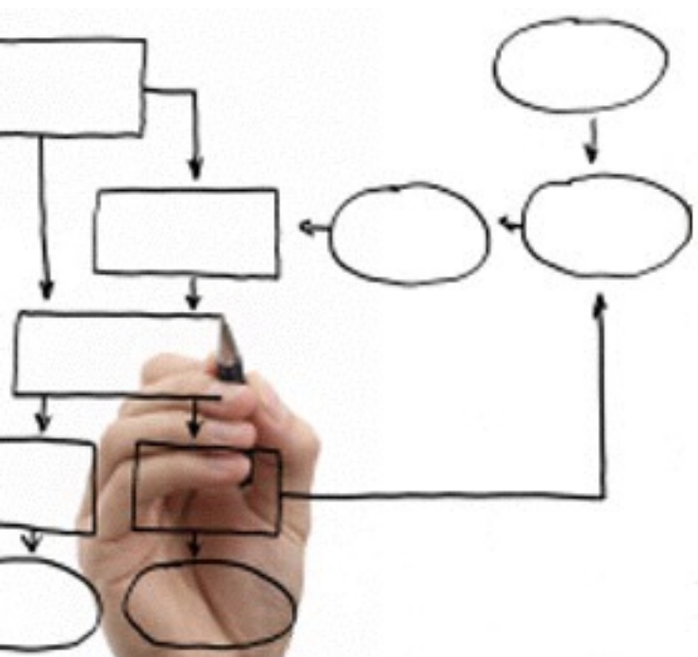
Methods for the specification and verification of business processes

MPB (6 cfu, 295AA)

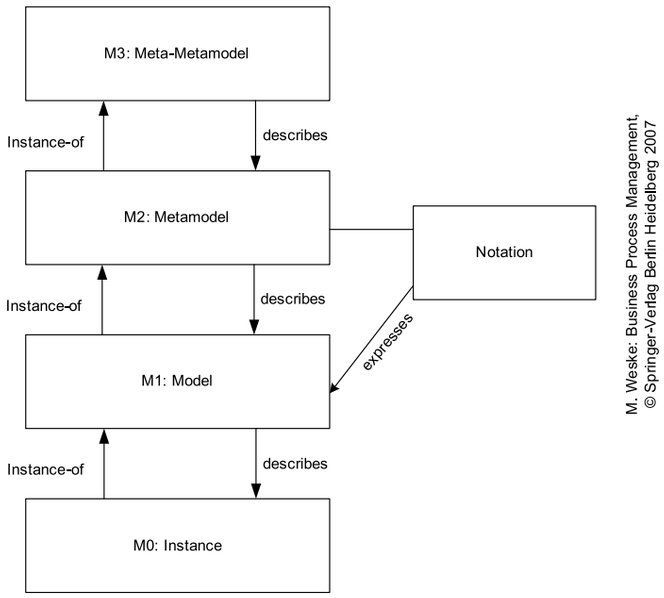


Roberto Bruni

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

04 - Models and Abstraction

Object



Overview of the conceptual models and abstraction mechanisms in business process modeling

Ch.3.1--3.3 of Business Process Management: Concepts, Languages, Architectures

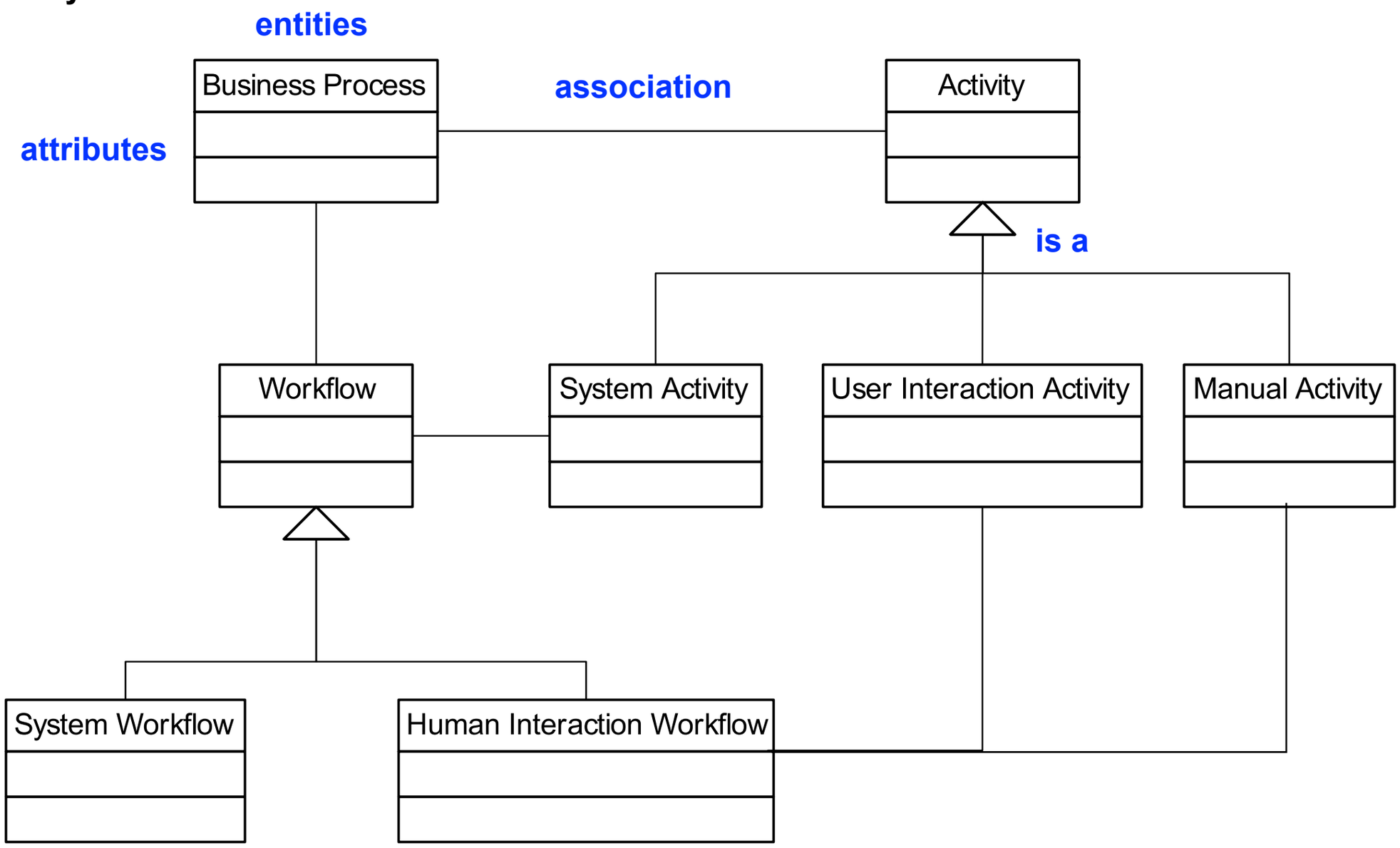
Model

A model is a simplified representation of reality

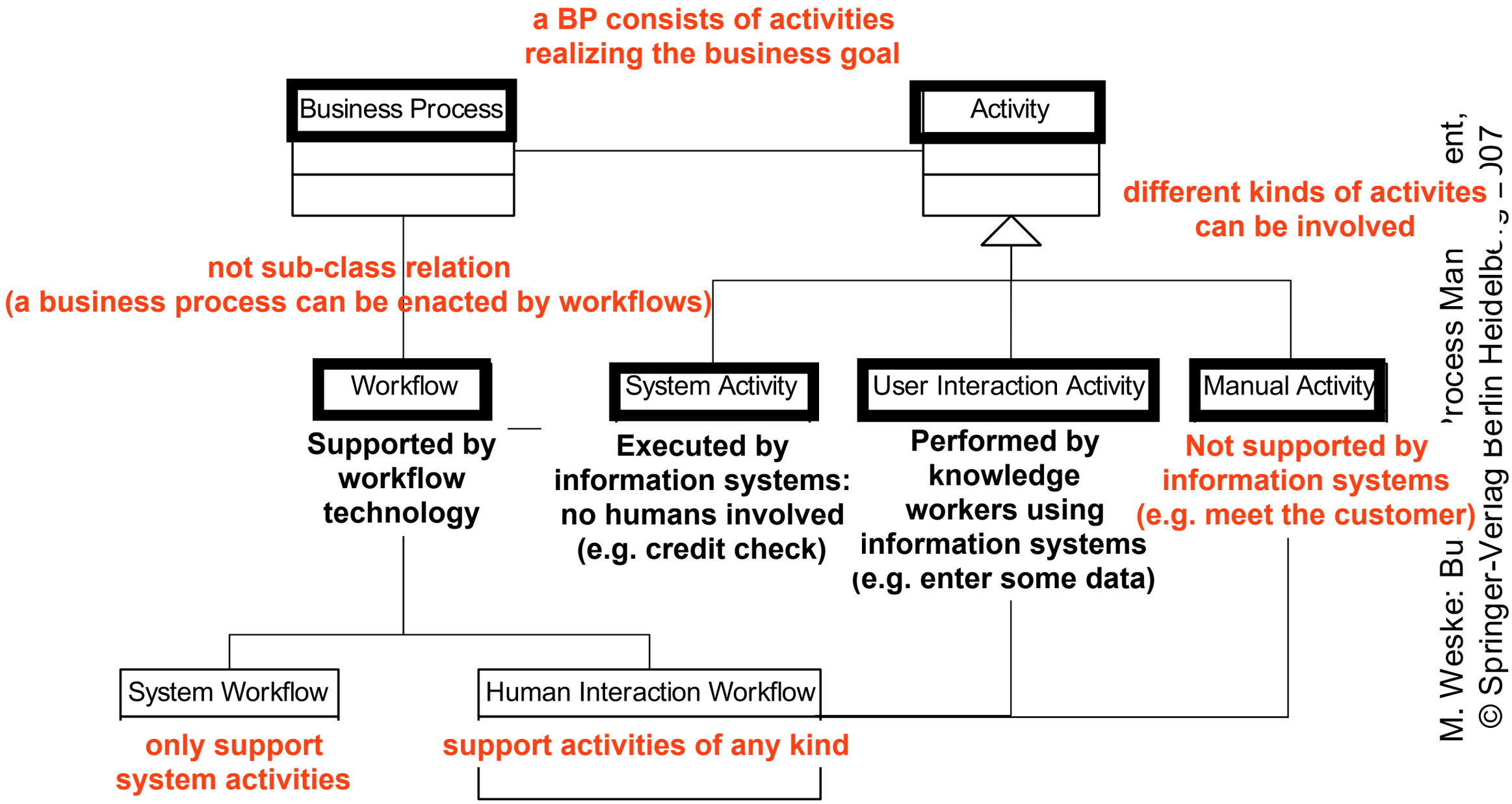
"Essentially all models are wrong,
but some are useful"
(George P. Box)

Conceptual model of business processes

UML-like syntax



Conceptual model of business processes



Workflow management

Needs of:

Explicit representation of process structures in process models

Controlled enactment of business processes according to these models

Workflow management coalition (WfMC)

Founded in the ‘90s by vendors, users, academia: fix standard for Wf representation and execution

http://www.wfmc.org

Workflow

Definition: a **workflow** is the automation of a business process, in whole or in part,

during which documents, information, or tasks are passed from one participant to another for action,

according to a set of procedural rules

Workflow Management Coalition

WfMC

Workflow management system

Definition: a **workflow management system**
is a software system
that defines, creates, and manages Wfs execution,
running on one or more workflow engines,
able to interpret the workflow definition,
able to interact with workflow participants, and
able to invoke the use of IT tools and applications

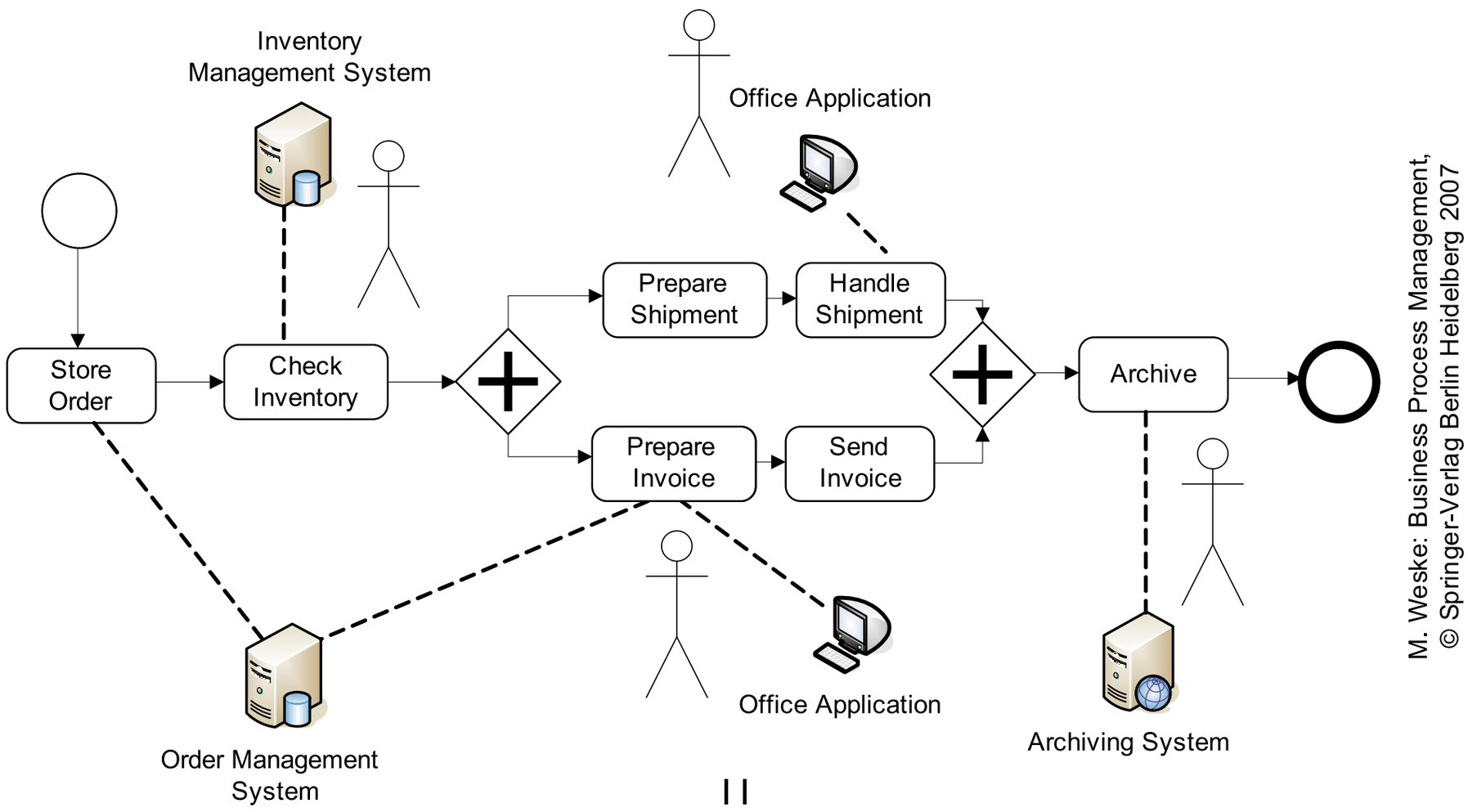
Workflow Management Coalition
WfMC

System workflow

Definition: a **system workflow** consists of activities that are implemented by software systems without any user involvement

Human interaction workflow

Definition: Workflows in which humans are actively involved and interact with information systems are called **human interaction workflows**.



