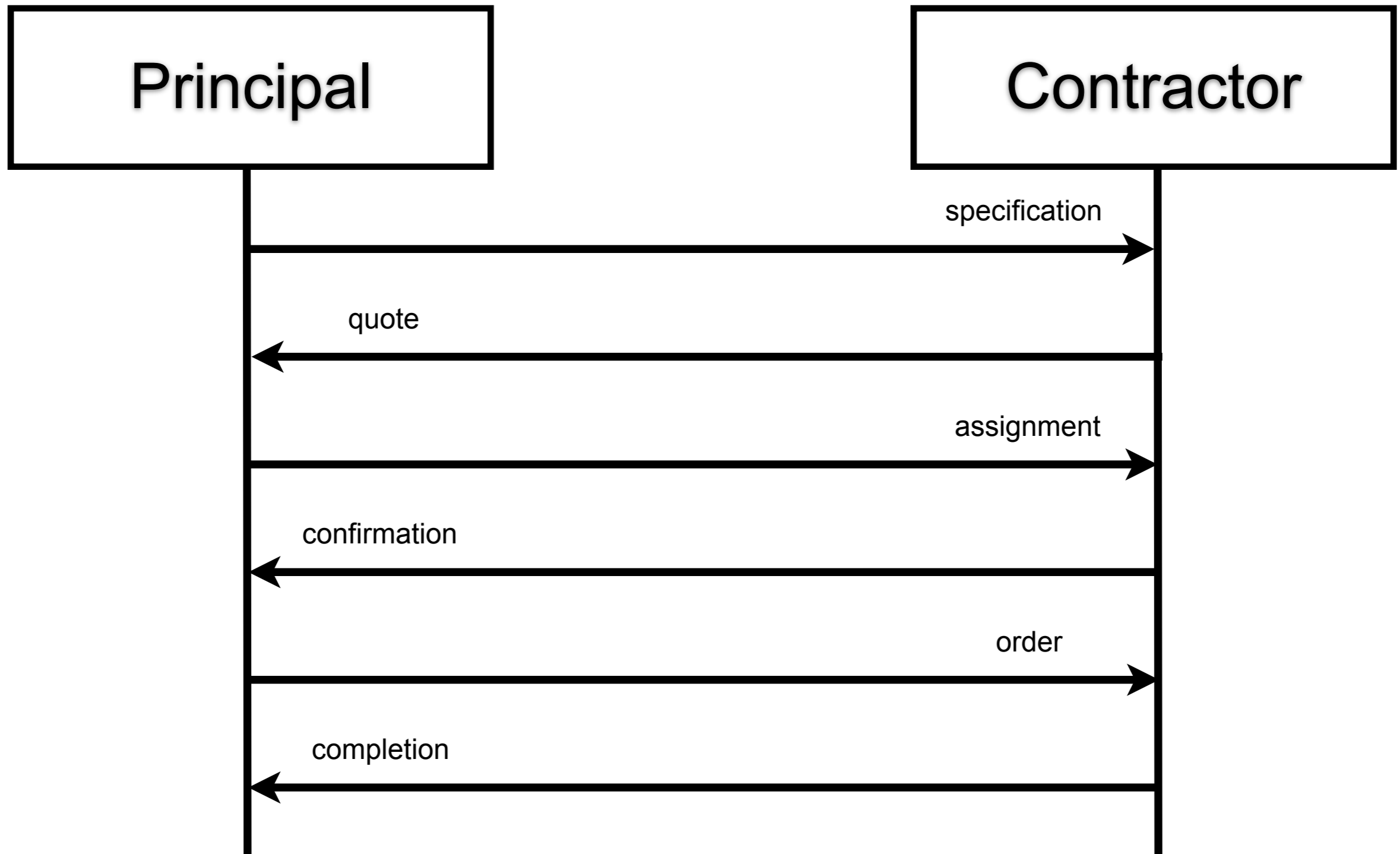
Principal | Contractor

specification →

← quote

assignment →

← confirmation

order →

← completion

Contract tree example

transport from A to Z
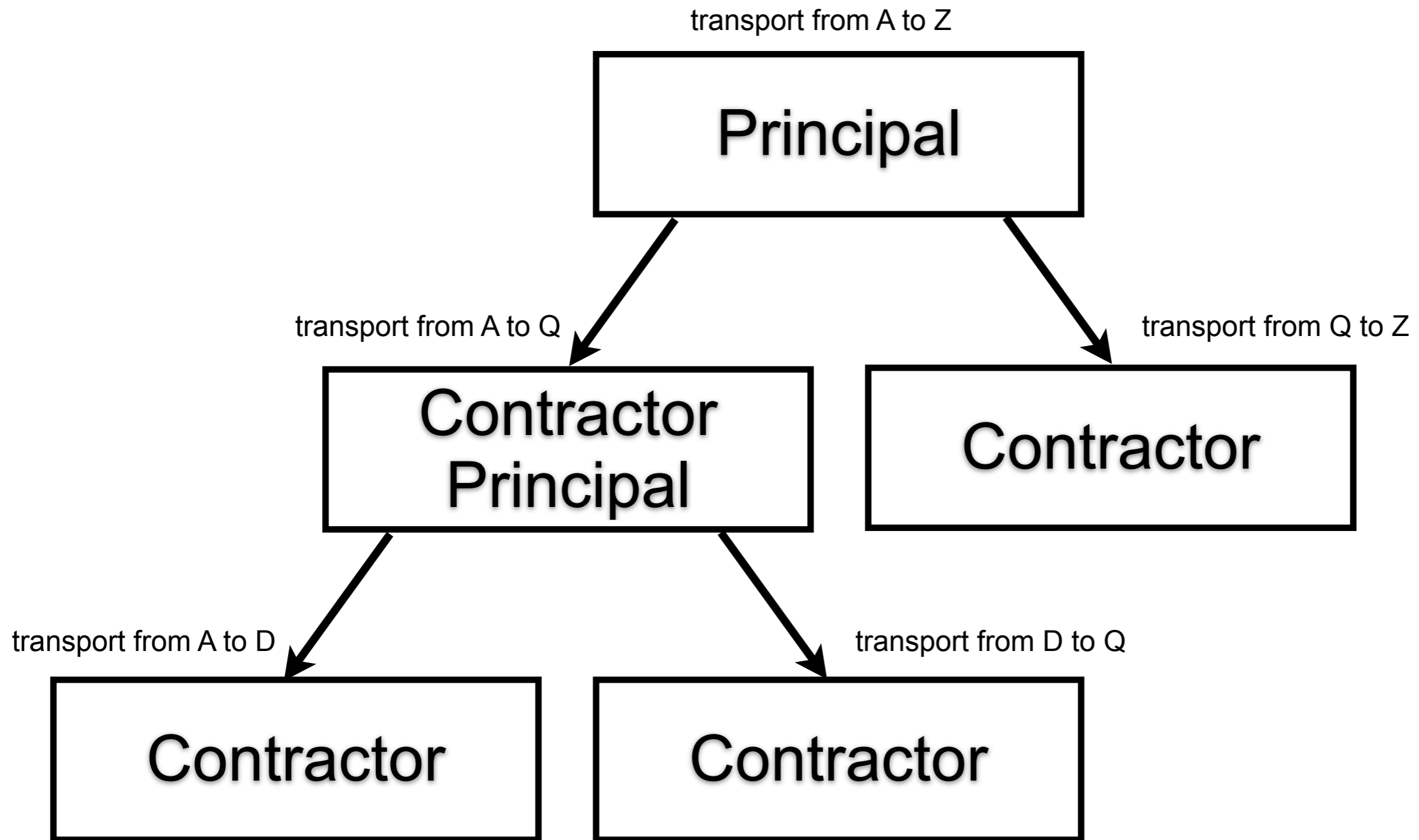
```
                    ┌─────────────┐
                    │  Principal  │
                    └─────────────┘
                   /               \
transport from A to Q          transport from Q to Z
        ┌──────────────┐        ┌──────────────┐
        │  Contractor  │        │  Contractor  │
        │  Principal   │        └──────────────┘
        └──────────────┘
        /              \
transport from A to D    transport from D to Q
  ┌──────────────┐    ┌──────────────┐
  │  Contractor  │    │  Contractor  │
  └──────────────┘    └──────────────┘
```

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Issues

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☐ **Processes and distribution of work**

☐ Process management

Case

Many different types of work exist
(baking bread, making forniture, design a building,
collect surveys to compile a statistic)

They have in common the **case**:
one tangible thing produced or modified
(bread, forniture, house, diagram)
but more abstract cases are also possible
(a lawsuit, an insurance claim, digital data)

Synonyms: work, job, product, service, item

Procedure

Working on a case is typically discrete in nature

Every case has a beginning and an end

Each case can be distinguished from any other case

Each case involves a **procedure** being performed:
the tasks to be carried out and the conditions that
determine the order of the tasks

Synonyms: process, project

Task

A **task** is a logical unit of work that is carried out as a single whole

Example: Make a Pizza

1. Check ingredients
2. Check tools
3. Make the dough balls
4. Prepare toppings (while dough rises)
5. Shape dough balls into pizza
6. Top it
7. Cook it

Tasks?
Procedures?
Cases?

Knowledge

Some tasks can be performed by a computer without human intervention

Executing some tasks may require human intelligence: a judgement or a decision
(a bank employee decides about a loan request)

Persons need **knowledge** to execute tasks
(their past experience, company guidelines)

Resource

A **resource** is the generic name for
a person, machine or group of persons or machines
that is responsible for a task

Activity

An **activity** is
the performance of a task by a resource

Various cases may share the same procedure, but
each case may involve different activities to be
carried out, depending on case **attributes**
(one insurance claim may involve objections and
another one may not)

Example: Make a Pizza

1. Check ingredients
2. Check tools
3. Make the dough balls
4. Prepare toppings (while dough rises)
5. Shape dough balls into pizza
6. Top it
7. Cook it

Knowledge?
Resources?
Activities?

