



IV. Business Process Modelling

business process modelling, patterns, UML activity and state diagrams, business process management systems (BPMS)

Presentation: N.C. Danh (2018)

DIRECTION

NORTHEAST EAST SOUTHEAST SOUTH SOUTHWEST WEST

What is a business process?



Hammer & Champy definition:

"A business process is a set of partially ordered activity aimed at reaching a well-defined goal"

[Hammer&Champy, 1994]

What is a business process?



Laudon & Laudon definition:

"The unique ways in which organisations coordinate and organize work activities, information, and knowledge to produce a valuable product or service"

[Laudon&Laudon, 2000]

Another definition: " A business process is a set of related activities that create customer value"

Example: A sales process



A **sales process** (order fulfillment) contains the following **activities**:

- Accept customer order
- Select, inspect and package merchandise
- Ship merchandise
- Receive customer payment

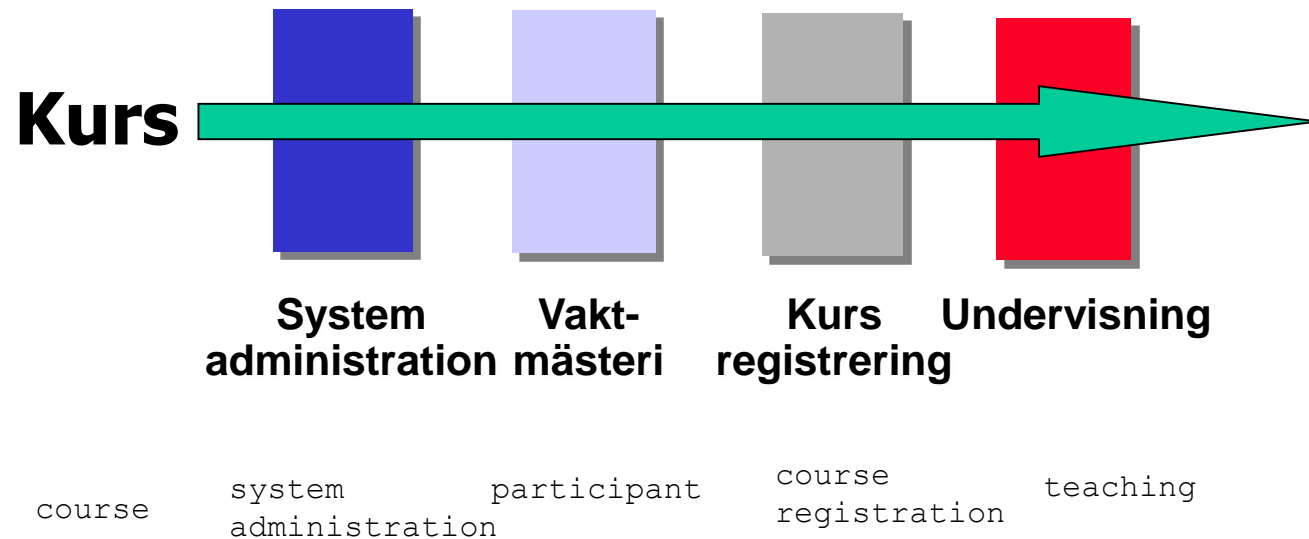
[Denna et. al., 1995]

Examples of a business processes



- A sales process (order fulfillment)
- A manufacturing process
- A customer relationship process
- An IT System maintenance process ???

Business processes cross functions



Why focusing on business processes?



- re-engineering the business processes to make them more effective/efficient
- discover and adopt to changed customer demands
- automate the activities in business processes



- Syfte: att förstå organisationen samt de behov och problem som systemet skall lösa

Purpose: to understand the organization as well as the needs and problems some system should release.

- Leverabler: use cases, objektmodeller, dynamiska modeller, till exempel verksamhetsprocessmodeller (eng. “business process models”)

Deliverables: use cases, object models, dynamic models, such as business process models.

What is business process model?