Human interaction workflows

Goal:
support automation by driving the human activities according to the process model

Benefits:
reduce idle periods
avoid redundant work
improve human/machine work integration

Human collaboration

When task performed by humans are involved in the workflow, it is not sufficient to equip workers with adequate software:

their collaboration must be supported

shared data repositories and work handover can speed-up office procedure considerably

Concepts in human interaction workflow

Roles = groups of employees that qualify for being responsible of certain activities.
Increased flexibility: different persons can cover the same role at different time in different cases

Work item list (also called **in-basket**) =
when an item is selected
the respective application is started;
when completed
the knowledge worker informs the workflow engine

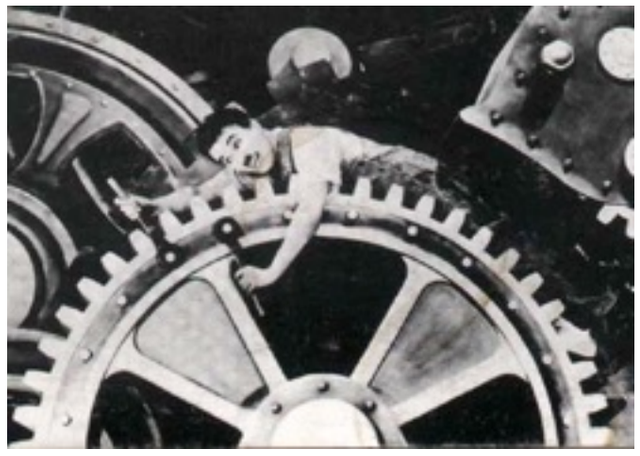
Some limitations

Problems with knowledge workers:

User acceptance issues

Machine burdening of workers

Little room for creativity and flexibility



Abstraction

To derive general rules and concepts
from specific examples of some phenomenon,
by selecting only the aspects which are relevant
for a particular purpose

A way to cope with complexity

Guiding principle

Separation of Concerns (SoC)
(to separate a system into distinct features that overlap in functionality as little as possible)

E. W. Dijkstra Archive

the manuscripts of

Edsger W. Dijkstra

1930–2002

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(photo ©2002 *Hamilton Richards*)

Edsger Wybe Dijkstra was one of the most influential members of computing science's founding generation. Among the domains in which his scientific contributions are fundamental are

- algorithm design
- programming languages
- program design
- operating systems
- distributed processing
- formal specification and verification
- design of mathematical arguments

In addition, Dijkstra was intensely interested in teaching, and in the relationships between academic computing science and the software industry.

http://www.cs.utexas.edu/users/EWD/

On the role of scientific thought (EWD447)

Let me try to explain to you, what to my taste is ***characteristic for all intelligent thinking****.*

It is, that one is willing to study in depth an aspect of one's subject matter ***in isolation for the sake of its own consistency****, all the time knowing that one is occupying oneself only with one of the aspects.*

On the role of scientific thought (EWD447)

...
*We know that a program must be **correct** and we can study it from that viewpoint only;*
*we also know that it should be **efficient** and we can study its efficiency on another day, so to speak.*
*In another mood we may ask ourselves whether, and if so: why, the program is **desirable**.*

But nothing is gained —on the contrary!— by tackling these various aspects simultaneously.

On the role of scientific thought (EWD447)

...
It is what I sometimes have called ***"the separation of concerns"****, which, even if not perfectly possible, is yet the only available technique for effective ordering of one's thoughts, that I know of.*

...
it does not mean ignoring the other aspects, it is just doing justice to the fact that
from this aspect's point of view, the other is irrelevant.

On the role of scientific thought (EWD447)

Business data processing systems are sufficiently complicated to require such a separation of concerns and the suggestion that in that part of the computing world "scientific thought is a non-applicable luxury" puts the cart before the horse: the mess they are in has been caused by ***too much unscientific thought****....*

SoC: an example

HyperText Markup Language (HTML):
organization of webpage content

Cascading Style Sheets (CSS):
definition of content presentation style

JavaScript (JS):
user interactions

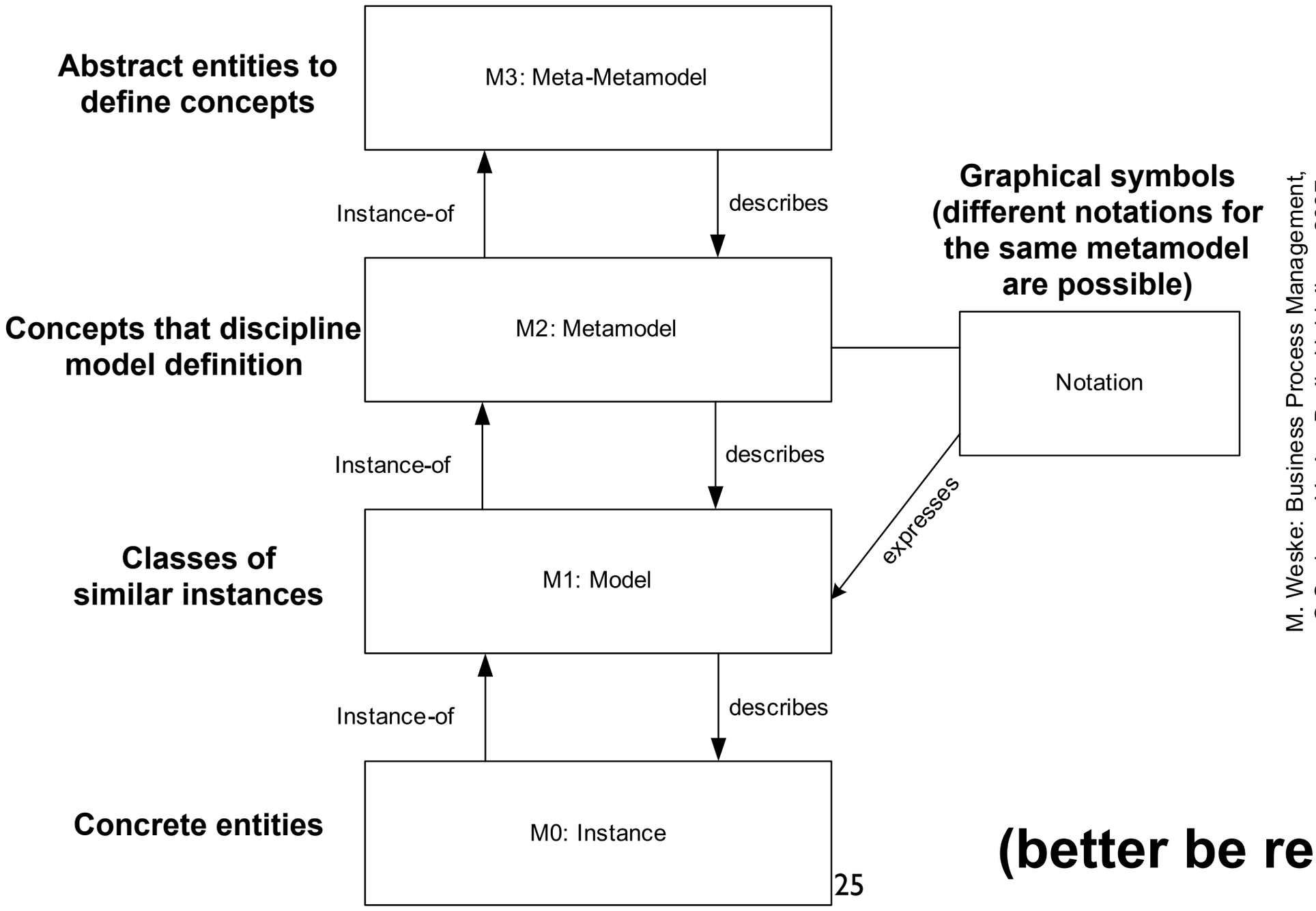
Abstractions

Horizontal: separation at different modeling levels

Aggregation: separation at different granularity levels

Vertical: separation at different subdomains

Horizontal abstraction (modeling levels)



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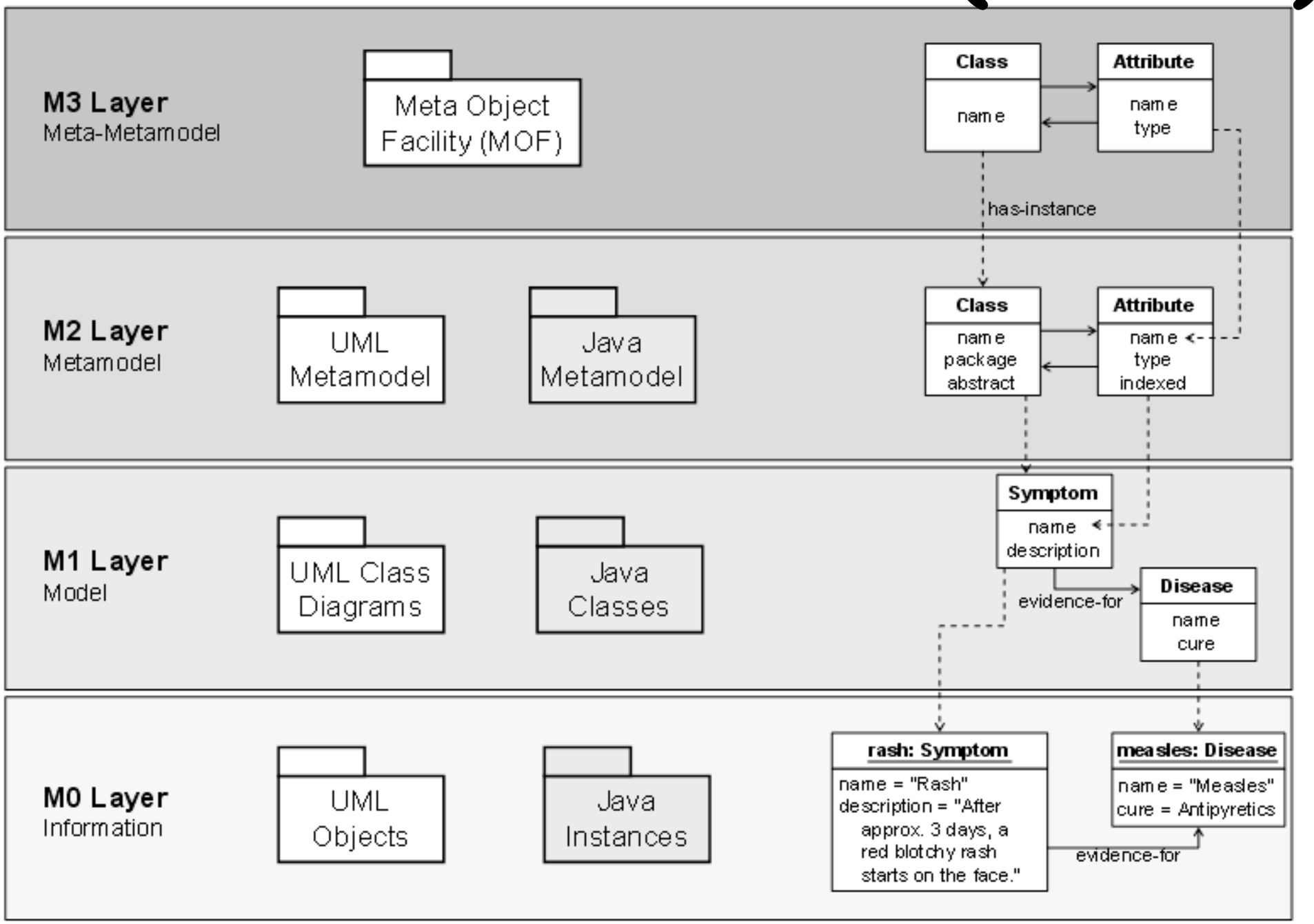
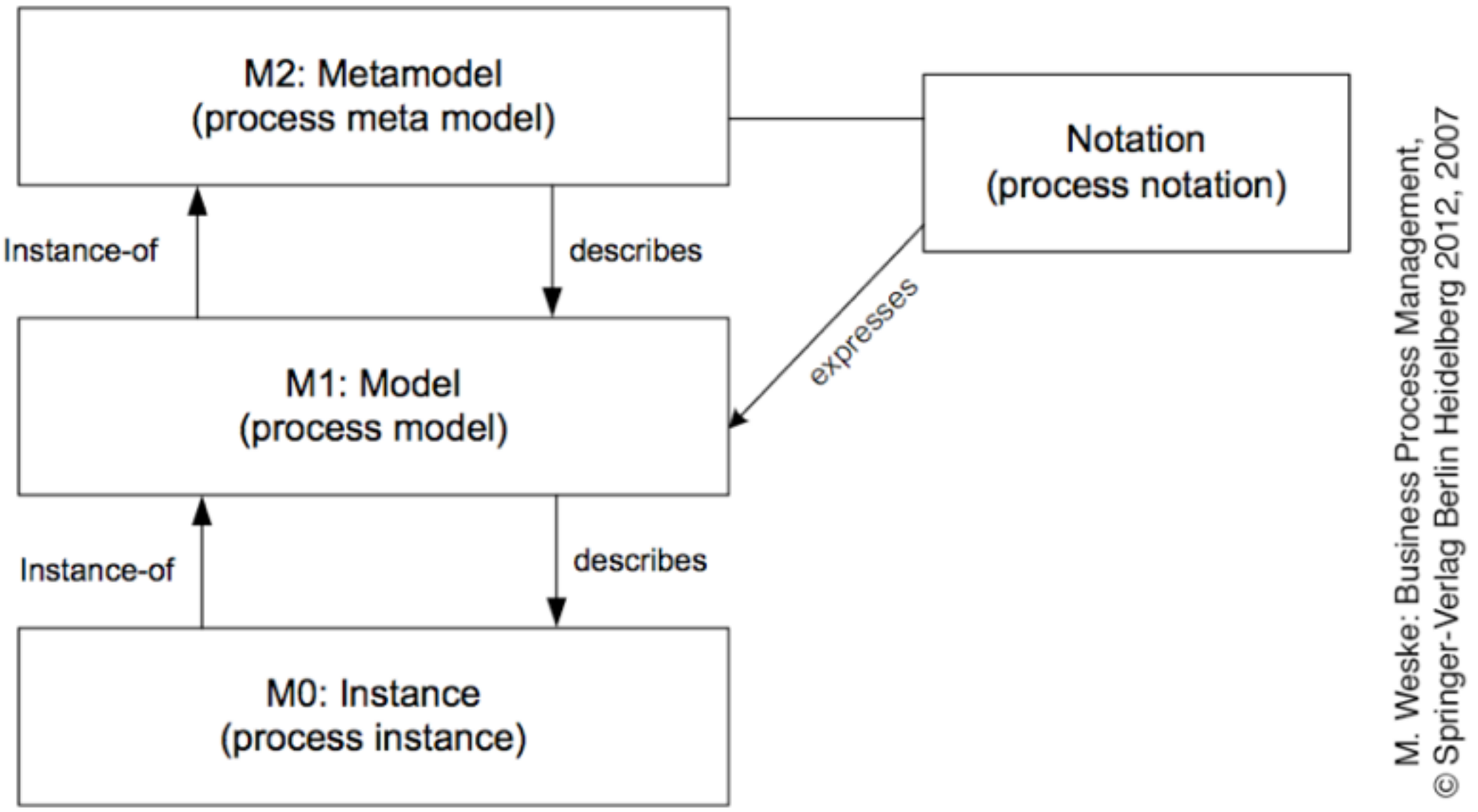
(better be read bottom-up)