Example: Make a Pizza

Knowing the procedure is essential, but

Not all recipes are the same

Not all pizzas taste the same

Execution is important

Training is important

Cases vs procedures

The number of procedures in a company is (generally) finite and far smaller than the number of cases to be handled

Example: it is easier to make
one hundred skirts with the same pattern
than one hundred skirts using different patterns

Example: off-the-rack is cheaper
than made-to-measure

Economy of scale

The cost per case falls
as the number of cases increases

Strategy: keep the number of procedures small and
make the number of cases that each can perform as
high as possible

Profit, after all, is the ultimate objective
(not necessarily the best one)

Example

Insurance companies want to
keep the number of claims as low as possible,
but this is generally a factor they cannot control

They can try to **keep low the number of procedures**,
but the risk is to make them too much complex
(a unique procedure to handle all cases is
possible in principle, but inefficient in practice)

Ideal situation:
a small number of good procedures,
with a lot of cases to be handled by each of them

Counter-examples?

What about tailor-made suits?
one case per process?

What about architects and houses?
each case designed from scratch?

Not so different?

Tailors and architects can exploit standard
approaches for each case

Tailor process:
take customer's measurement,
show a number of patterns,
modify the chosen pattern,
choose the fabric,
draw the pattern

Observation:
tasks can be highly dependent on cases

Issues

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☑ Processes and distribution of work

☐ **Process management**

What is all about

Each **product** that a company
provides to the market
is the outcome of a number
of **tasks** performed

Business processes are about
activities **understanding**,
correlation, **organization**
and **improvement**

Awareness

Process management systems
support and encourage
communication between employees
and make their activities more controllable

Process orientation roots (1990's)
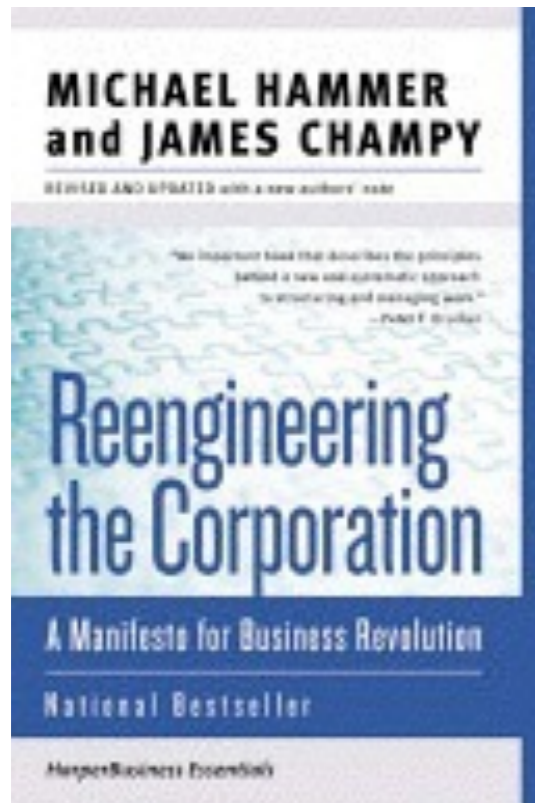
Seminal book advocating
the radical redesign of the business
process of a company
(as opposed to evolutionary improvements)

A **business process** is a **collection of activities**
that take one or more kinds of **input** and
create an **output** that is of value to the customer
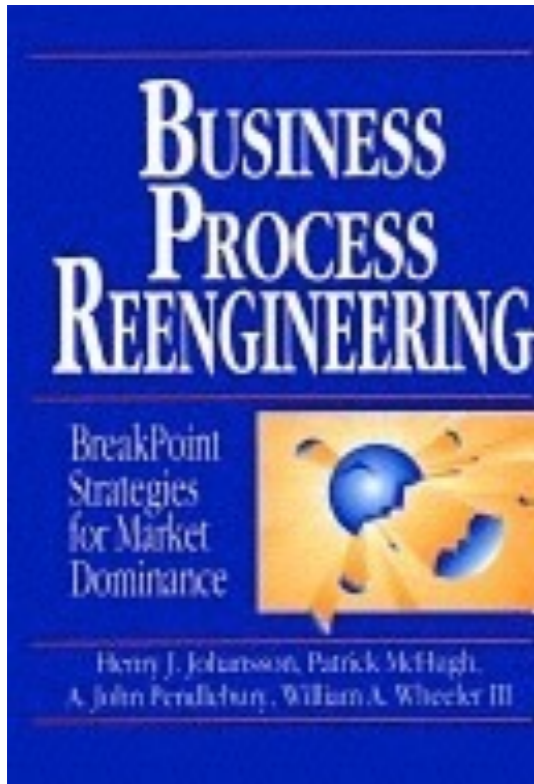*- Hammer & Champy (1993)*

