Business Processes Modelling

MPB (6 cfu, 295AA)

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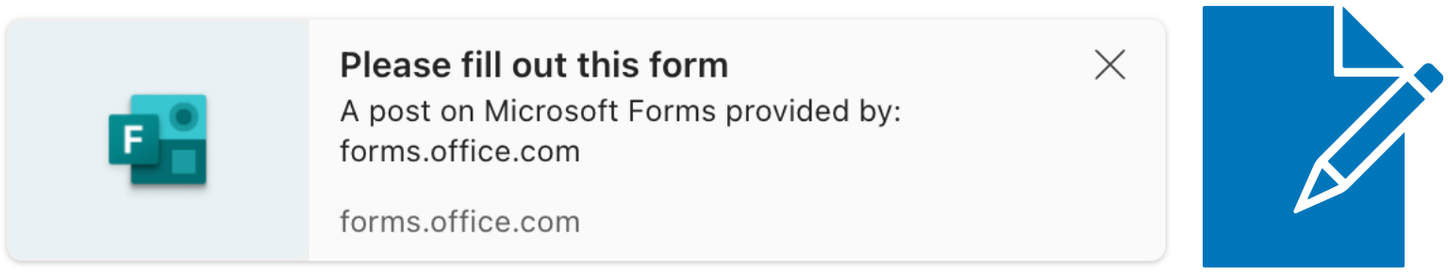
http://www.di.unipi.it/~bruni

02 - Business processes

Memo: Who are you?



Background check (form)

Enrollment number: 123456

Bachelor degree: Comp. Sci., Pisa, IT

MSc course of enrollment: Data Science and BI

Subjects of interest: Data analysis, AI

... :

Only 26 forms filled so far... please do it now

Let’s start

Terminology

Terminology

Generic terms, widely applicable to different working situations and companies

We fix preferred terms when possible, but allow synonyms interchangeably

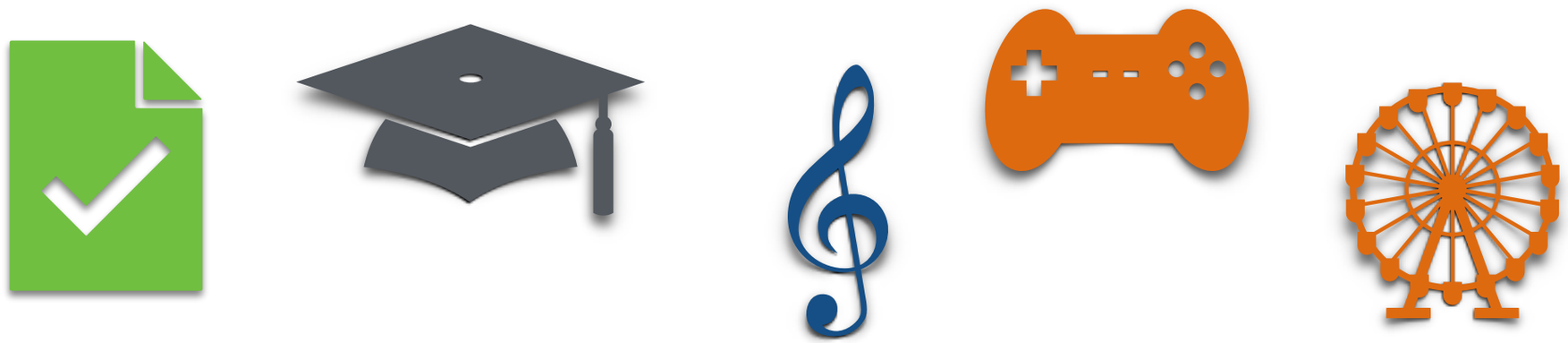
Ch.1 of Workflow Management: Models, Methods, and Systems
Ch.1 of Business Process Management: Concepts, Languages, Architectures

Process Orientation

Products and services

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

Immaterial products (**services**) are also frequent
(e.g., credit approval, knowledge, entertainment)



Work

All products are the outcome of some **work:**
a specific task, duty, function, or assignment
often being a part of some larger activity

Market

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

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

We buy products we cannot make ourselves

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

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

Association game

As of August 2025, here are the actual best selling products on A###n based on daily sales volume. These represent the most popular and highest-selling items across all categories:

1. 31,247 daily units	Anker PowerCore 10000 (power bank)
2. 28,932 daily units	Apple AirPods Pro (2nd Gen)
3. 24,183 daily units	CeraVe Daily Moisturizing Lotion
4. 21,800 daily units	Echo Dot (5th Gen)
5.19,847 daily units	Fire TV Stick 4K Max
6. 23,400 daily units	Hanes Men’s EcoSmart Hoodie
7. 21,200 daily units	Instant Pot Duo 7-in-1 (multicooker)
8. 22,100 daily units	Kindle Paperwhite
9. 19,800 daily units	Ninja AF101 Air Fryer
10. 20,500 daily units	The Ordinary Hyaluronic Acid