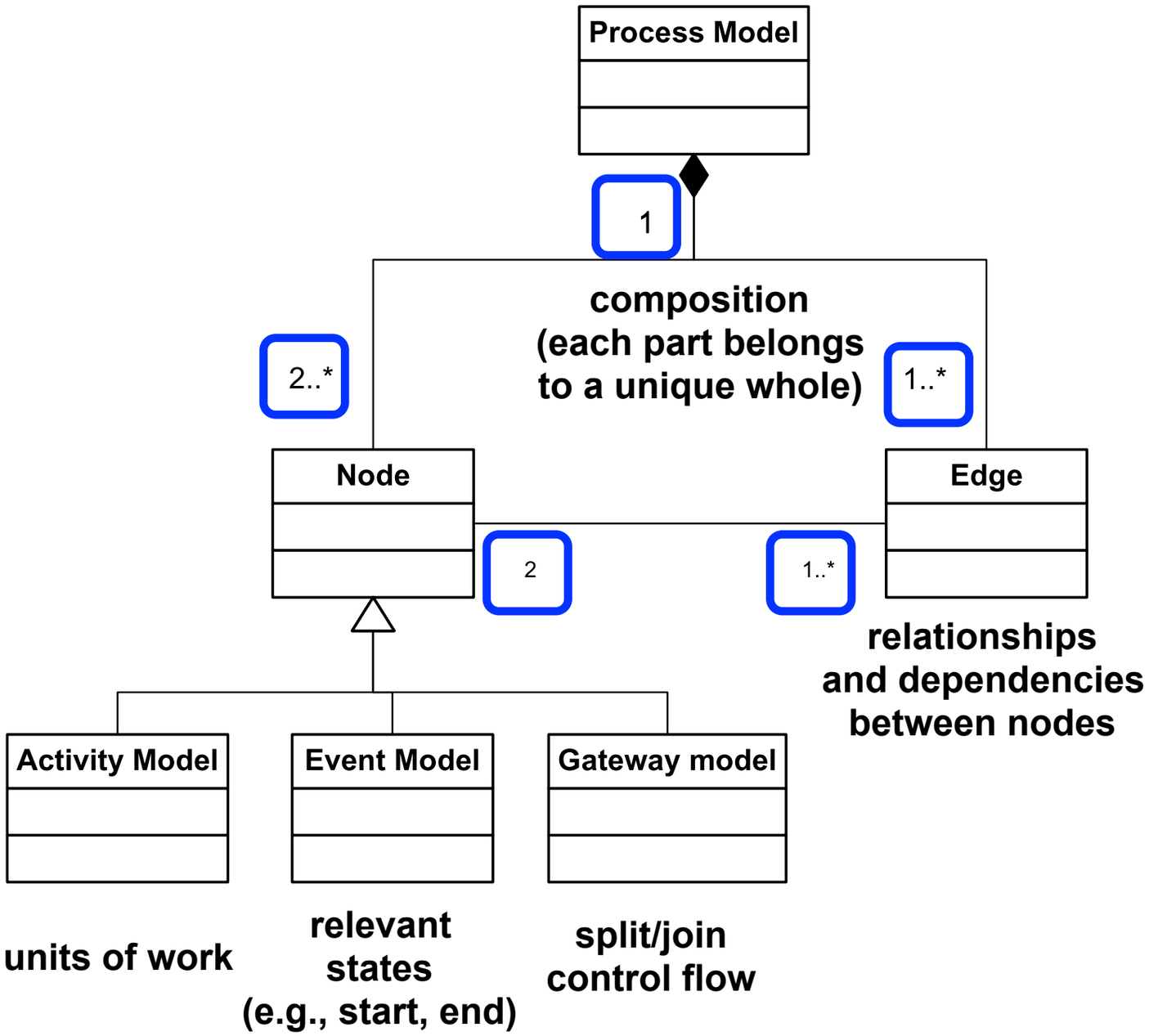
An example: MOF metamodel (OMG)



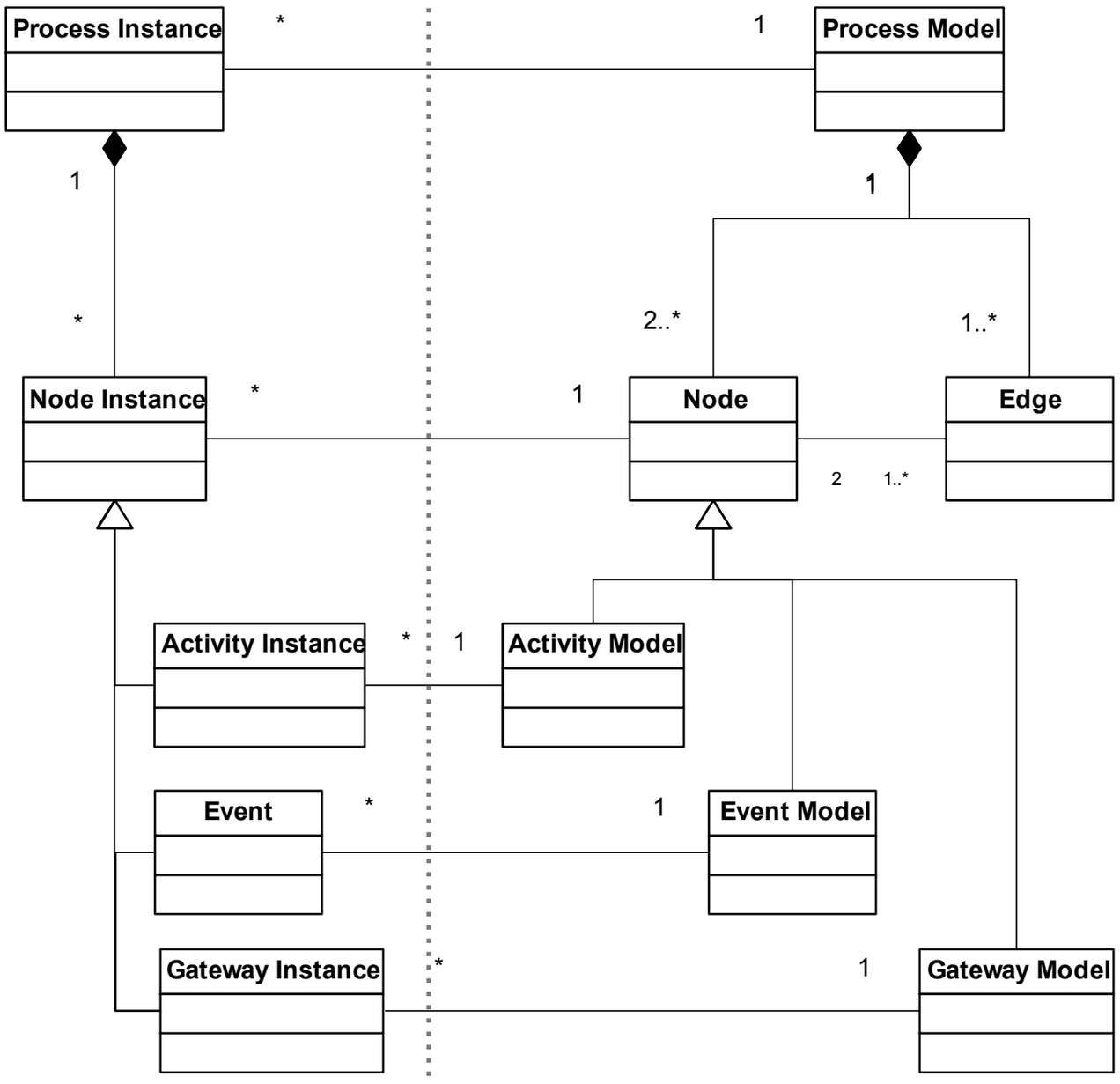
Process models and process instances



A process metamodel (level M2)



Process models and process instances

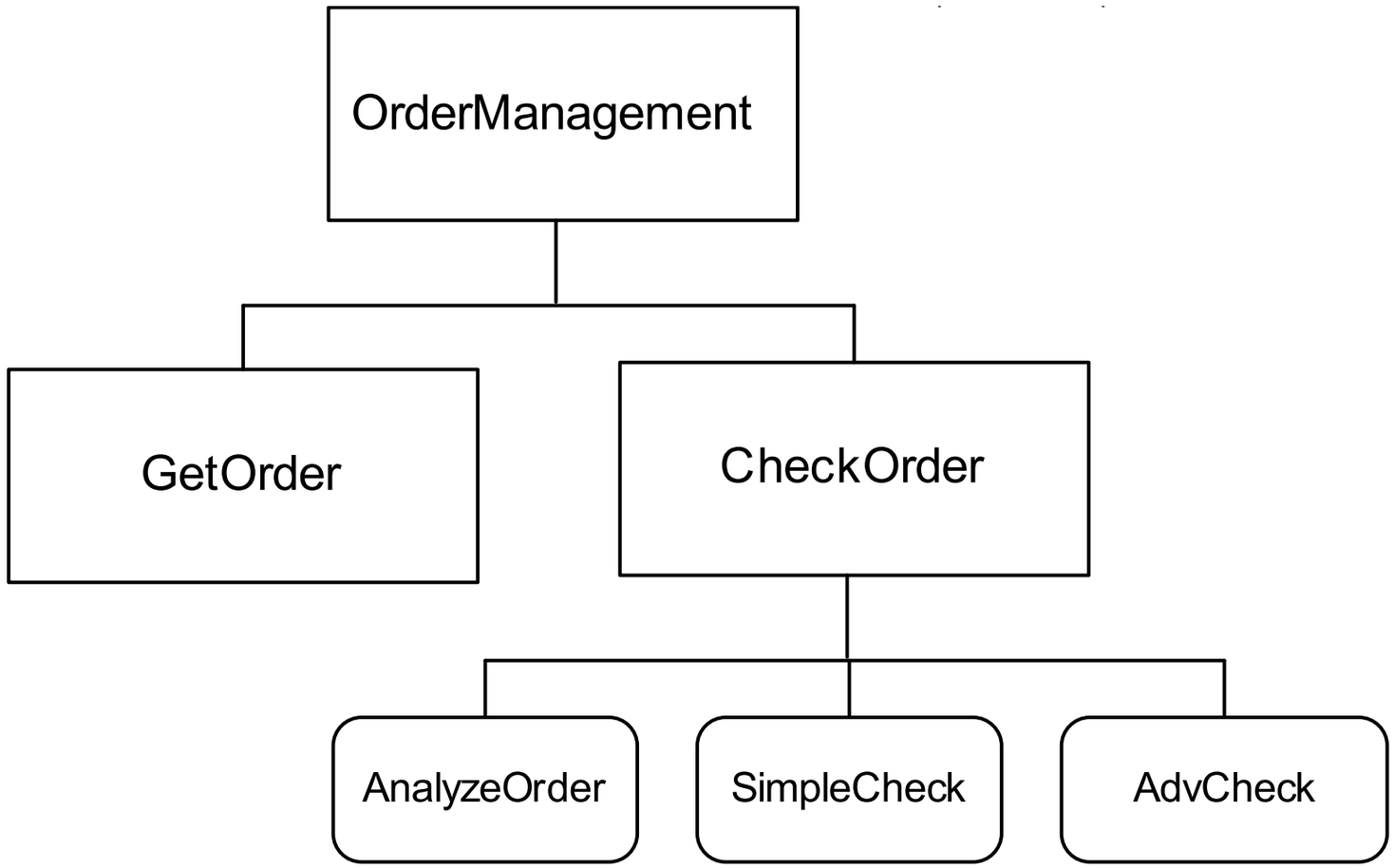


Aggregation abstraction

Multiple elements of a lower level of granularity can be grouped and represented by a single artifact at the higher level of granularity