How vs What

The main innovation is the shift of focus on the business logic of the process (**how work is done**), instead of the product perspective (**what is done**)

Keywords

Hammer & Champy: **collection, input, output**

Process orientation roots (1990's)

The transformation that occurs in the process should add value to the input and create an output that is more useful and effective to the **recipient**

A process is a set of **linked** activities that take an input and transform it to create an output.
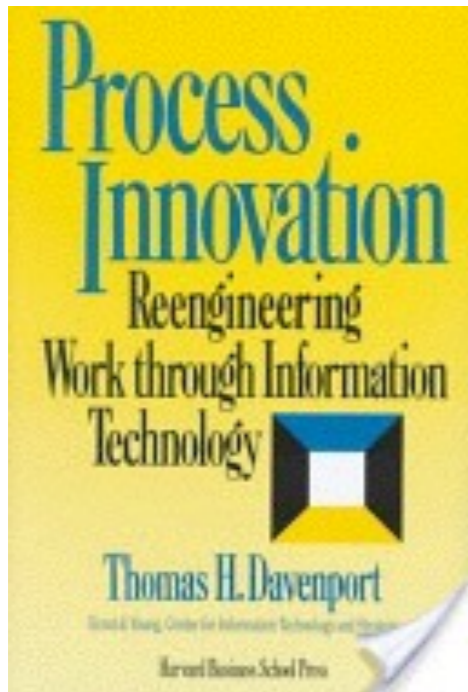
- Johansson et al. (1993)

Keywords

Hammer & Champy: **collection, input, output**

Johansson et al.: **recipient, linked**

Process orientation roots (1990's)

Processes as **structured** sets of activities designed to produce a specific output for a particular market

A **process** is a specific **ordering** of work activities across **time** and **space**, with a **beginning** and an **end**.

- Davenport (1993)

More from Davenport

Unless designers or participants can agree on the way work is and should be **structured**, it will be very difficult to systematically improve, or effect innovation in, that work

Following a structured process is generally a good thing, and there is nothing inherently slow or inefficient about acting along process lines

Keywords

Hammer & Champy: **collection, input, output**

Johansson et al.: **recipient, linked**

Davenport: **structure, ordering, time, space, begin, end**

More from Davenport

Processes that are clearly structured are amenable to **measurement** in a variety of dimensions have cost, time, output quality, and customer satisfaction

When we reduce cost or increase customer satisfaction, we have bettered the process itself

ROI = Return on Investment

CUSTOMER SATISFACTION

CUSTOMER
Predict Customer Behavior based on demographics and purchasing habits

PRODUCT
Improve product positioning, identify product associations for promotions, and plan shelf positioning

CHANNEL
Campaign Management, Analysis and Design for different channels

TECHNOLOGY as an enabler to
1. Reaching the pinnacle of customer service
2. Achieving high success rates in adoption of new products
3. Exceeding planned ROI's on every campaign through accurate targeting

More from Davenport

Processes also need clearly defined **owners** to be responsible for design and execution.

Ownership must be seen as an additional or alternative dimension of the organizational structure.

During periods of radical process change, ownership **takes precedence** over other organizational structures. Otherwise process owners will not have the power or legitimacy needed to implement process designs that violate organizational charts and norms

More from Davenport

In service industries
it is nearly impossible to distinguish between
innovative new services offered to the customers
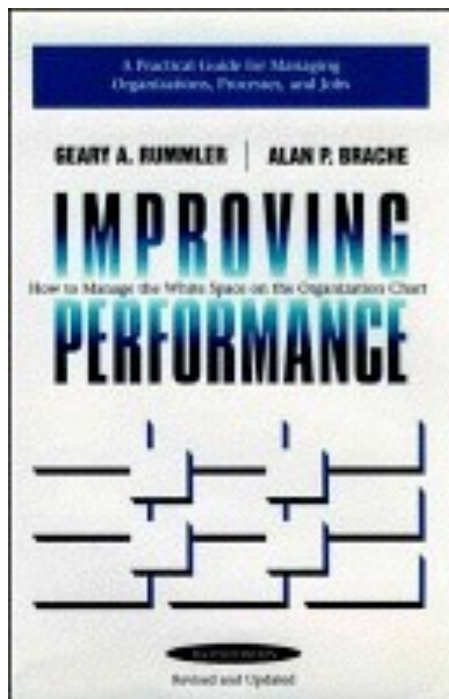and the **innovative processes** that enable them

Keywords

Hammer & Champy: **collection, input, output**

Johansson et al.: **recipient, linked**

Davenport: **structure, ordering, time, space, begin, end, measurement, ownership, innovation enabling**

Process orientation roots (1990's)

Some processes result in a product or service that is received by an organization's external customer.
We call these **production** processes.

Other processes produce products that are invisible to the external customer but essential to the effective management of the business.