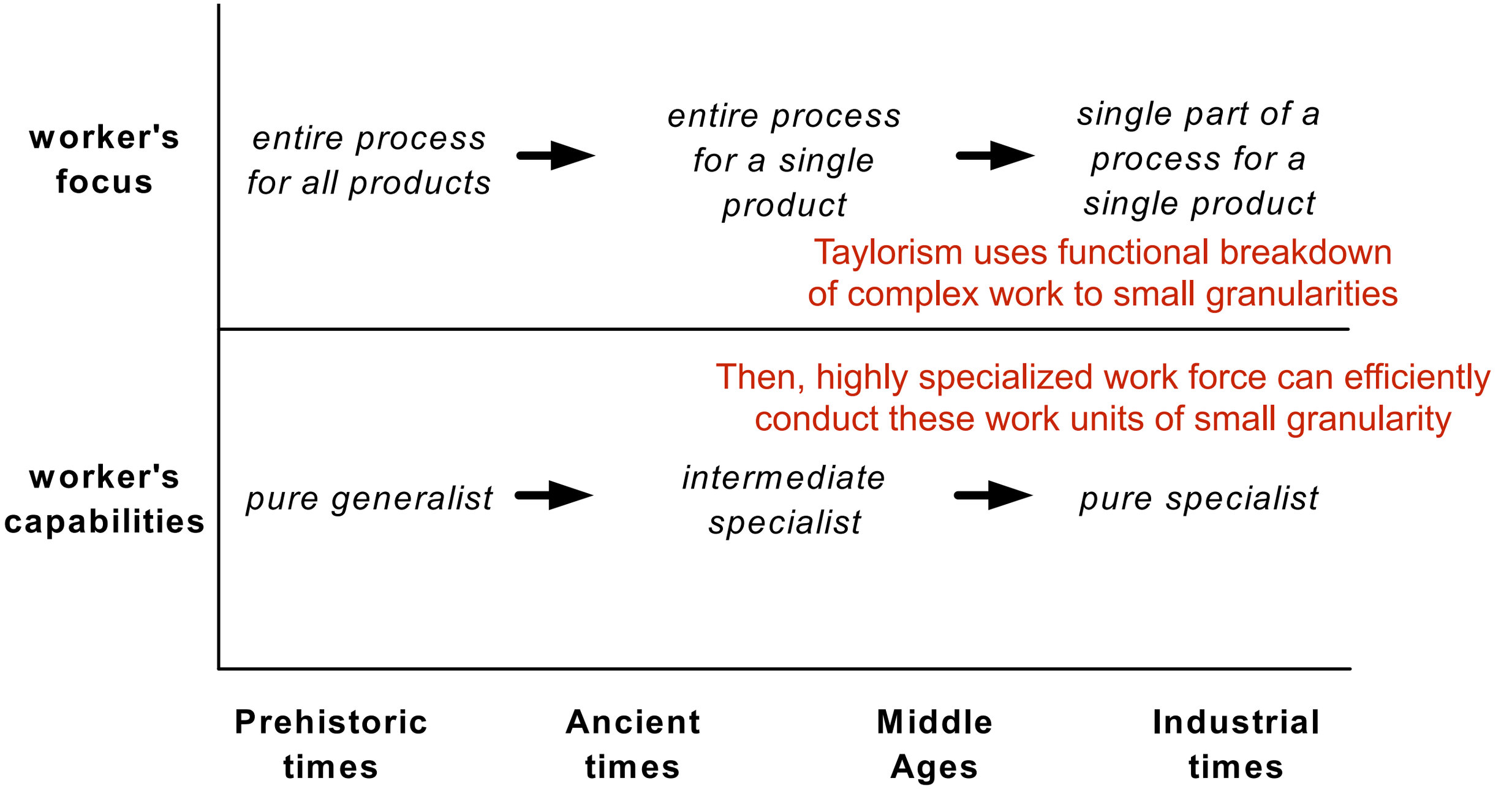
Work units

People organize specialized **work units**
(limited range of products, highly efficient)

Relatively autonomous divisions:
they know how to do some specific product
or how to provide some specific service

Process orientation is based on a critical analysis
of a concept to organize work units originally
introduced by Frederick Taylor (1856-1915)

Road to Taylorism



Taylorism

Aim: to improve industrial efficiency

by analysing work, the "one best way" to do it would be found (time and motion study)

Distinction between mental (planning work) and manual labor (executing work)

Detailed plans, specifying the job and how it was to be done, were to be formulated by **management** and communicated to the **workers**

Handovers

Taylorism has proved successful in manufacturing and fuelled the industrial revolution
(assembly lines)

Fine-grained activities require many **handovers** of work in order to process a given task

Until early nineteenth century the products were typically assembled in a few steps only, so handovers were not introducing much delays

Moreover, tasks were of simple nature and did not require any context information on previously conducted steps

Pitfall of Taylorism

Plain functional breakdown is not efficient in business organizations that process **information** and **immaterial data**

Steps of a business process are often related to each other

Context information on the whole case is required during the process

The handovers of work cause a major problem because of that
(workers require knowledge)

Process Orientation

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

In large companies, high degree of specialization causes the big picture to be lost by employees
(why do they have to do the things they are told to do?)

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

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

Not only process orientation serves to capture the activities a company performs, but also to **study** and **improve** the **connections** between activities

Process perspective

It is instrumental to **combine** multiple units of work of small granularity into work units of larger granularity to reduce the handover of work

As a consequence, workers must have broader skills and competencies
(knowledge workers must have a broad understanding of the ultimate goal of their work)

Main effect, at the organizational level, process orientation is best achieved using a **matrix organizational structure**

Organizational Structures

Organizational structure

Each resource has the ability to carry out particular tasks and each task can be performed only by certain resources
(e.g., bank tellers are not allowed to grant mortgages)

In a process we can indicate:
which tasks need to be performed,
the order in which they must be carried out,
who should do them

The way in which work items are allocated to resources (people, machines) is very important to the efficiency and effectiveness of the workflow

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

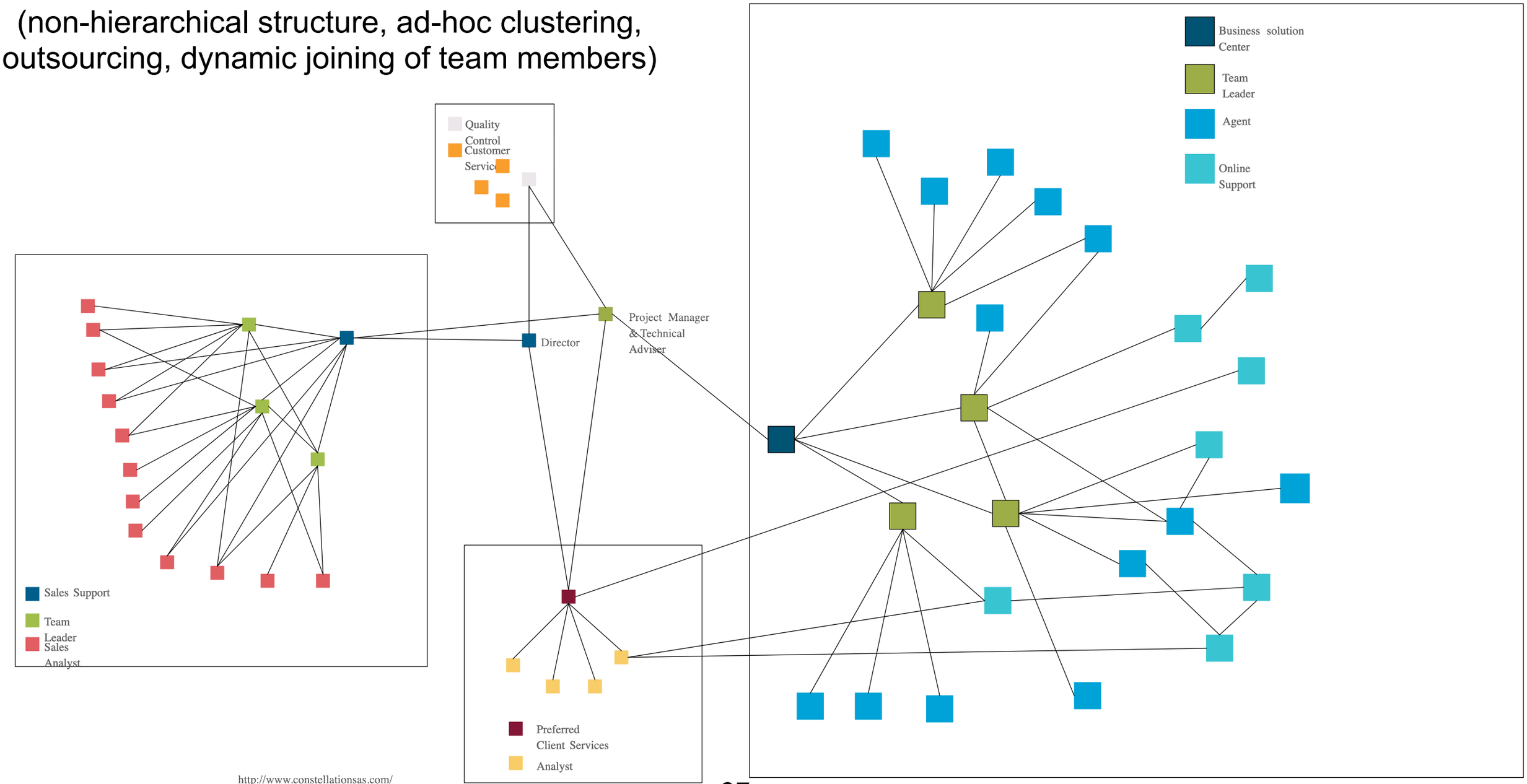
Classification criteria can involve:
functions: functional properties and skills;
roles: position in the organization (like groups or work units)

A single resource can fulfil several roles, at the same time or at different times

Network structure

Network: autonomous actors collaborate
to supply products or services

(non-hierarchical structure, ad-hoc clustering,
outsourcing, dynamic joining of team members)



http://www.constellationsas.com/

Hierarchical structure

Hierarchical: structured as a tree

…

what is a “tree”?