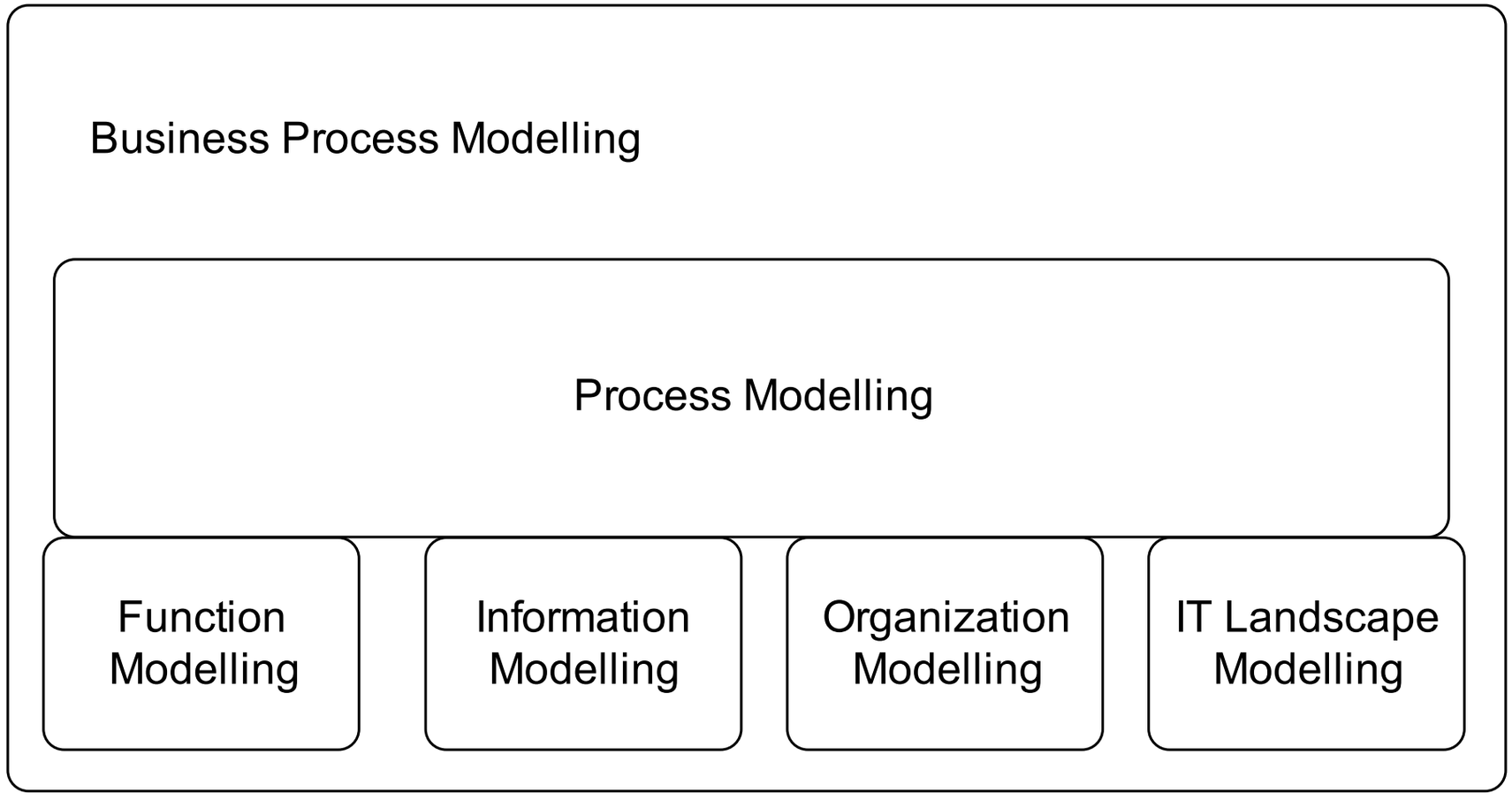
Different from horizontal abstraction, where all activities lie at the same level of abstraction

A sample aggregation



Vertical abstraction (domain separation)

BPM includes multiple modelling domains, integrated by Process Modelling

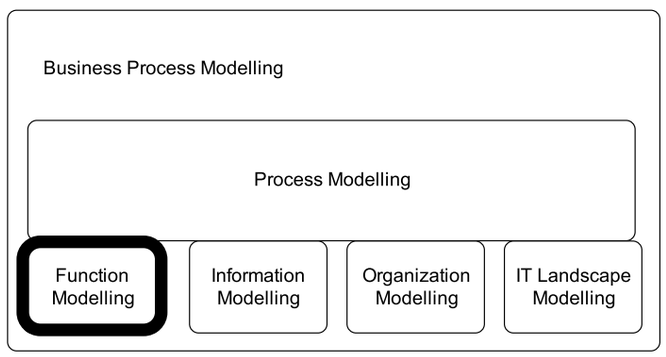


Function models

Units of work enacted by processes
(at different levels of granularity)

Informal description, textual documents
(coarse-grain business level)

Formal description, function specifications
(fine-grain software layer)



Value Chains

Value chains are a way to organize the work that a company conducts to achieve its business goal

Value chains were developed by Michael Porter to organize high-level business functions and to relate them to each other

Value systems

Companies have goals to fulfill

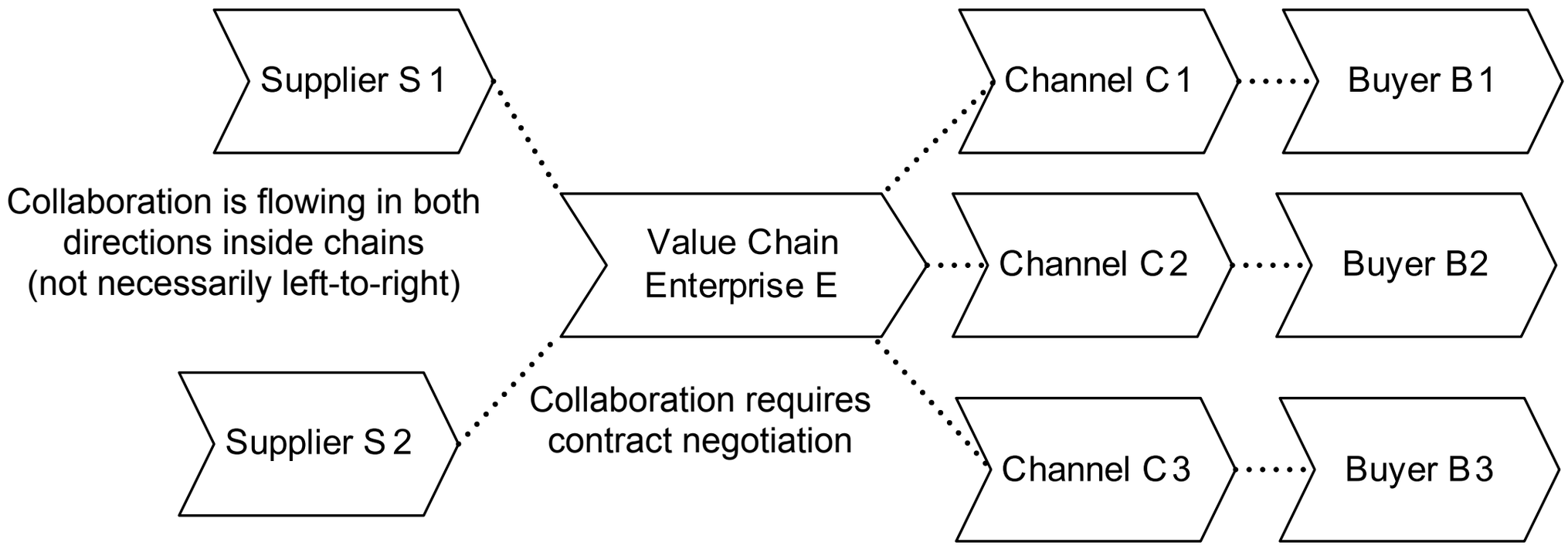
To reach their goals,
companies can cooperate with each other

The value chains of cooperating companies
become linked/related to each other:
they form a **value system**

Value systems can provide an immediate
understanding of ``how a company operates''

Value systems

Informal, high-level business functions decomposition
produce a
Value system
made of
Value chains
centred at the enterprise E under consideration



Ecology of value chains

``gaining and sustaining competitive advantage depends on understanding not only a firm's value chain but how the firm fits in the overall value system"

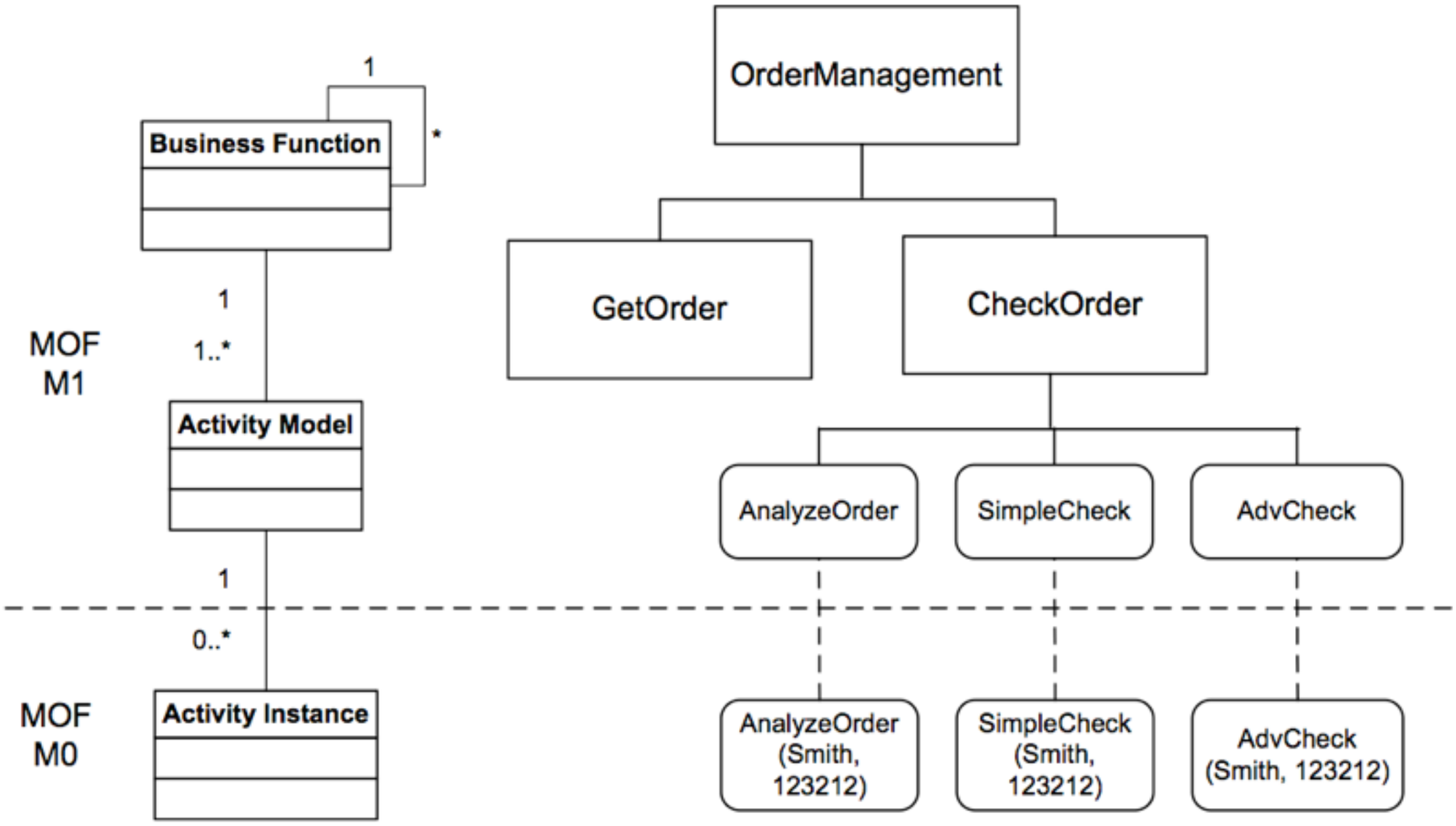
- Porter

High-level business functions

The value chain of a company has a rich internal structure, consisting of a set of coarse-grained business functions
(e.g. Order management, Human resources)

High-level business functions can be decomposed into finer-grained functions
(this is called **functional decomposition**)
(e.g. from ``Order management'' to ``storing'' and ``checking'' orders)

Activity models and activity instances



Value chains and processes

Porter was not able to identify the role of processes within value chains

However, process-orientation can fit very well with value-chains and functional decomposition

Key factor:
the granularity of business processes must be in line with the particular goals associated with the supported business function

Process Orientation

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

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

Taylorism

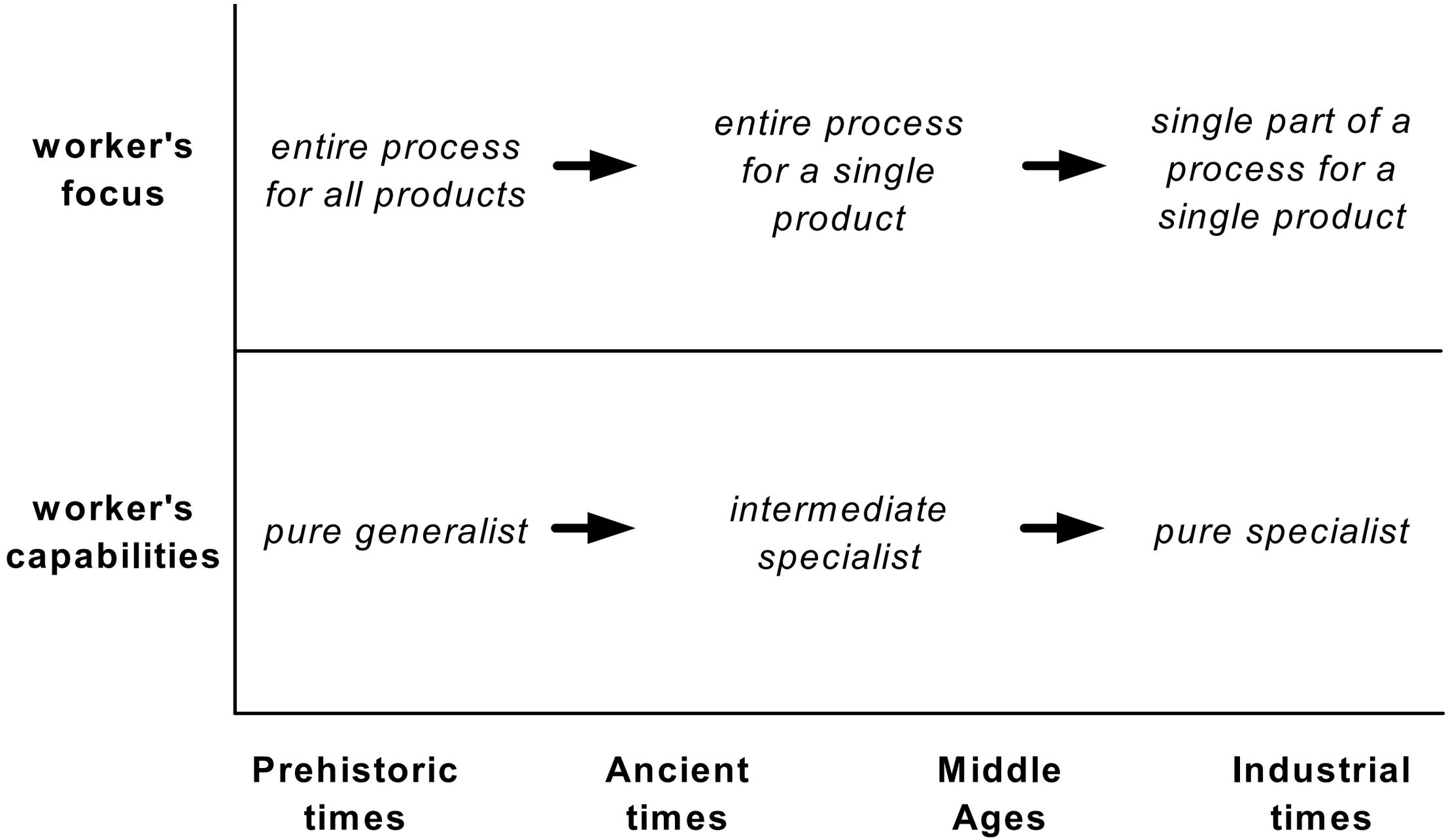
Process orientation is based on a critical analysis of a concept to organize work units originally introduced by Frederick Taylor (1856-1915) to improve industrial efficiency