- Rummler & Brache (1995)

Primary process

Produce company's products
(**production** processes)

Customer-oriented, even if sometimes the
customer is not known in advance

Generate income for the company

Examples: raw materials purchase, service sale,
design and engineering, distribution

Secondary process

Support primary processes
(**support** processes)

Examples: machinery purchase and maintenance, personnel management (recruitment and selection, training, work appraisal, payrolls, dismissal), financial administration, marketing
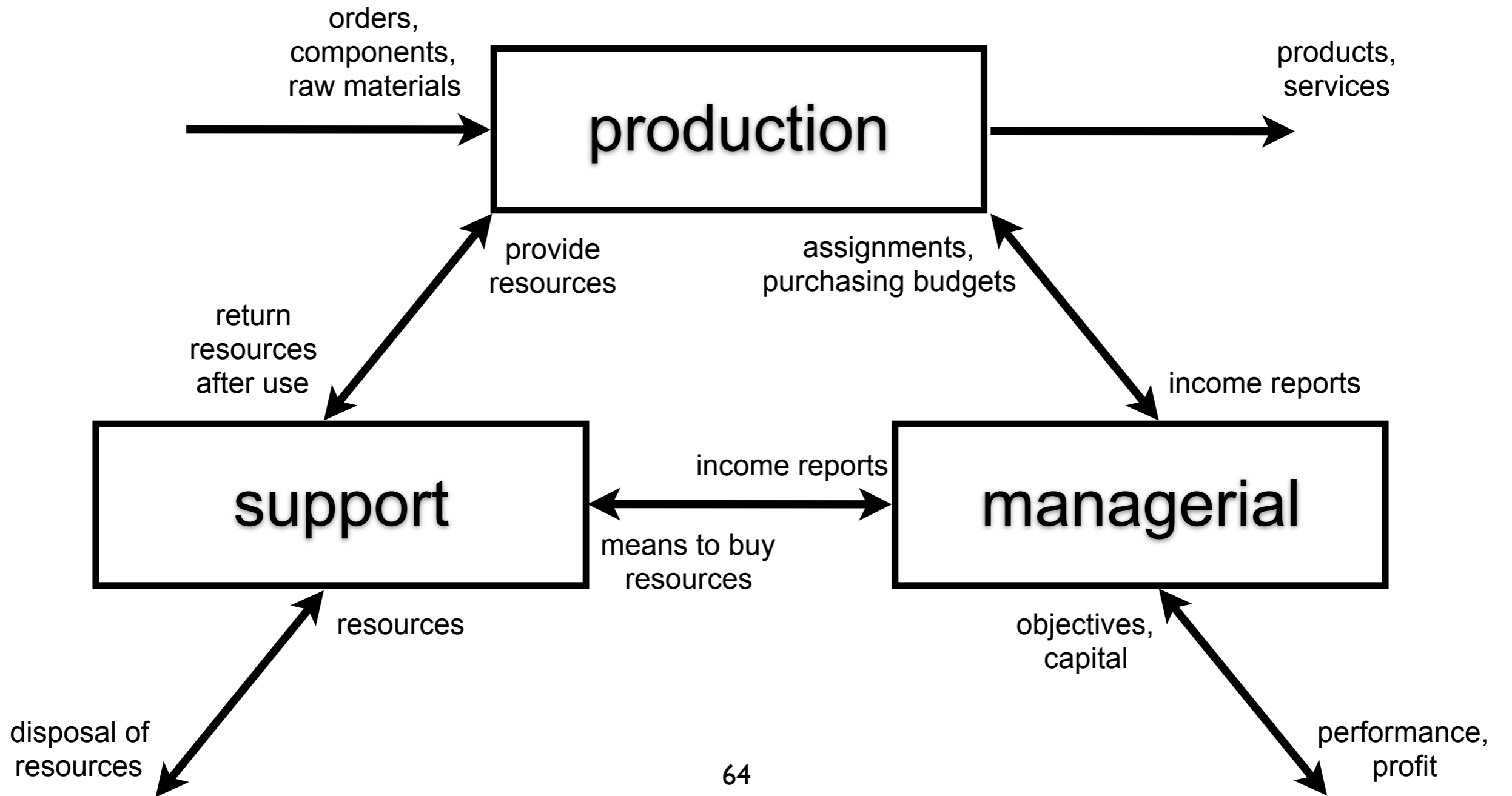
Tertiary process

Direct and coordinate primary and secondary ones (**managerial** processes)

Fix objectives, allocated resources and preconditions for the managers of other processes

Examples: maintenance of contracts with financiers and other stakeholders

1, 2, 3

orders, components, raw materials → **production** → products, services

provide resources

return resources after use

assignments, purchasing budgets

income reports

support ← income reports → **managerial**

means to buy resources

resources

disposal of resources

objectives, capital

performance, profit

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Keywords

Hammer & Champy: **collection, input, output**

Johansson et al.: **recipient, linked**

Davenport: **structure, ordering, time, space, begin, end, measurement, ownership, innovation enabling**