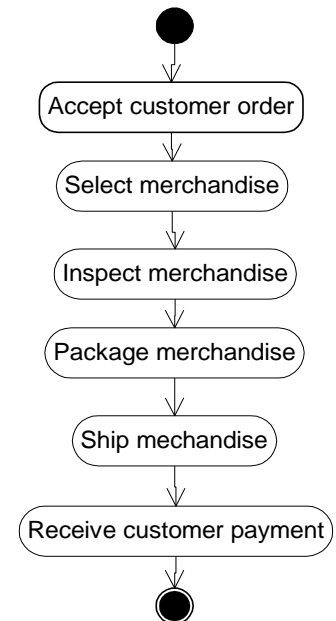


A business process model:

- is a **representation** of a business process in the real world
- is a **simplified description** of a business process
- **has a purpose** (- to be used for software development or education - for software developers, users or business managers, etc)

A business process model is often represented (visualised) as a **graph/diagram**, because it:

- gives a better overview and structure
- makes it easier to communicate between different stakeholders

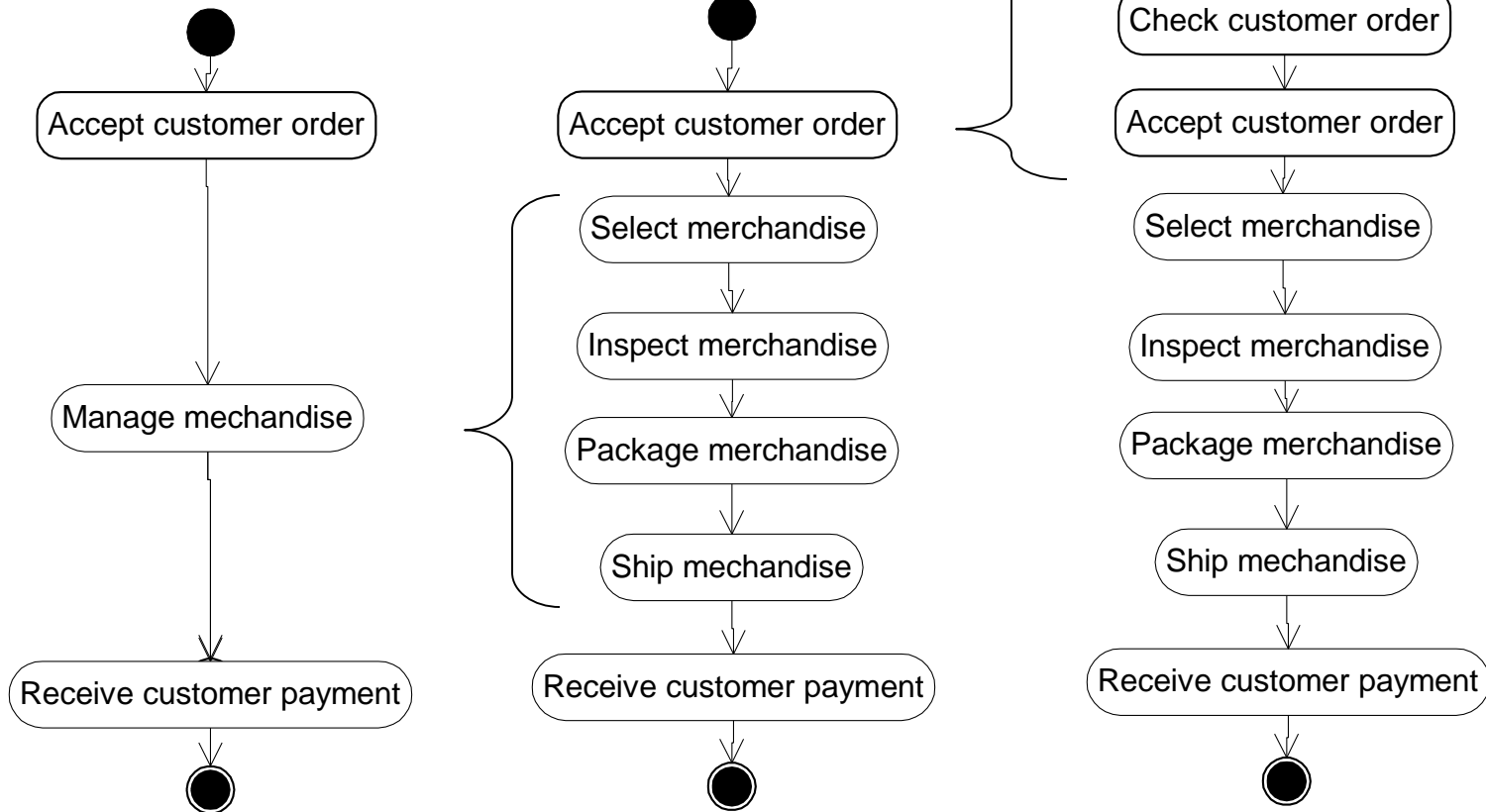