We have seen the notion of a graph (vertices + edges)

tree: a graph such that any two vertices are connected by **exactly one path**

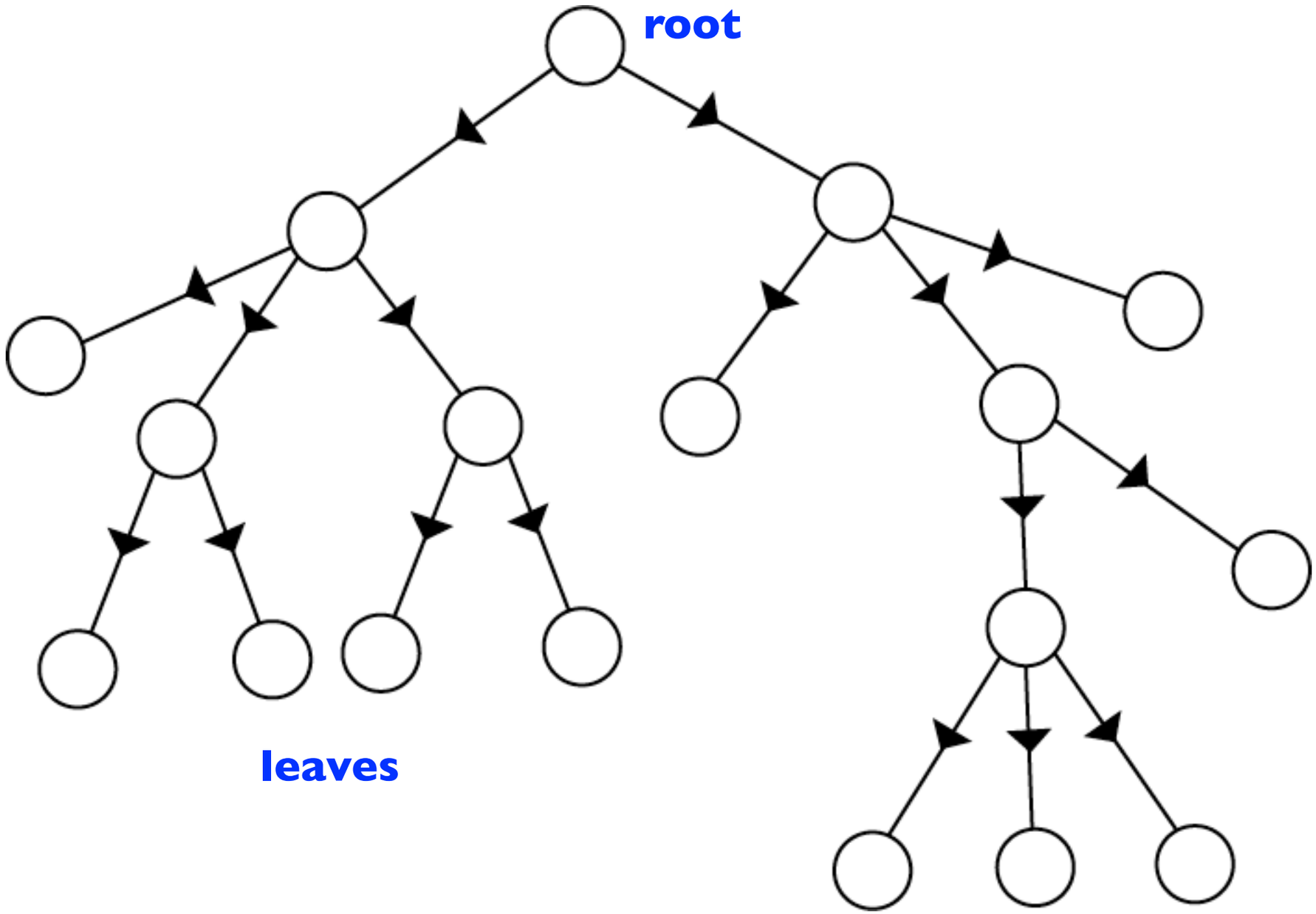
or equivalently

tree: a connected acyclic graph

leaf: a vertex of degree 1

rooted tree: a tree with one distinguished vertex (the **root**)
its edges can be implicitly oriented away from the root