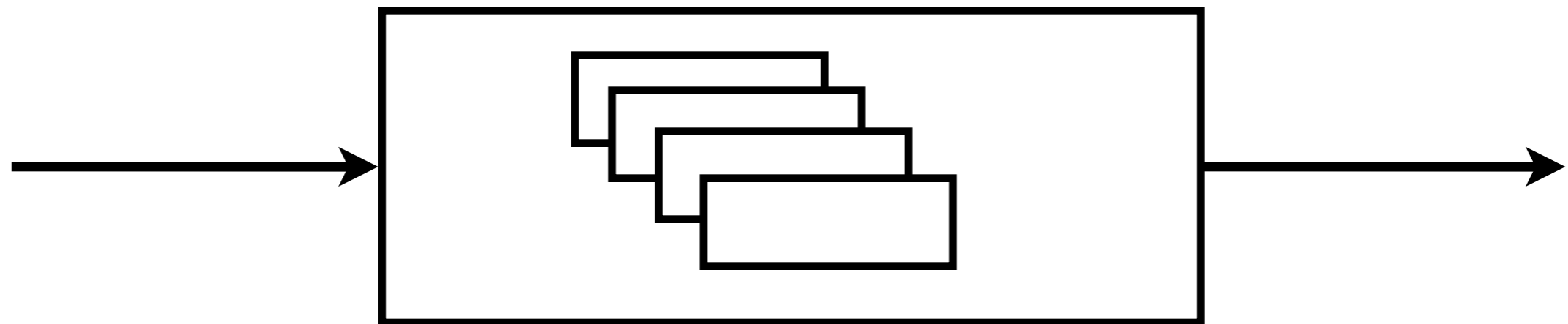*Rummler & Brache:* **production, support, managerial**

Summing up

Definability

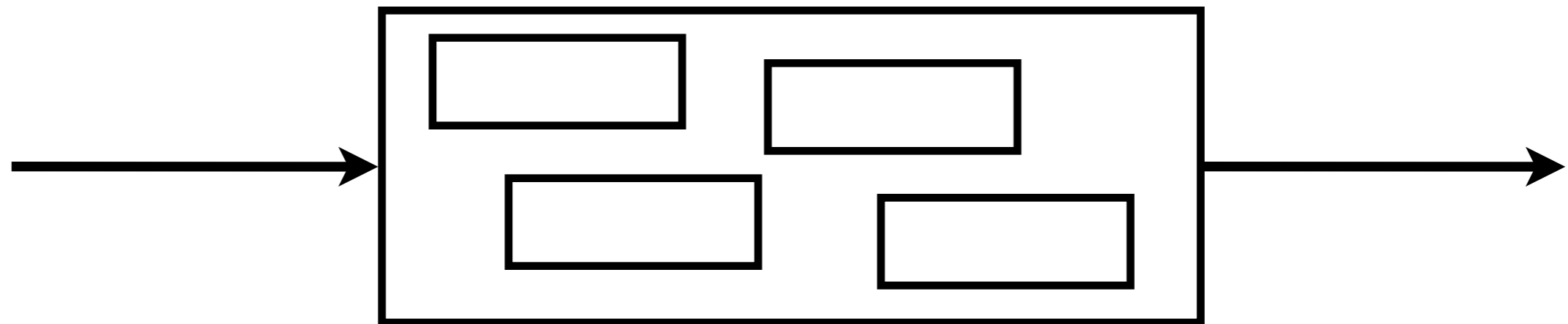Processes must have clearly defined boundaries, input and output

Structured

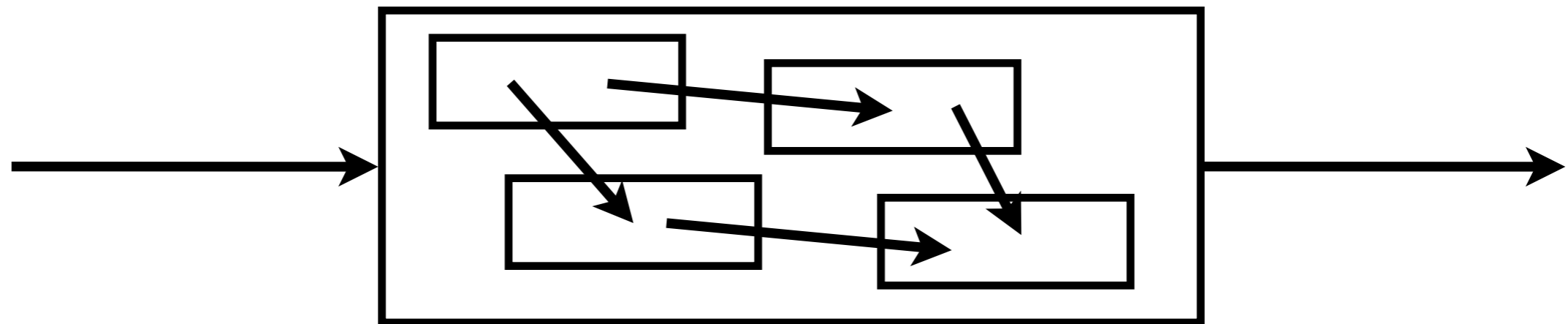Processes wrap up a collection of tasks

Ordered

Process tasks are ordered according to their position in time and space

Linked

Process activities are linked along a value-added chain

Example

$$S = \{a, b, c, d, e, f\}$$

$$a \sqsubseteq b \sqsubseteq d \sqsubseteq f \qquad a \sqsubseteq c \sqsubseteq e \sqsubseteq f \qquad c \sqsubseteq d$$