Taylorism uses functional breakdown of complex work to small granularities

Then, highly specialized work force can efficiently conduct these work units of small granularity

Taylorism has proved very successful in manufacturing and fuelled the industrial revolution

Taylorism


worker's focus
entire process for all products
entire process for a single product
single part of a process for a single product
worker's capabilities
pure generalist
intermediate specialist
pure specialist
Prehistoric times
Ancient times
Middle Ages
Industrial times

Handovers

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

Taylorism proved inefficient for organizing work in modern enterprises

Pitfall of Taylorism

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 required knowledge)

In the end, functional breakdown proved inefficient in modern business organizations that mainly process information

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

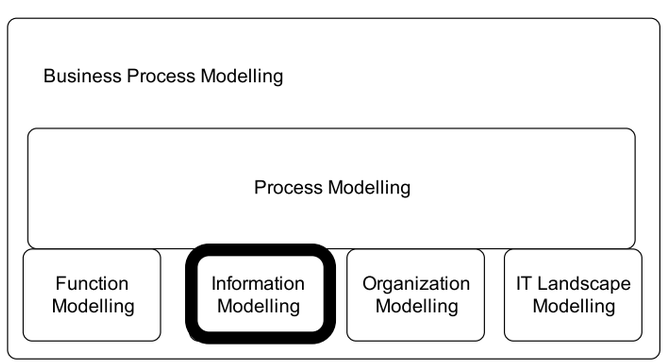
As a consequence, workers must have broader skills and competencies
(knowledge workers must have a broad understanding of the ultimate goal of their work)

Main effect, at the organizational level, process orientation led to the characterization of high-level operations (usually, less than a dozen), called **organizational business processes**

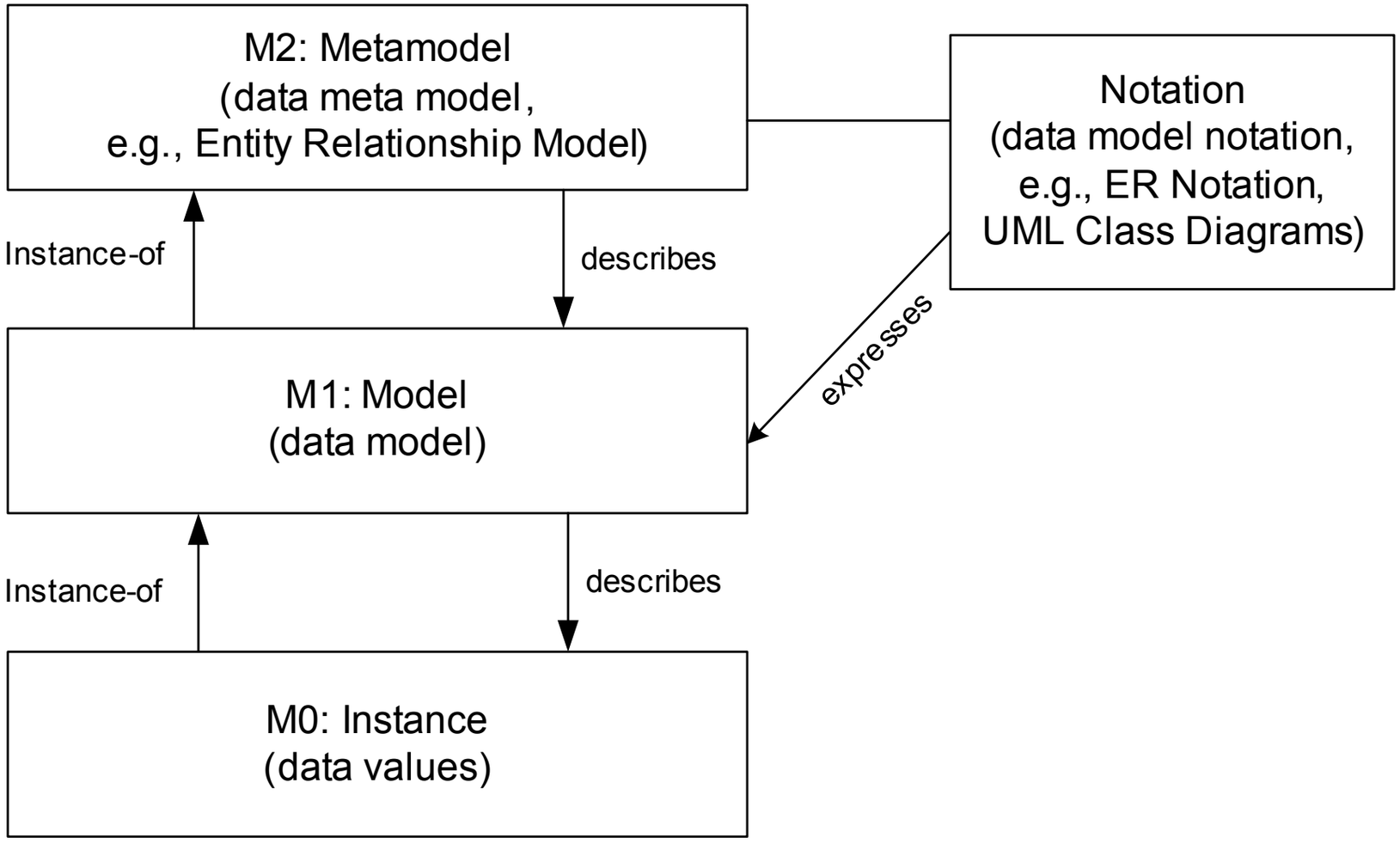
Information models

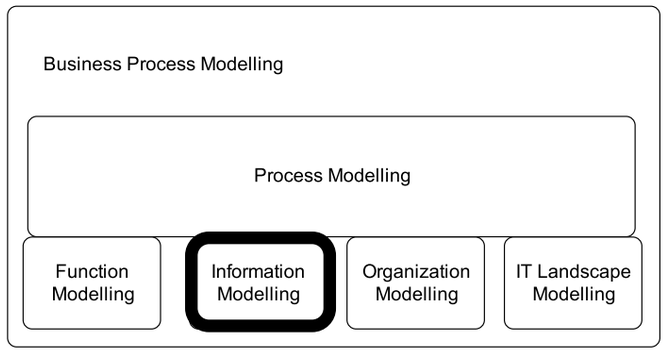
Data representation is crucial:
all decisions made during a business process
depends on data values

Data dependencies between activities
are also important
(ensure data-availability, reduce waiting time)



Data models



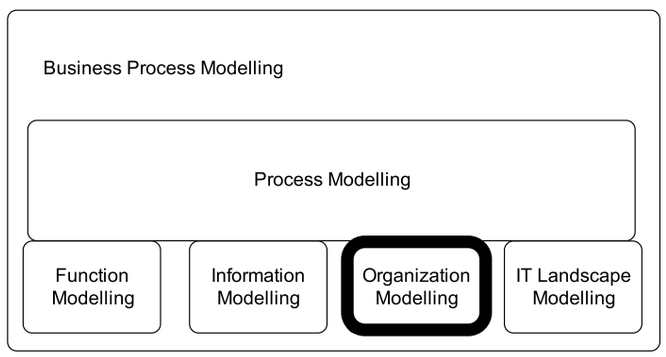


Organizational models

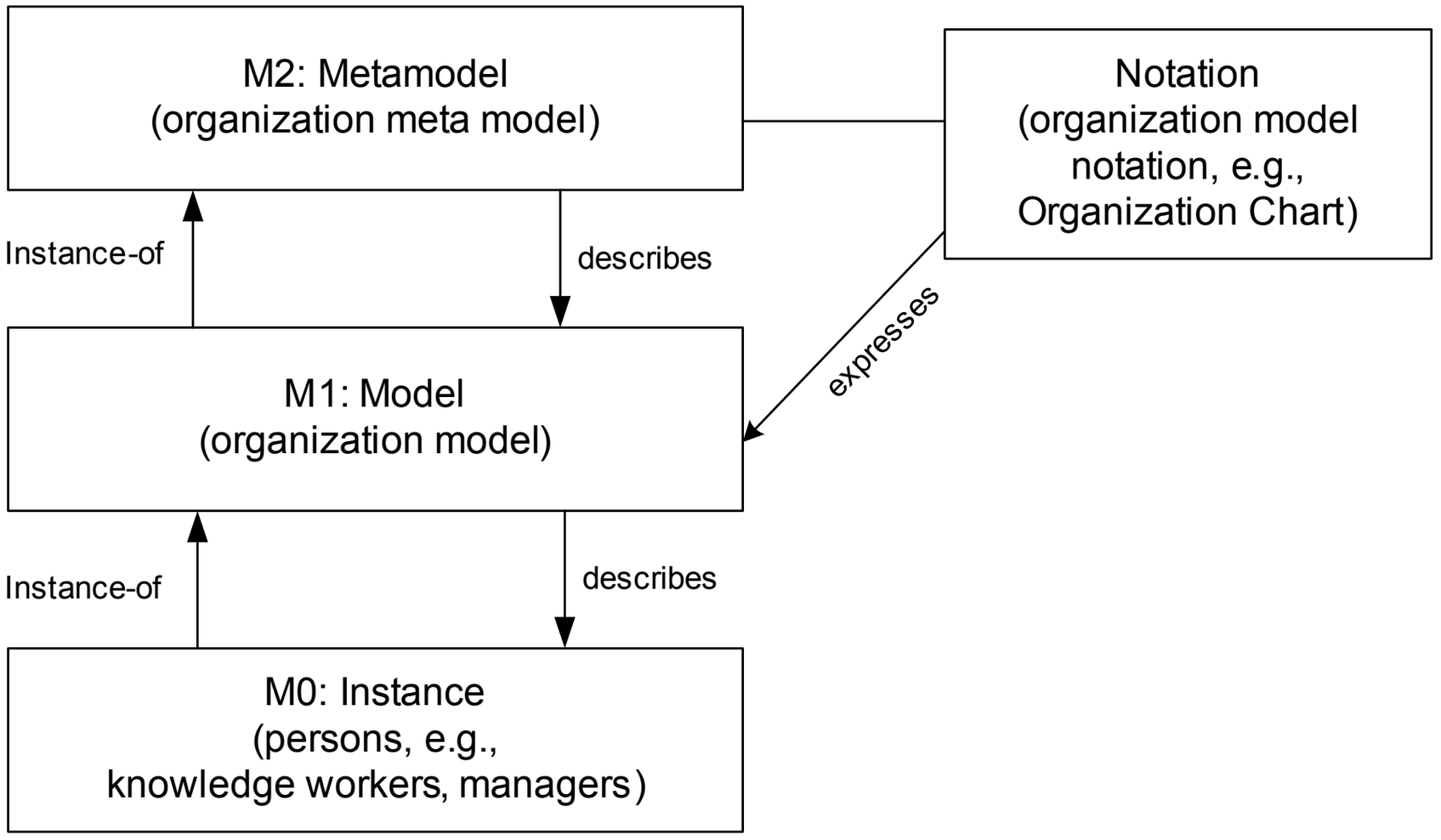
Organizational structure must be represented