A sales process model



A sales process model:

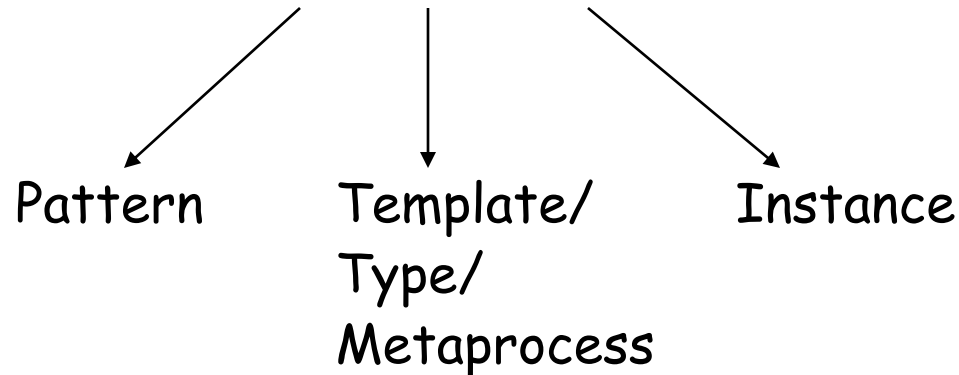
- at different levels of abstraction



Different modelling forms



Business process modelling forms



A business process (a template/type)



Business process modelling forms

Pattern

Template/
Type/
Metaprocess

Instance

*"An organisation's
sales business
process"*

What is a pattern?



Robert Fowler definition:

"A pattern is an idea that has been useful in one practical context and will probably be useful in others"

[Fowler, 1997]

What is a business process pattern?