Which of the following are correct sequences?
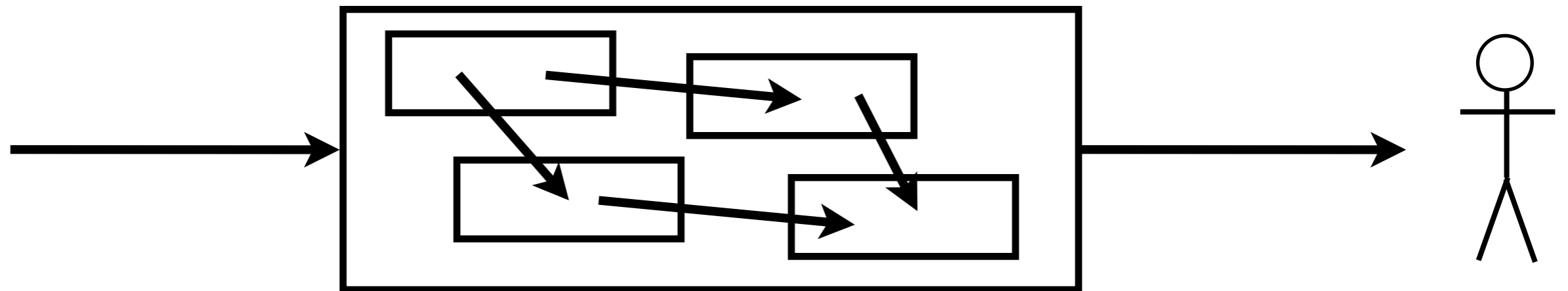
abcdef