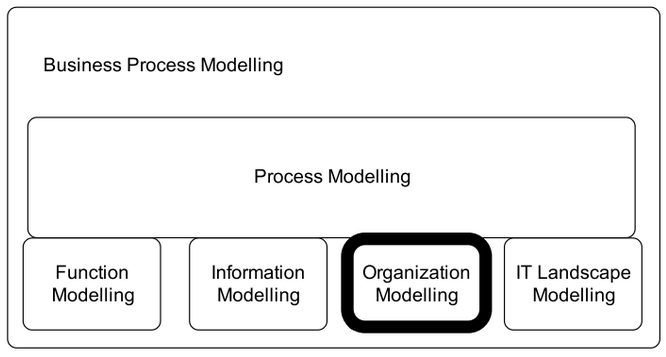
Activities must be associated

to specific roles or departments

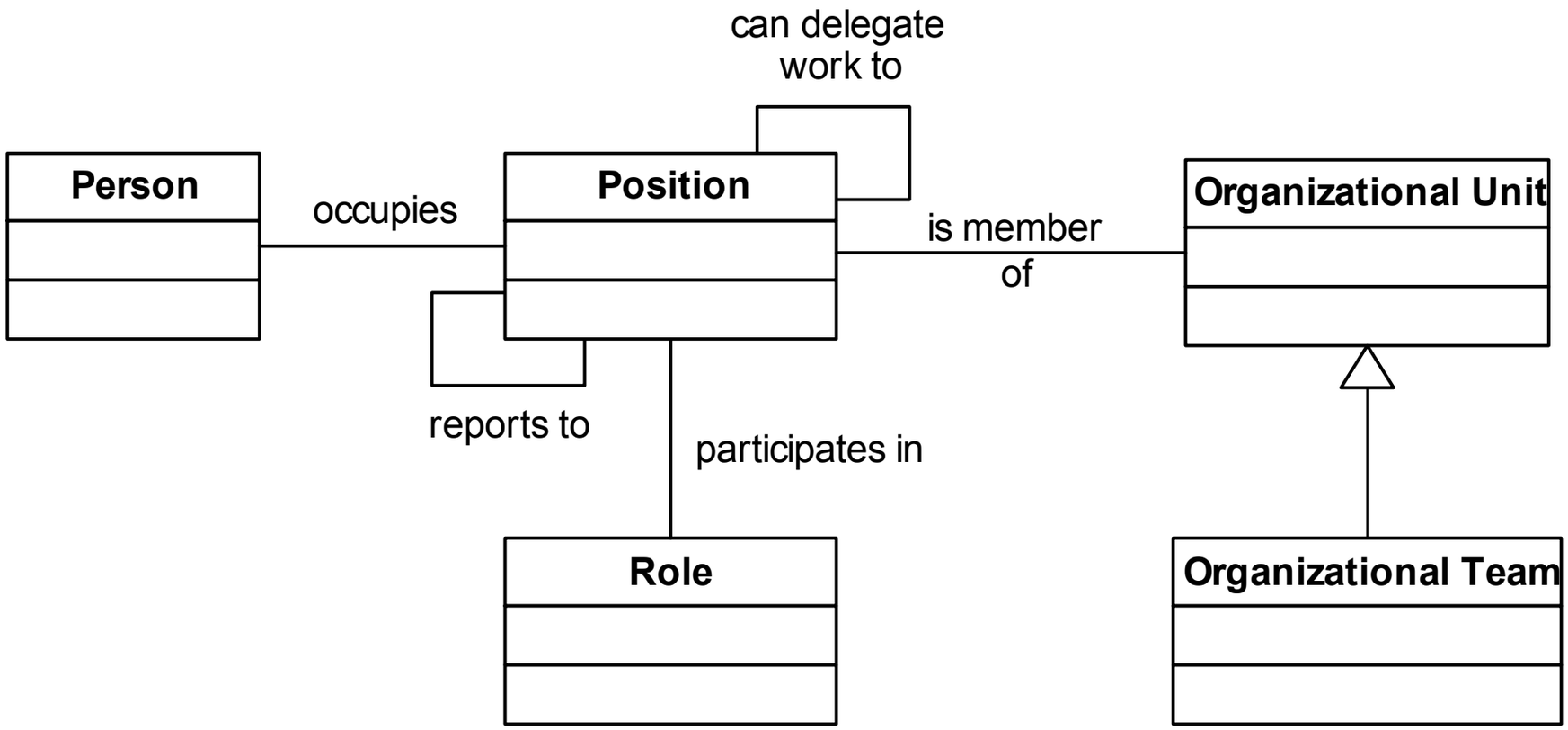


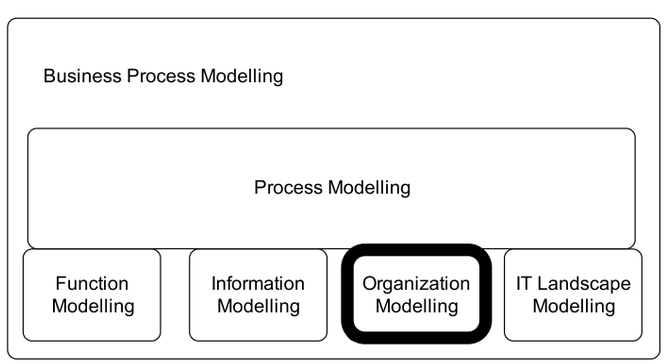
Organizational models





An organizational metamodel

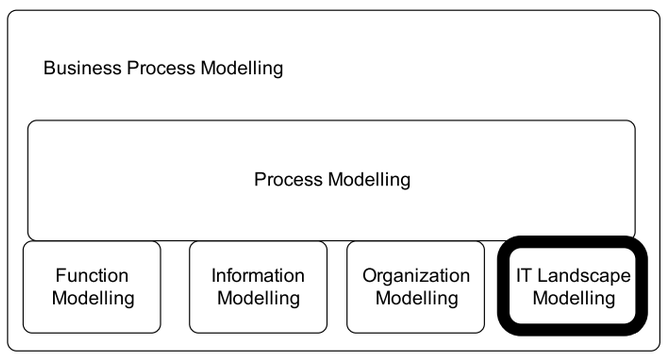




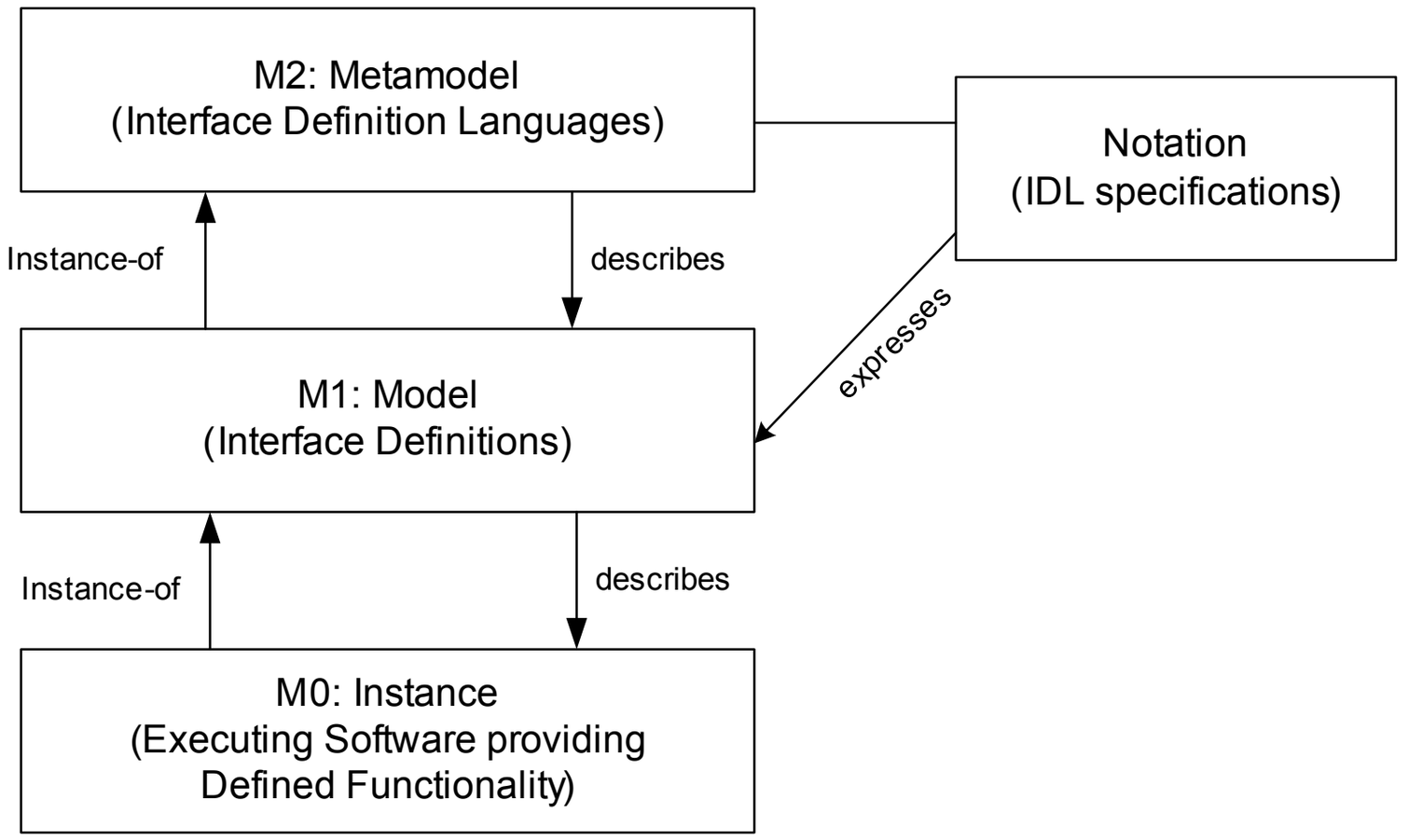
IT landscape

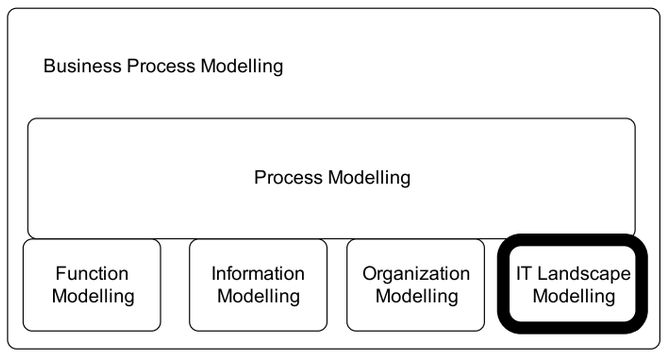
Many activities in a business process are supported by information systems

Information systems and programming interfaces needs to be represented because they provide functionalities



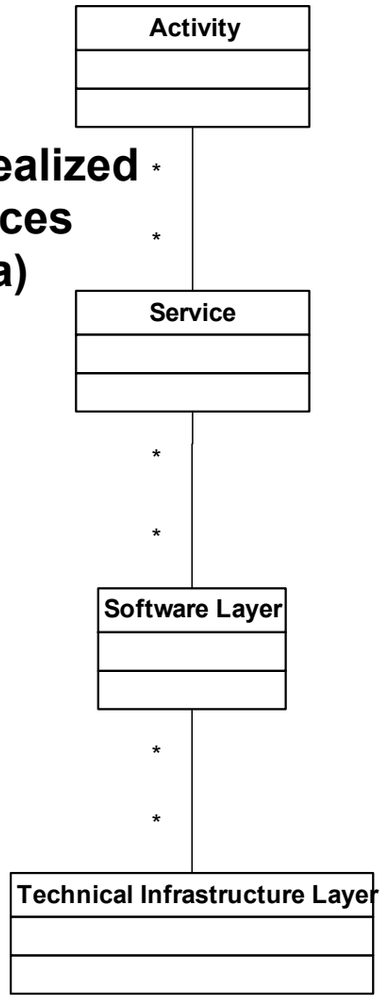
Interface Definition Languages

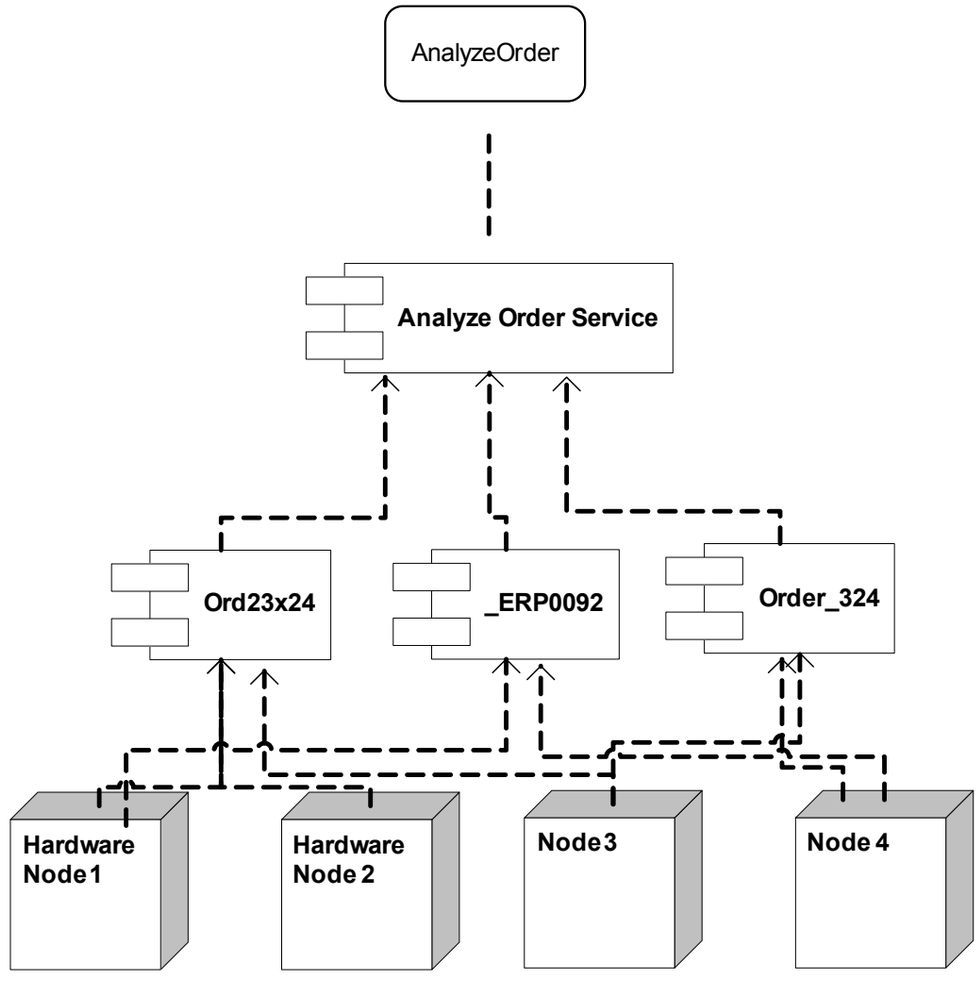


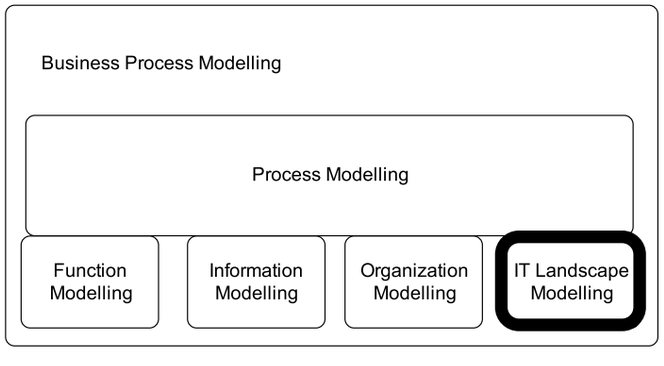


Service enabling

An activity can be realized by multiple services (and vice versa)