A rooted tree

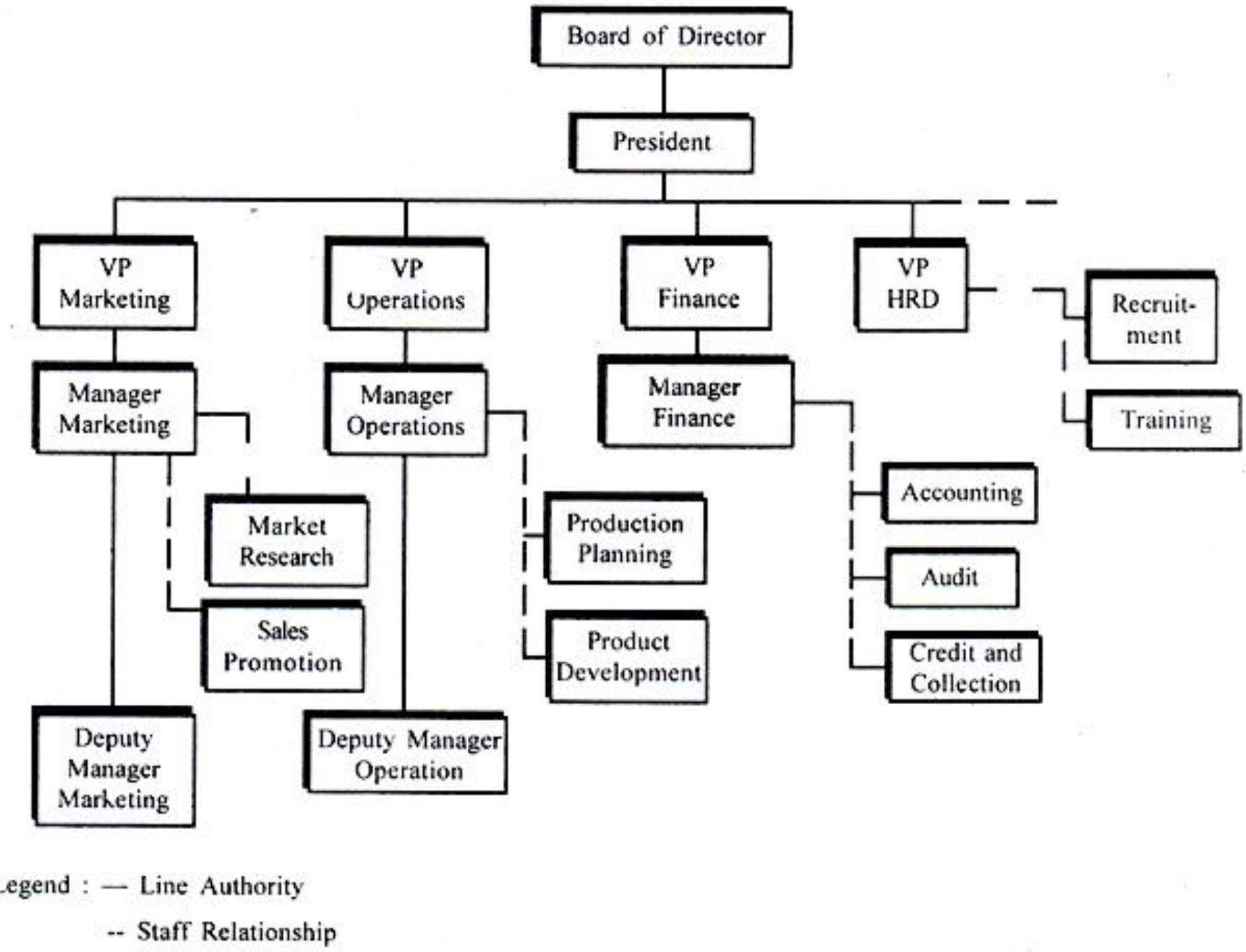


Hierarchical structure

Hierarchical: tree structure,

- internal nodes are individual roles/ functions,
- leaves are staff or departments,
- branches are authority relationships

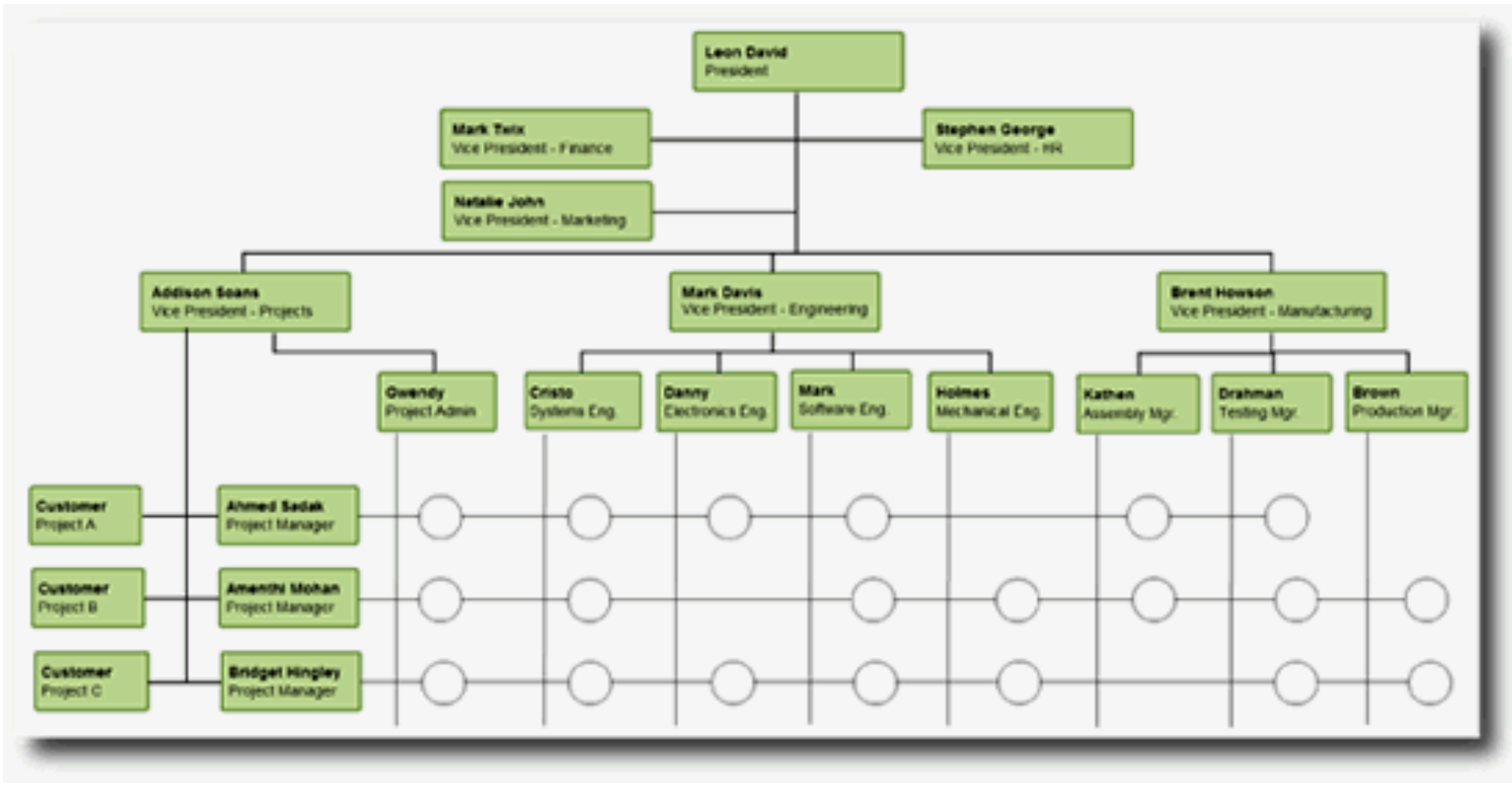
Also called organization chart



Matrix structure

Matrix:
join hierarchical and (dynamic) functional dimension:
one row for each process

(each person can have one or more functional bosses, known as **project leaders**)