abcedf

abdcef
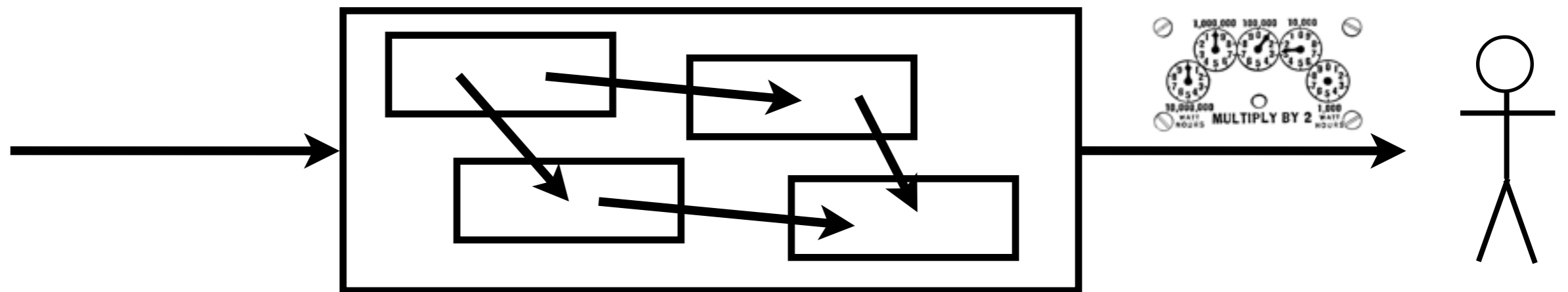
acebdf

acbedf

acefbd

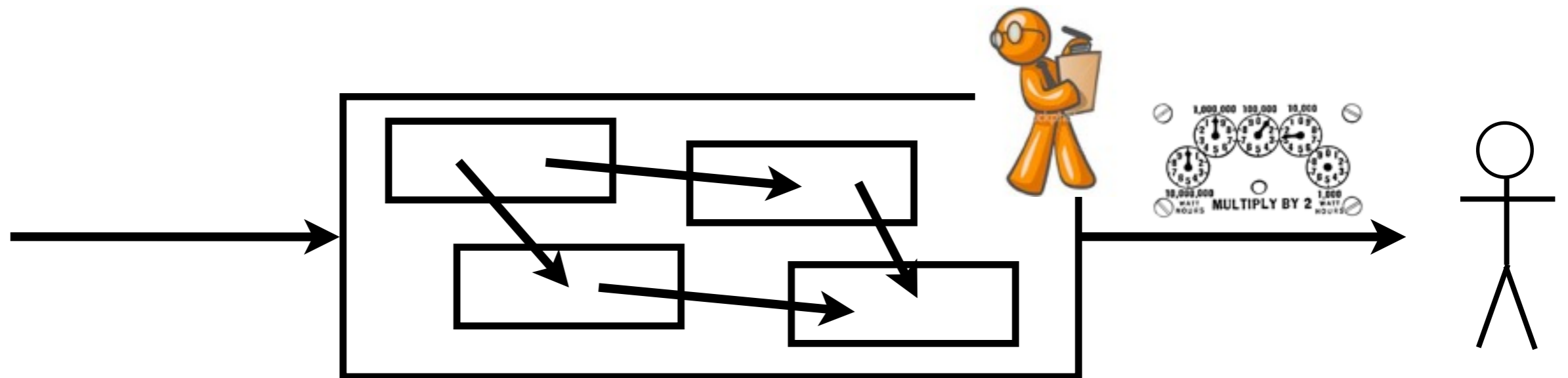# Customer

The process output has a recipient

Measurability
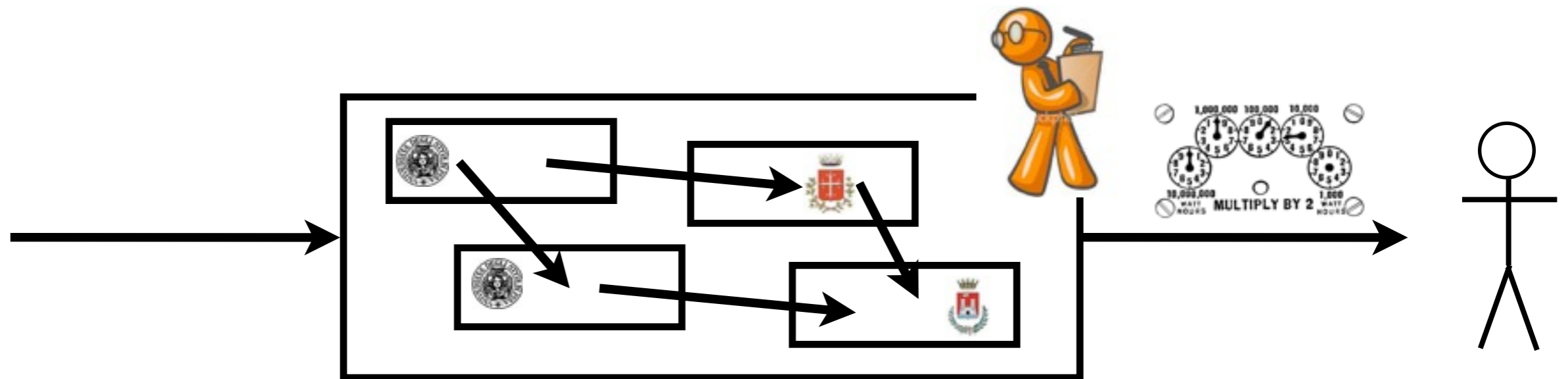
The process output can be evaluated

Ownership

There is one responsible for the performance and continuous improvement of the process

Cross-functionality

A process can span several functions within and across the organizational structure

Issues

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Some definitions

Business process

Definition: a **business process** consists of a set of activities that are performed in coordination in an organizational and technical environment.

These activities jointly realize a business goal.

Each business process is enacted by a single organization, but it may interact with business processes performed by other organizations.

- Weske

Business process management

Definition: **business process management** includes concepts, methods, and techniques to support the design, administration, configuration, enactment, and analysis of business processes.

- Weske

Business process management

The basis of business process management is the **explicit representation** of business processes with their **activities** and the **execution constraints** between them

Business processes can then be subject to **analysis**, **improvement**, and **enactment**

Business process management system

Definition: **business process management system** is a generic software system that is driven by explicit process representations to coordinate the enactment of business processes.

- Weske

Business process model

Definition: **business process model** consists of a set of activity models and execution constraints between them.

- Weske

Business process instance

Definition: **business process instance** represents a concrete case in the operational business of a company, consisting of activity instances.

- Weske

Model and instances

Each activity model acts as a blueprint
for a set of activity instances

Each business process model acts as a blueprint
for a set of business process instances

Abuse of notation

If no confusion is possible,
the term activity is used to refer to
activity models as well as activity instances

Analogously, the term process is used to refer to
business process models
as well as business process instances

Process-driven software

Business process models are the main artifact for implementing business processes

This implementation can be done by organizational rules and policies, but it can also be done by business process management (software) system

In this case the software system is driven by explicit process representations (models)

Process representations

Visual representations: diagrams and charts
understandable by humans
(few conventions, intuitive, BPMN, EPC, BPEL)

Languages: precise syntax
understandable by machines
(process dialects, XML schemes)

Models: precise semantics
understandable by scientists
(automata, Petri nets, workflow nets, YAWL)

Narrowing the gap

Organizational business aspects

Information technology

Reference framework

Fix the business management context
(organization)

Model and analyze processes

Process management systems
(IT support)