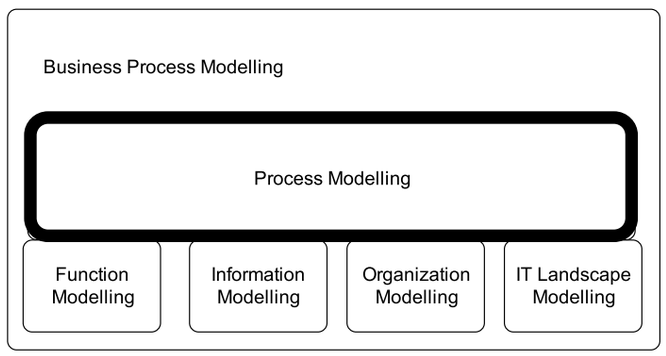


Process models

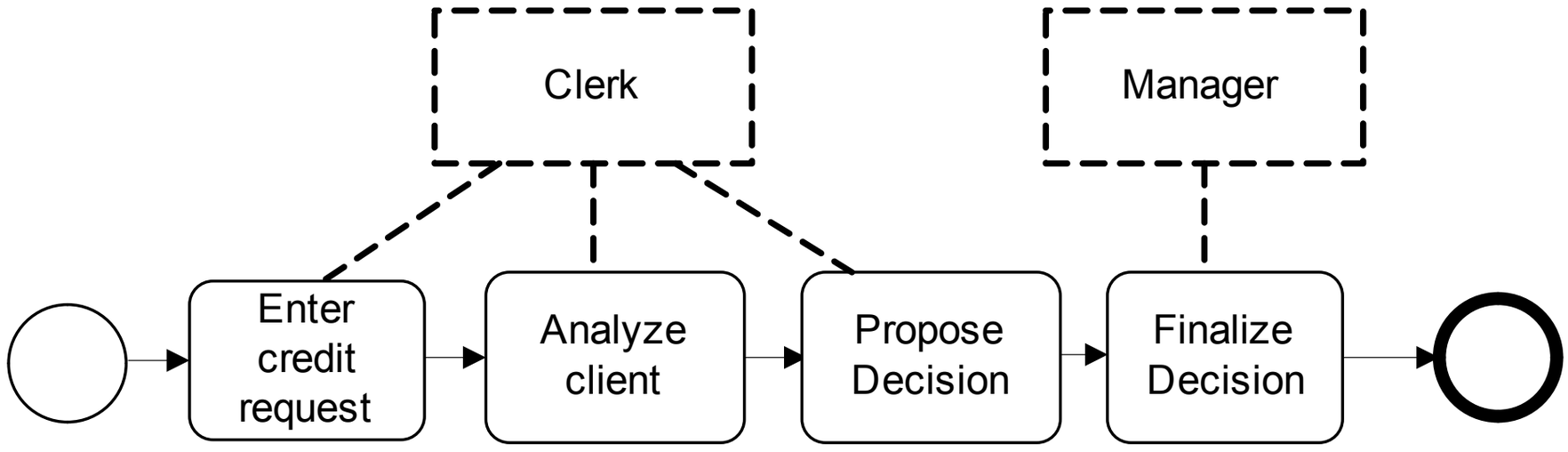
Define the glue between the subdomains

Relate functions and execution constraints

Relate data values with process instances
(e.g. the process of a credit approval may depend on the requested amount)



A process model with role information



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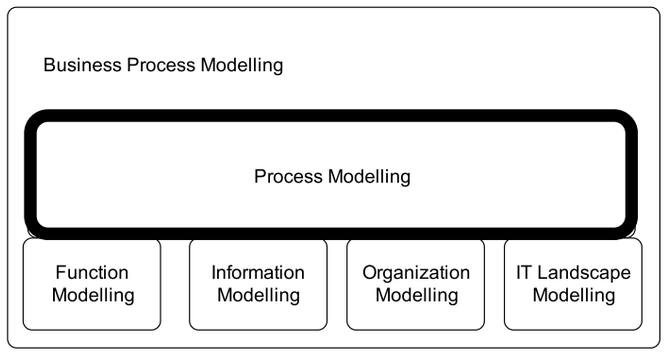
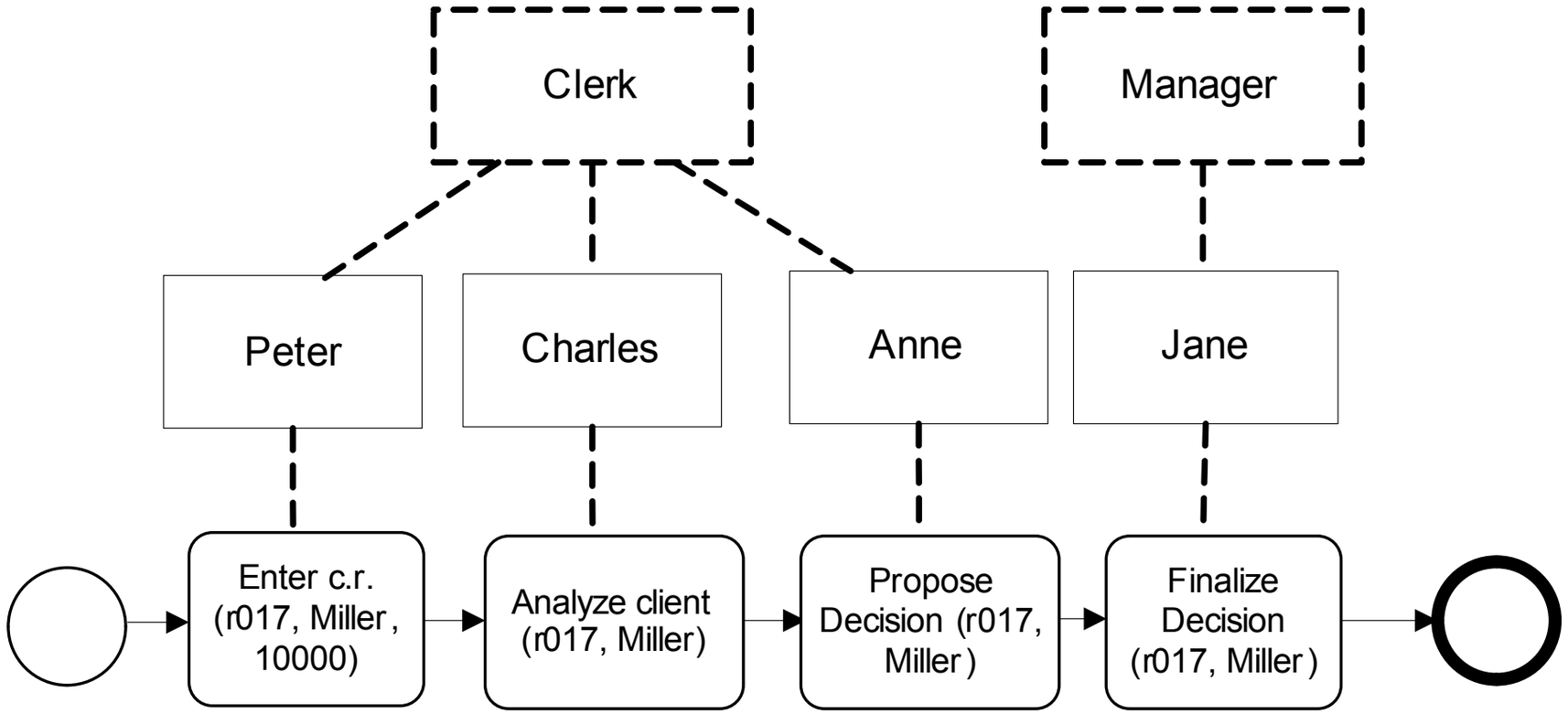
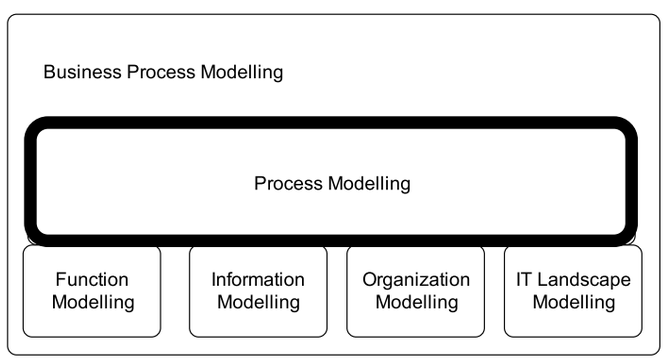


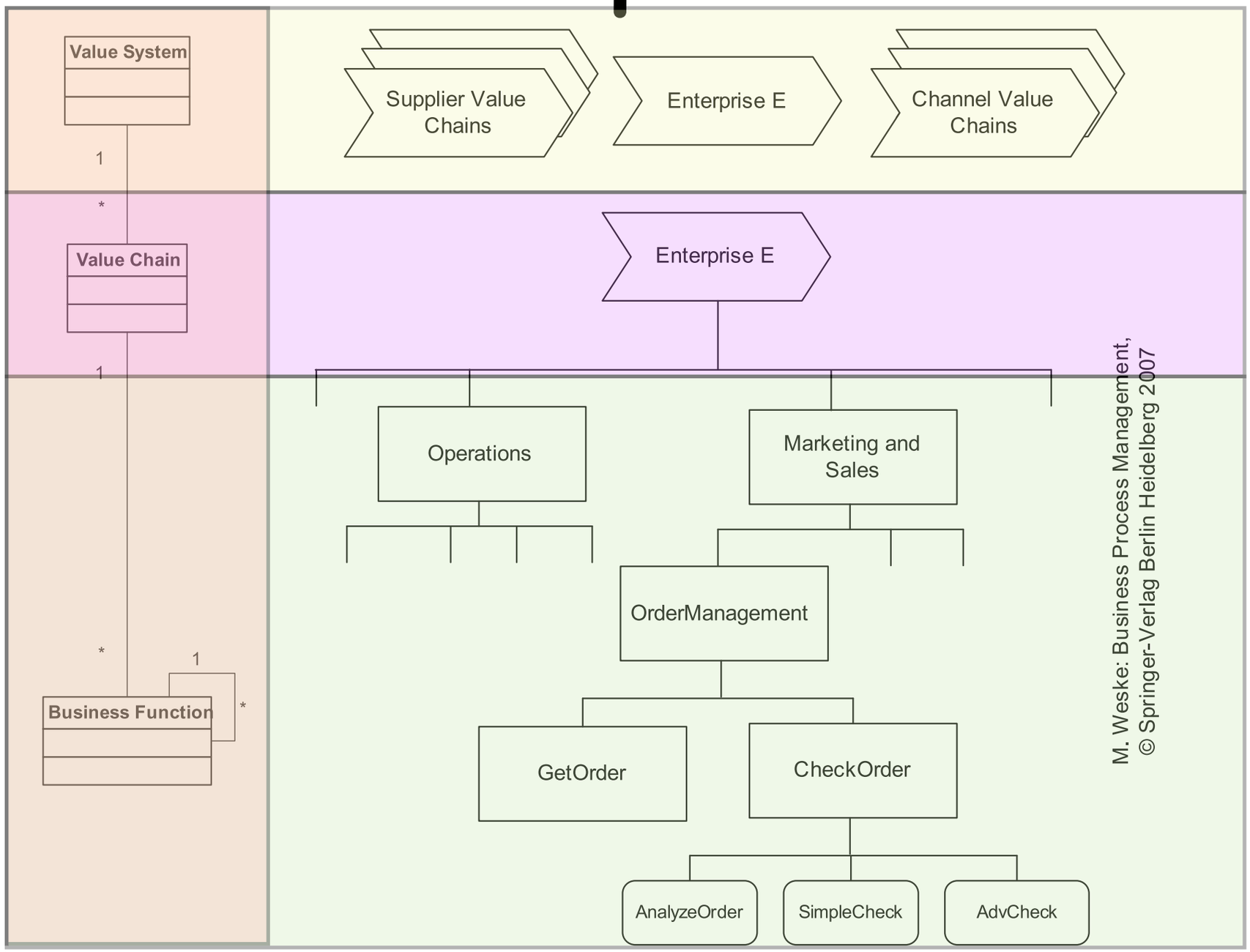
A process instance with workers information



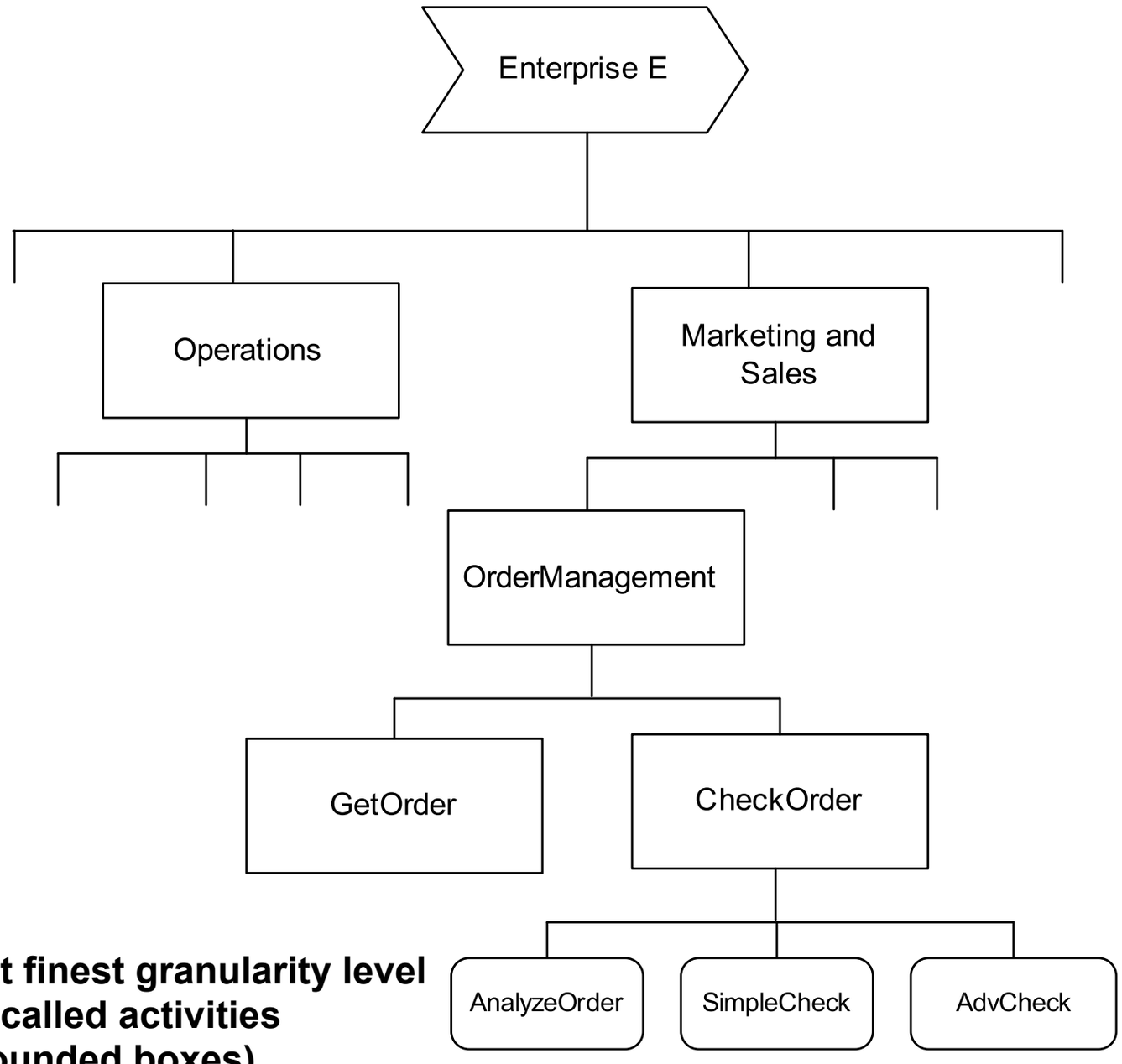


From business functions to business processes (and their implementation)