Business process modelling forms

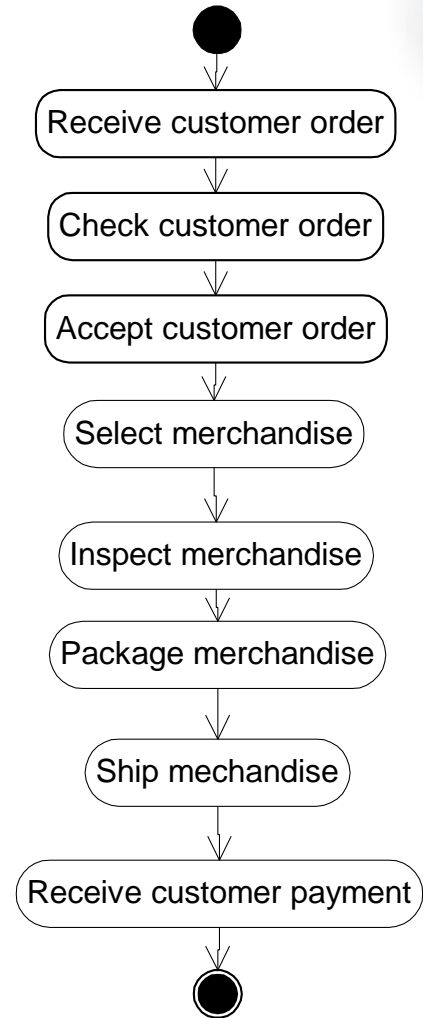
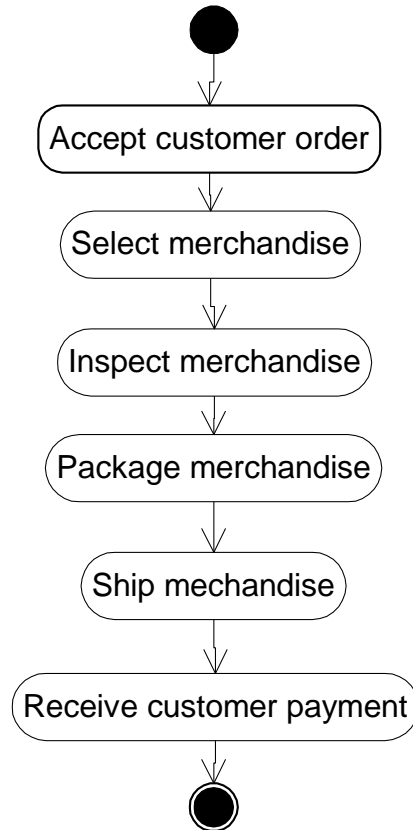
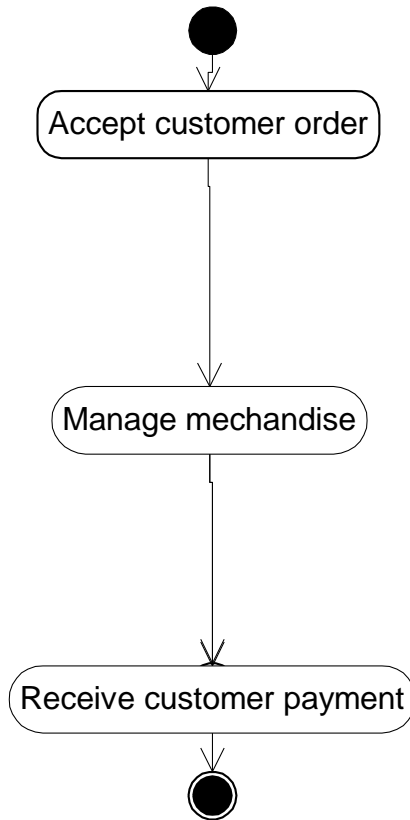
Pattern

↓
Template/
Type/
Metaprocess

Instance

*"An general sales
business process that
can be reused"*

A business process (template) or a pattern ?



A business process instance



Business process modelling forms

Pattern

↓
Template/
Type/
Metaprocess

Instances

*An organisation's
sales business
process for
customer X*

*(Orderno: 158,
Customer X,
Oct 15, 2002,
Ordersum: \$50)*

*An organisation's
sales business
process for
customer Y*

*(Orderno: 206,
Customer Y,
Oct 15, 2002,
Ordersum: \$ 200)*

Why different modelling forms?