Actors

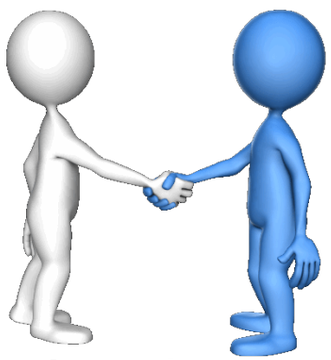
Principal and Contractors

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

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

Assignments ordered by bosses are often related to work for customers

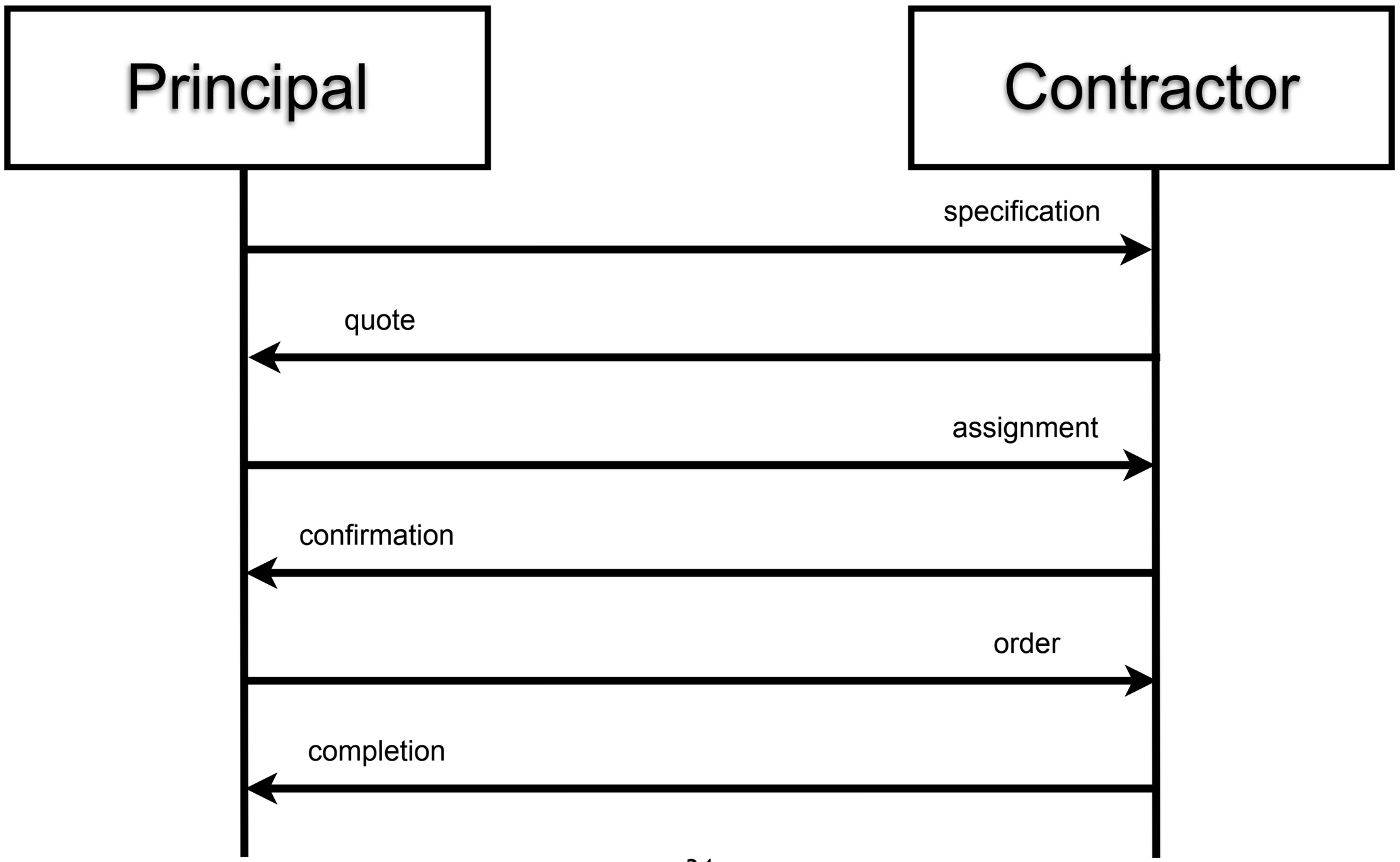
A person who is assigned a task is called **contractor** (assignments can be carried out by machines and computer applications as well as people)



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

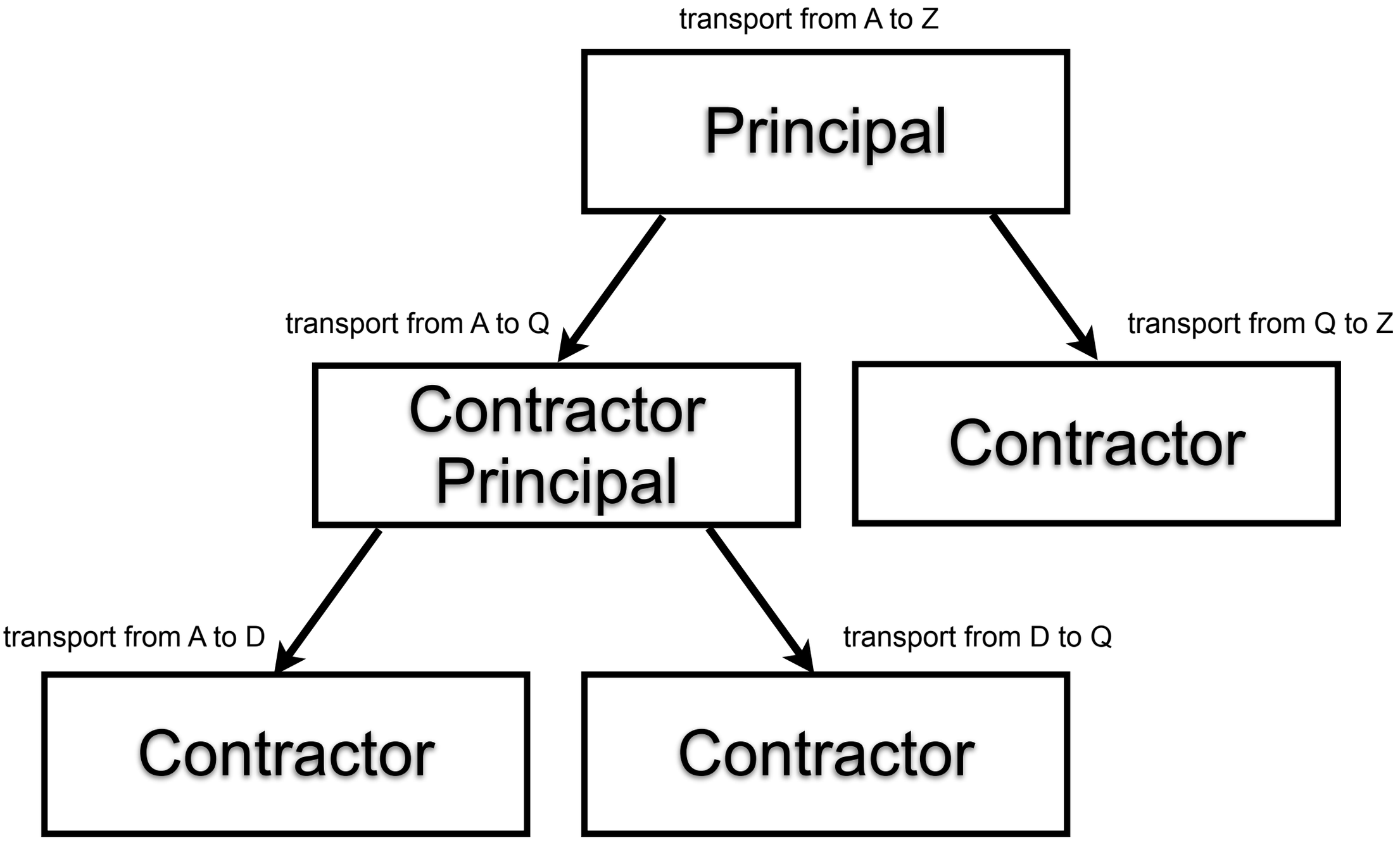
Protocol example



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 tree example



Cases and Procedures

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**:
often 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?