Step 1: Functional decomposition

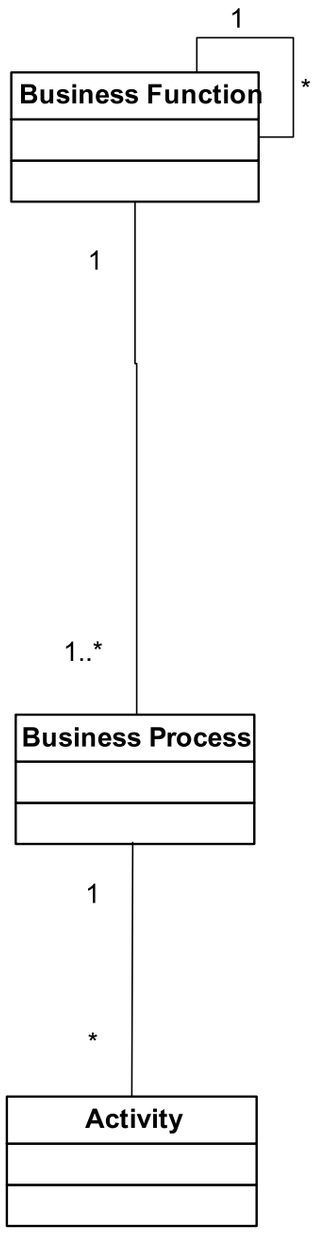


Business functions: activities

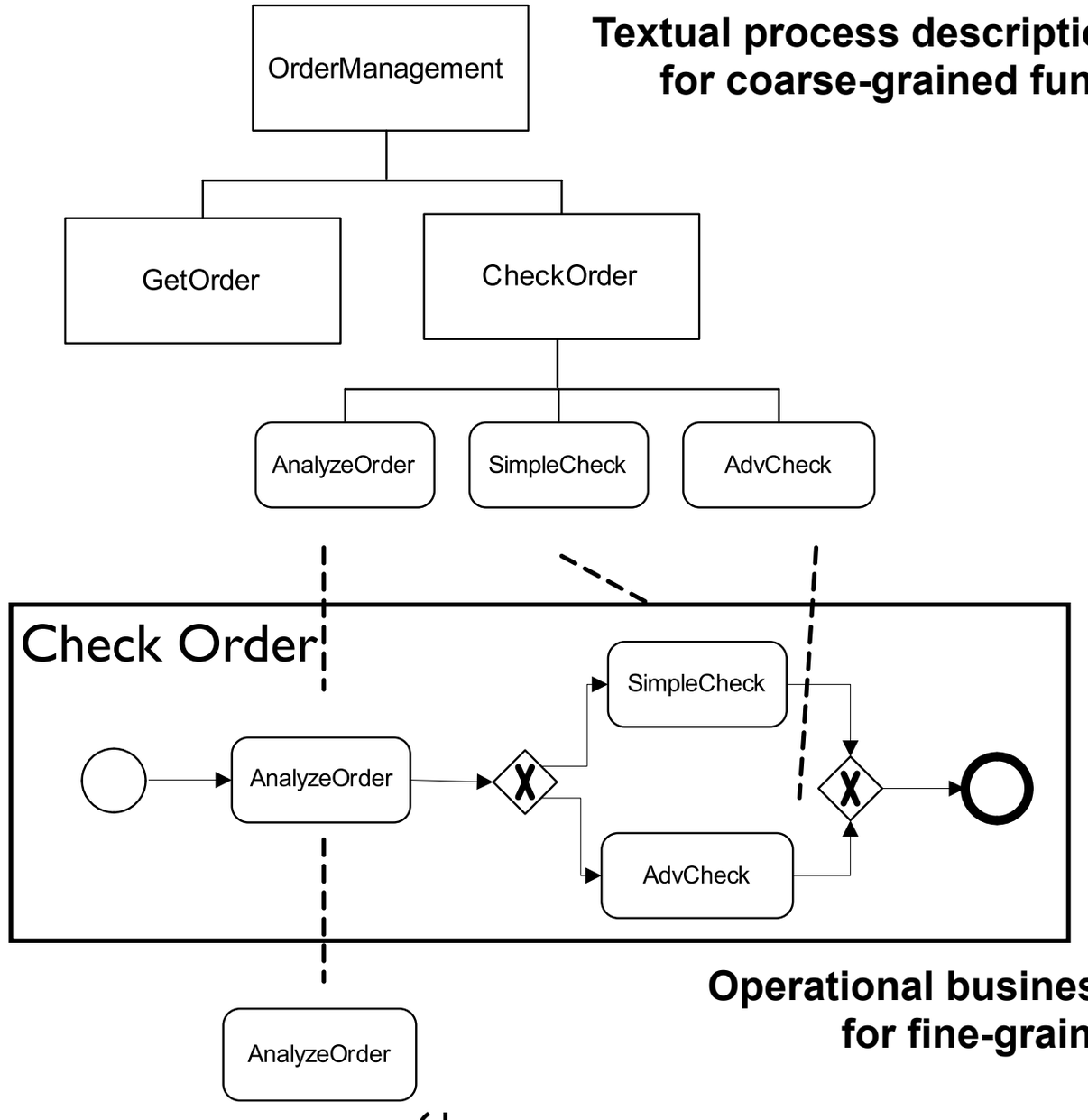


Functions at finest granularity level are called activities (rounded boxes)

Step 2: Structuring business processes



Fix execution constraints



Textual process descriptions are ok for coarse-grained functions

Operational business processes are ok for fine-grained functions

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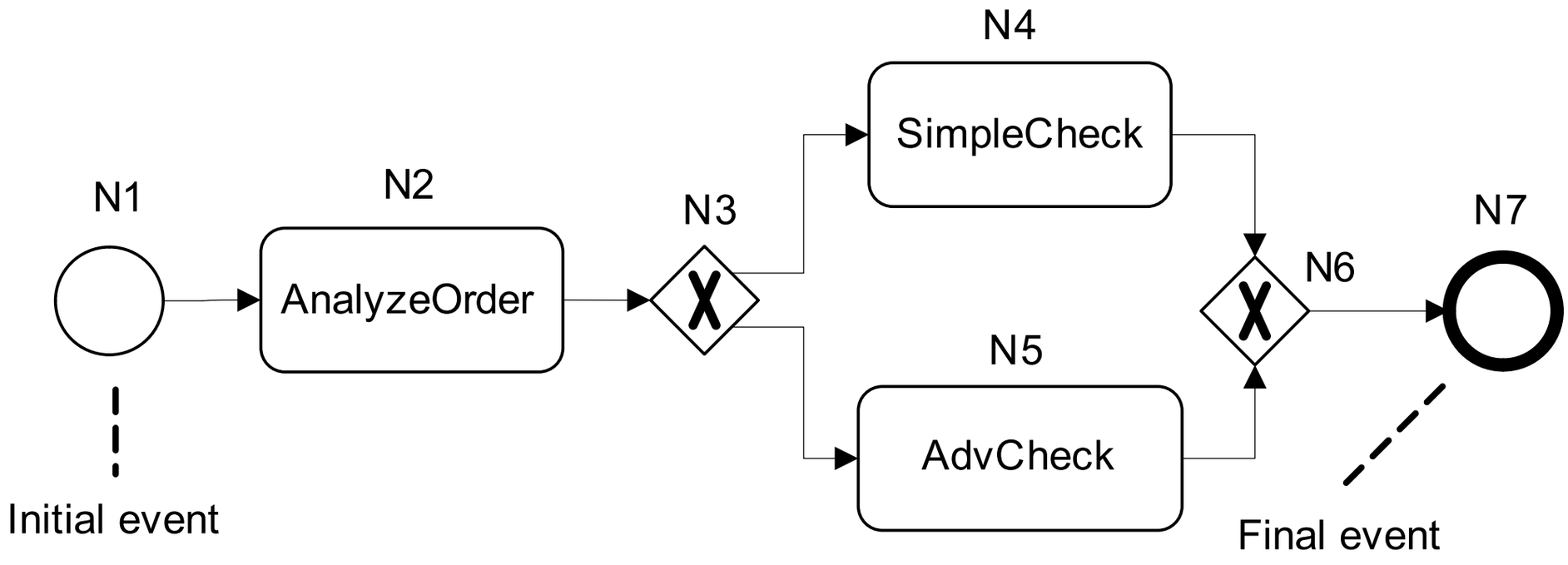
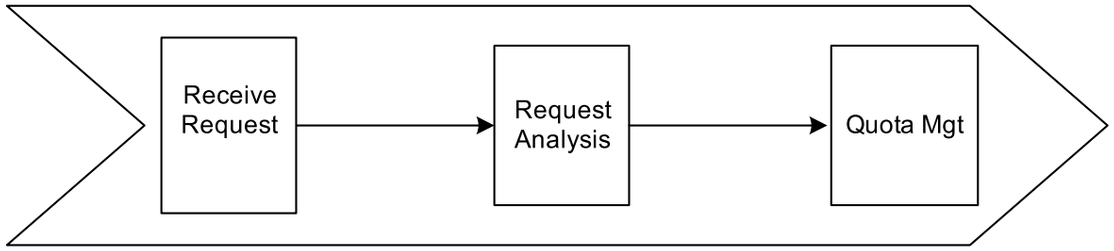
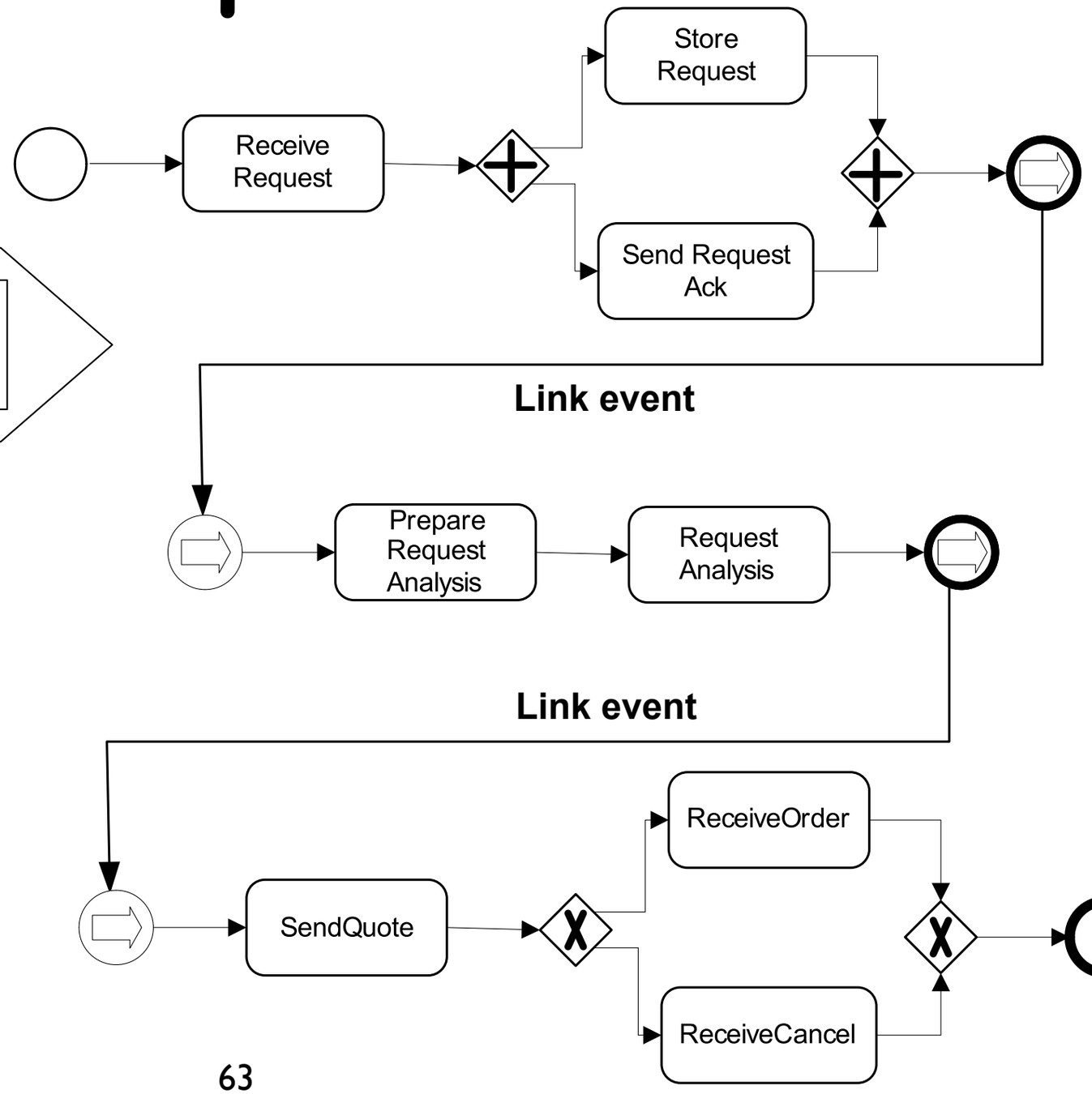
Start event / End event



Step 3: Related business processes



Value chain with related, high level functions



The end event of one process can trigger the start event of another process

Step 4: Activity implementation

Activities are functions at the finest granularity

They are the building blocks of operational business processes
(but sometimes activity implementation can be provided by knowledge worker)

From value system

...

...

to implementation