Business process modelling forms

Pattern

Use pattern libraries (best practices) to create a new business process

Validate a created business process against best practices to re-engineer it

Template/ Type/ Metaprocess

Make the organisation's stakeholders aware of the business processes

Automate business processes

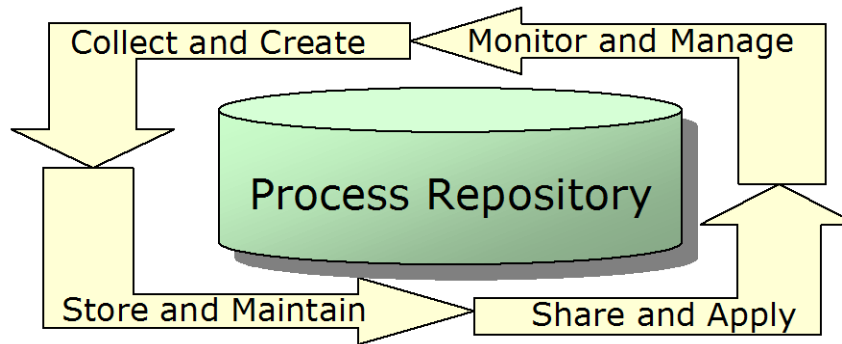
Simulate business processes

Instance

Track specific process instances' histories

Measure the efficiency of executed instances and find common bottlenecks

Business processes repository



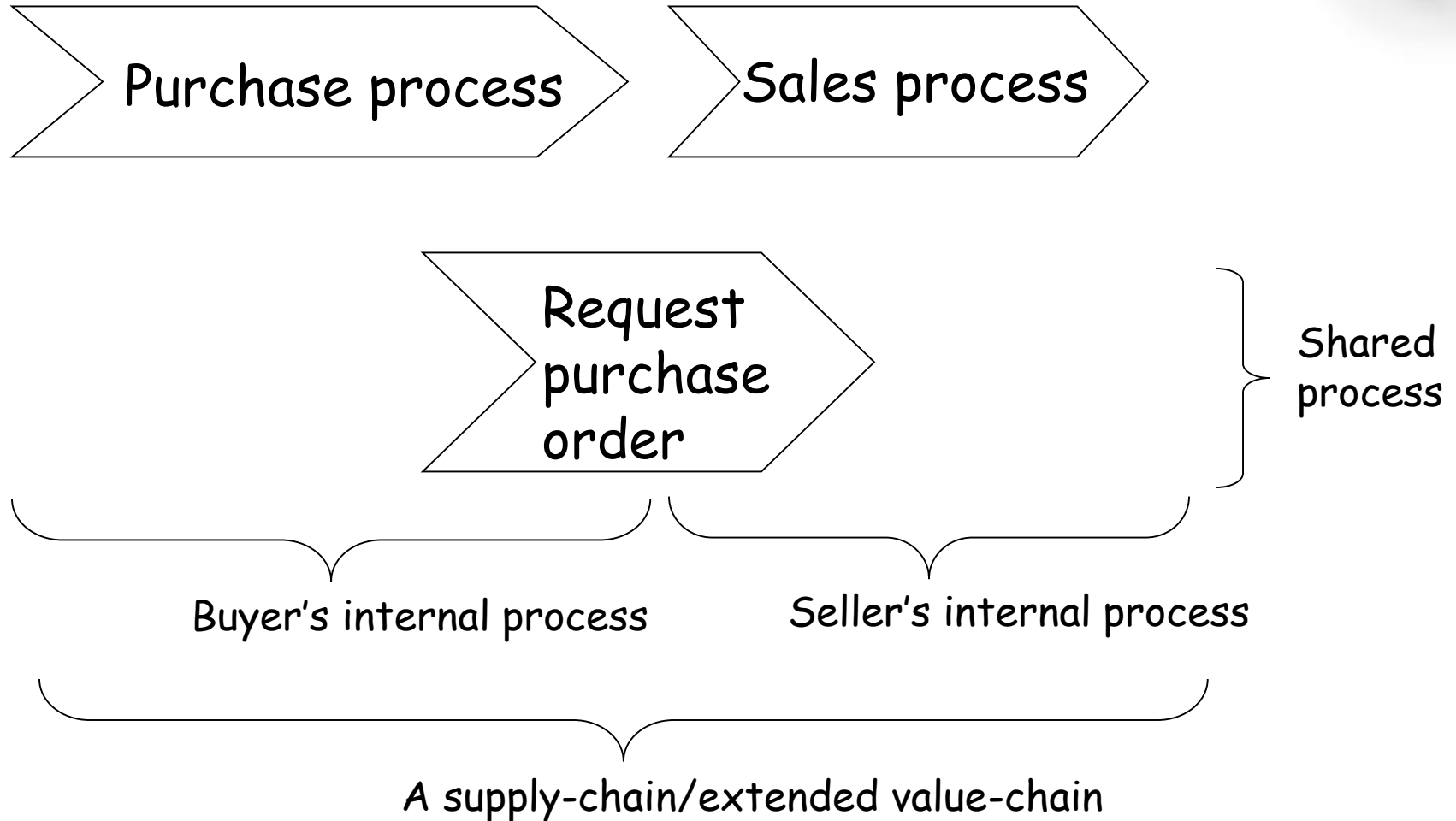
Collect and Create - acquire processes

Store and Maintain - the acquired processes are stored in a repository. There is a need for a design mechanism to make the processes easy to navigate and search (*MIT handbook, ebXML Catalog of Common Business Processes*)