Resource

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

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)

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)
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6. Top it
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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

(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

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:
task execution can be highly dependent on cases

Process Orientation

What BPs are about

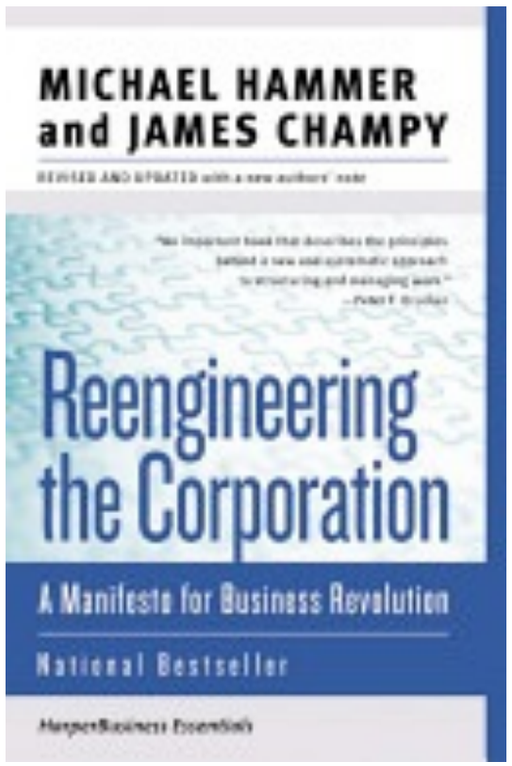
Each **product** that a company provides to the market
is the outcome of a number of **tasks** to be performed

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

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

Business process reengineering is based on the
understanding that **rapid, radical redesign of business processes can be the road to success**

Process orientation roots (1990's)



Seminal book advocating
the radical redesign of the business
process of a company
(as opposed to evolutionary improvements)

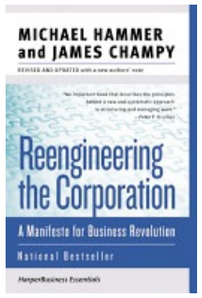
A **business process** is a **collection of activities**
that take one or more kinds of **input** and
create an **output** that is of value to the customer

- 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**)

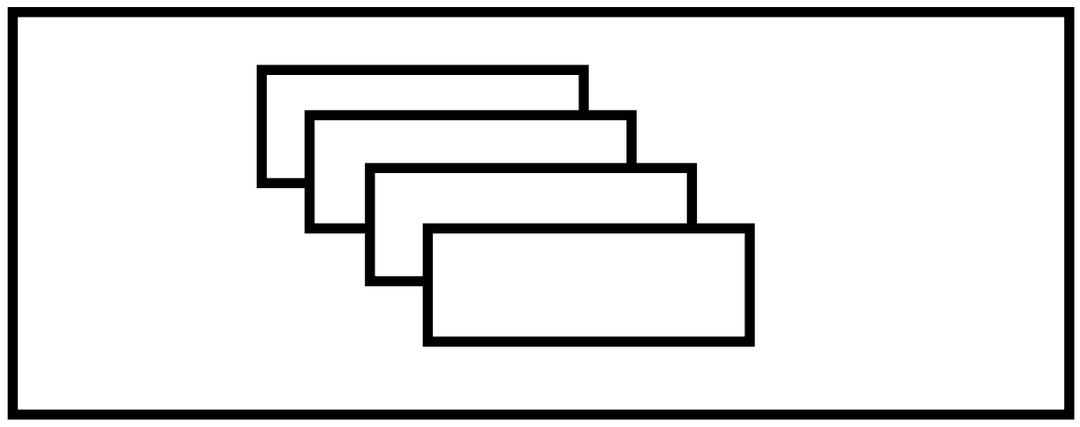
Keywords



collection, input, output

Collection

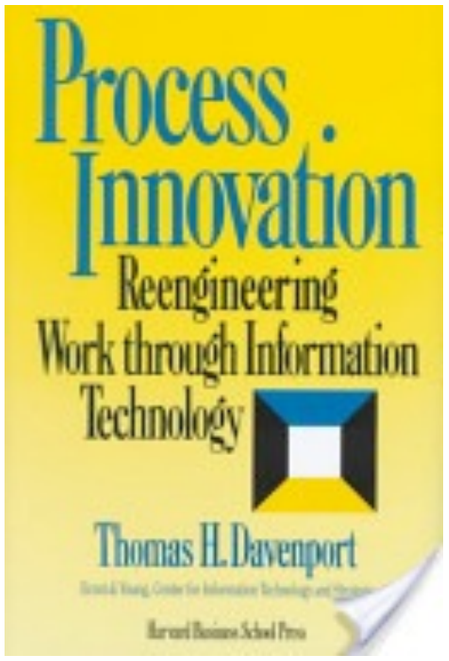
Processes wrap up a collection of tasks



Definability

Processes must have clearly defined boundaries, input and output

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**.

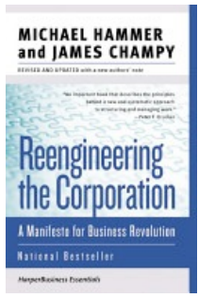
- Davenport (1993)

More from Davenport

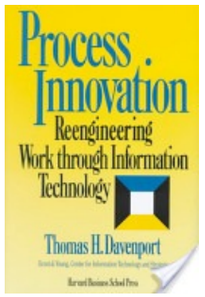
Unless designers or participants can agree on the way work is and should be **structured**, it will be very difficult to systematically improve, or effect innovation in, that work

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

Keywords



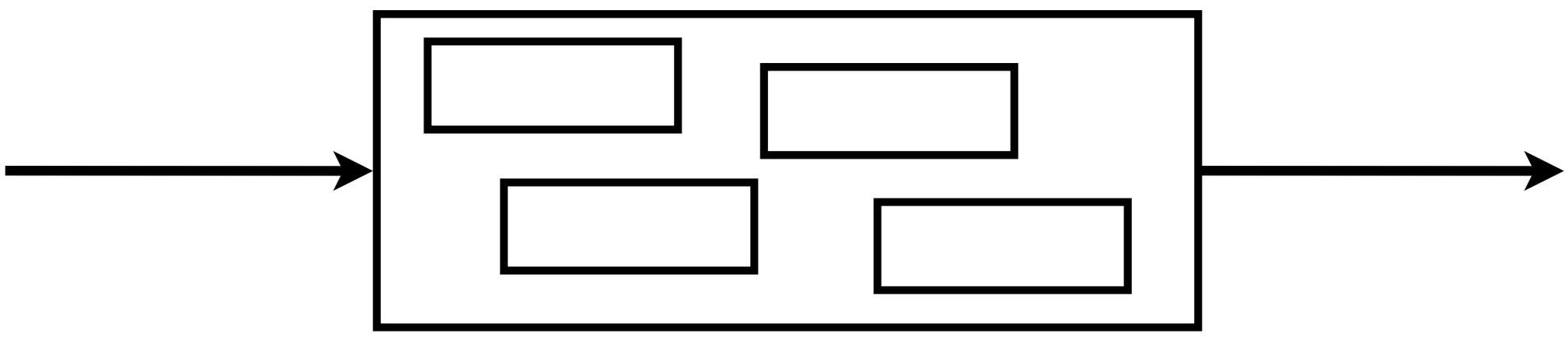
collection, input, output



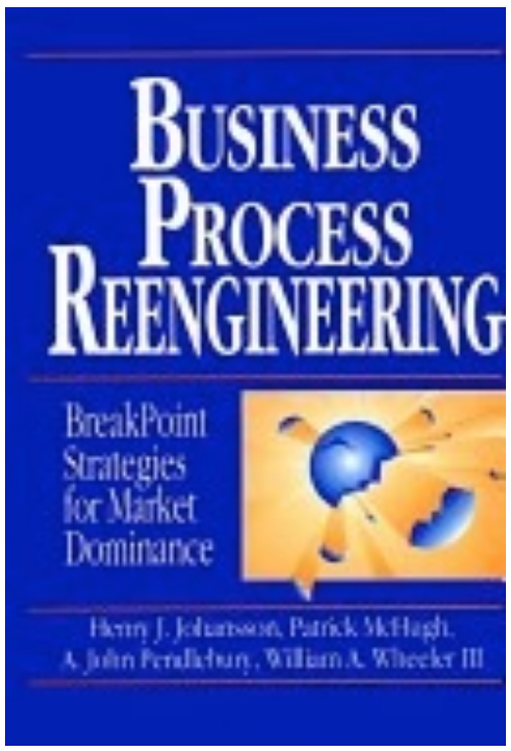
structure, ordering, time, space, begin, end

Ordered

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



Process orientation roots (1990's)

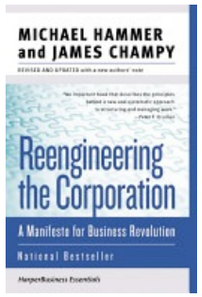


The transformation that occurs in the process should add value to the input and create an output that is more useful and effective to the **recipient**

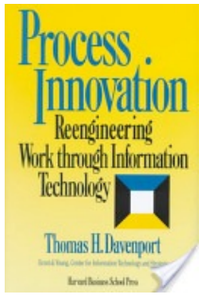
A process is a set of **linked** activities that take an input and transform it to create an output.

- Johansson et al. (1993)

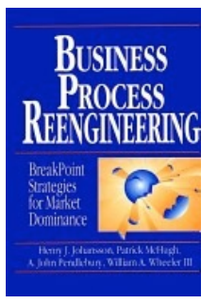
Keywords



collection, input, output



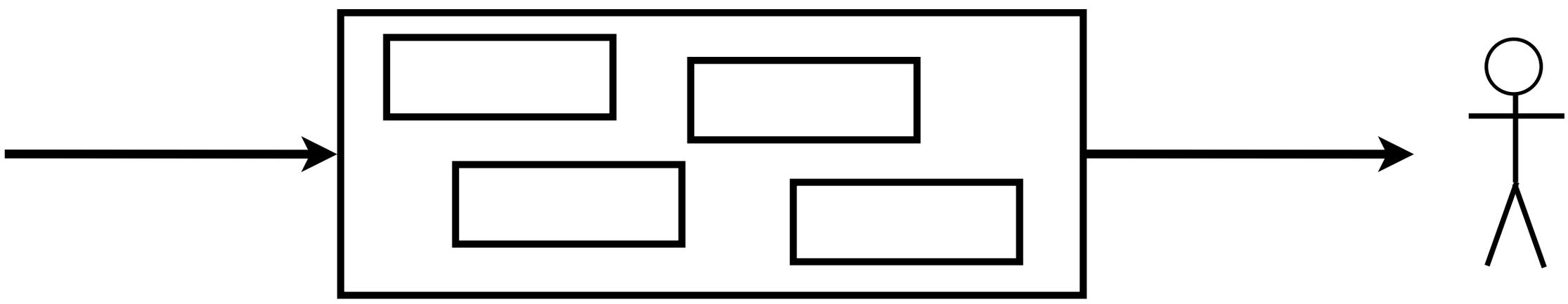
structure, ordering, time, space, begin, end



recipient, linked

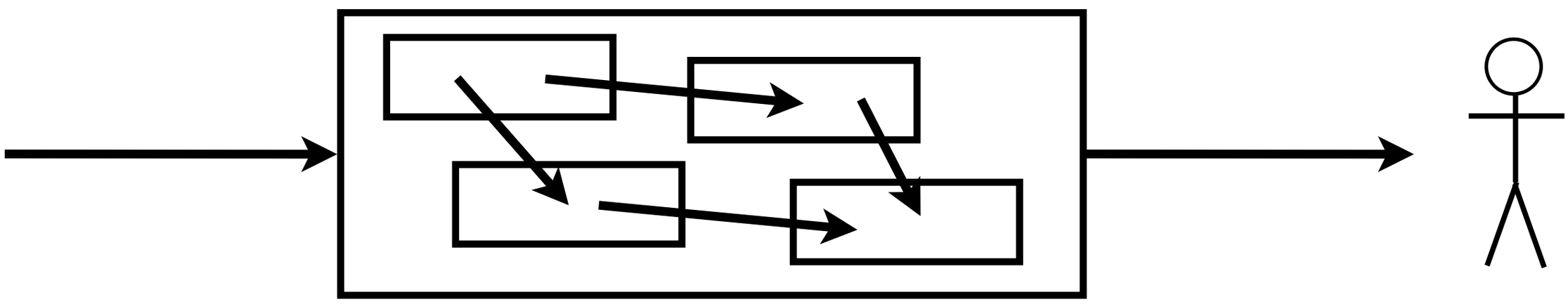
Customer

The process output has a recipient



Linked

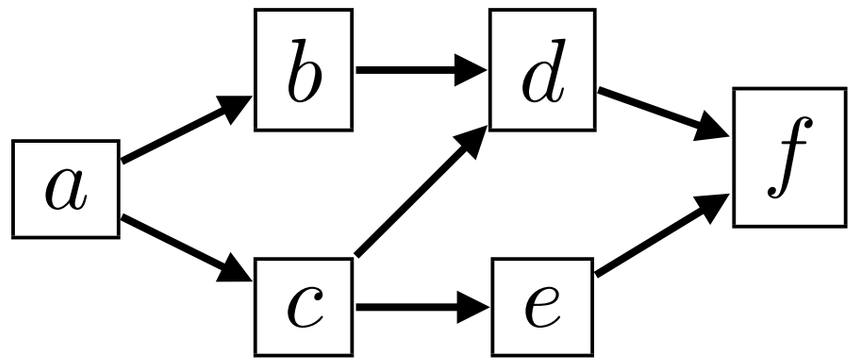
Process activities are linked along a value-added chain (order of execution)



Example

a set of tasks

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



a precedence relation $\prec$

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

Which of the following are correct execution traces?

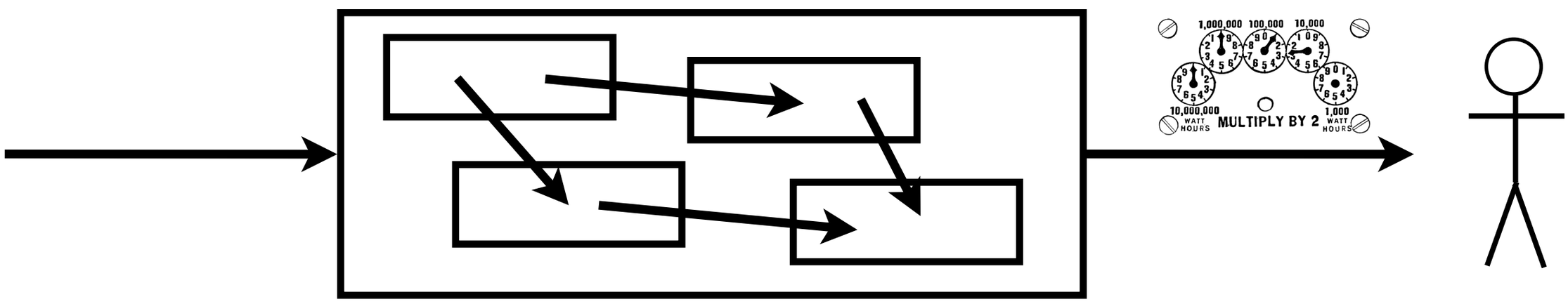
$a\,b\,c\,d\,e\,f$ $a\,b\,c\,e\,d\,f$ $a\,b\,d\,c\,e\,f$

$a\,c\,e\,b\,d\,f$ $a\,c\,b\,e\,d\,f$ $a\,c\,e\,f\,b\,d$

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



More from Davenport

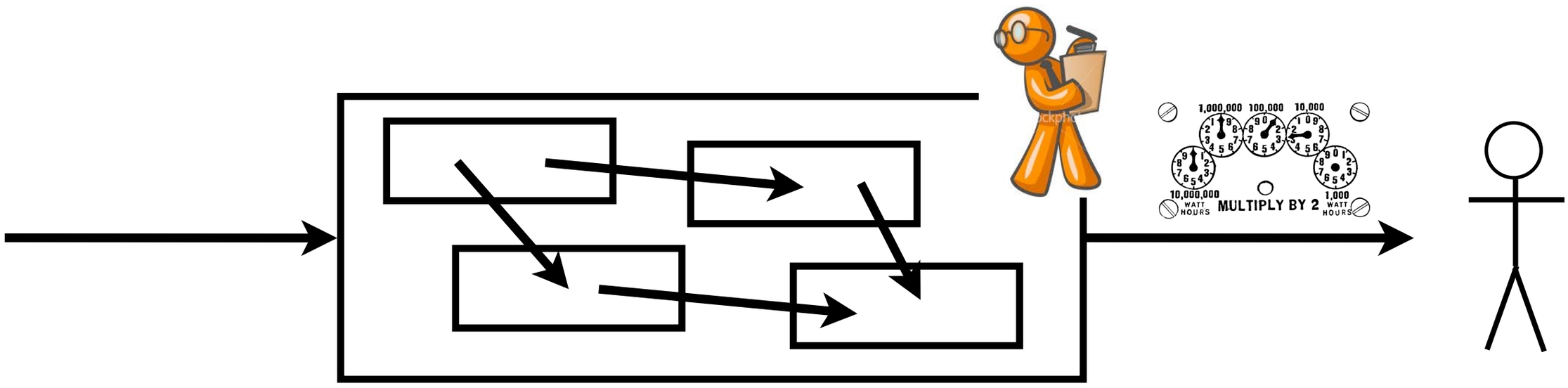
Processes also need clearly defined **owners** to be responsible for design and execution.

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

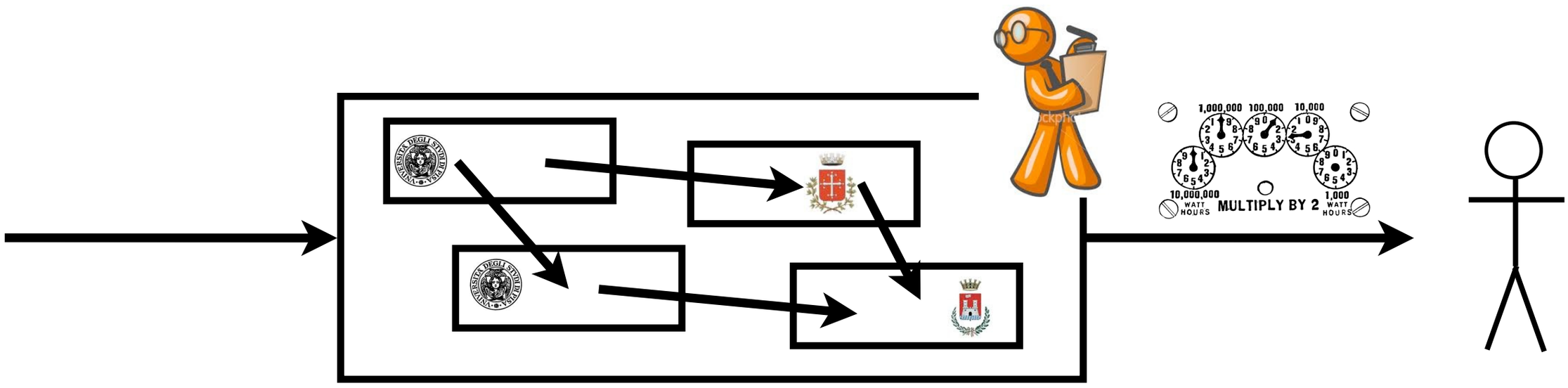
Ownership

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

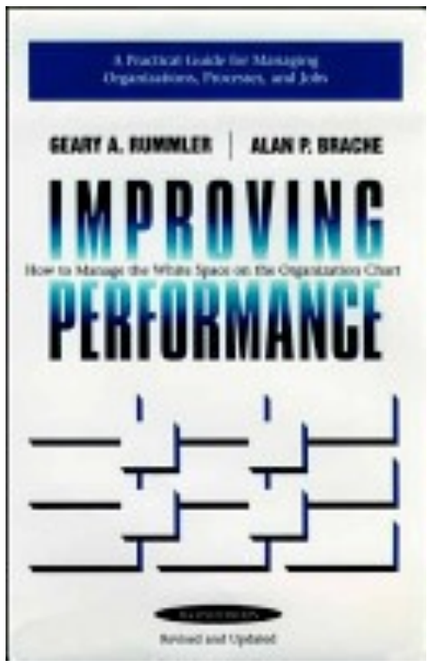


Cross-functionality

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



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

Standardization

The need of standard

Organizational business aspects

Information technology

Diagrammatic notation

Visual languages offer an important communication mean (intuitive, universal, immediate, non-technical, no / little prior knowledge required)

Natural choice: nodes and arrows (oriented graphs)

Standard

A predefined (small) set of shapes and lines
with non-ambiguous meaning

different colors, borders, symbols can be
used to assign different meaning
or add some information

e.g., different arrows for different dependencies

Important concept:
start, end, task, link, order, ownership, responsibility

Exercise

Invent your own diagrammatic notation
to describe the following interaction protocol
(choose symbols, shapes, colours carefully)

Alice wants to sell her car, Bob is interested in buying it.
Alice asks some quote.
Bob can accept the bargain, refuse it or make a counteroffer.
Alice can accept or make a counteroffer and so on,
Until either the bargain is accepted or refused.

Send your solutions to: `bruni@di.unipi.it`