Share and Apply - process repository is employed, which require: support for search and navigate, interfaces/different views for different users, and support for the user to understand the processes stored

Monitor and Manage - supervise and control (timestamp)

Internal vs. shared business processes



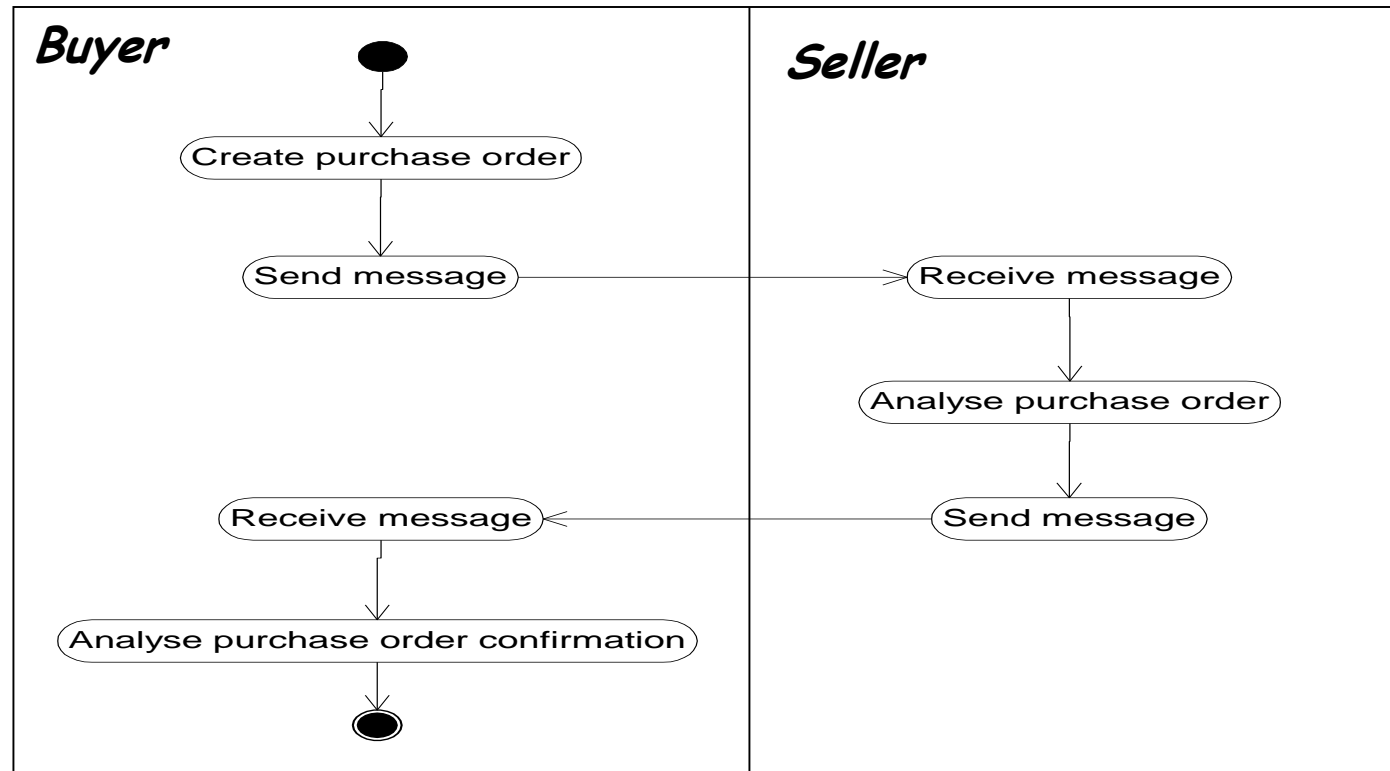
An external business process



Request purchase order

- support trading partners to issue and acknowledge new purchase orders

Request
purchase
order

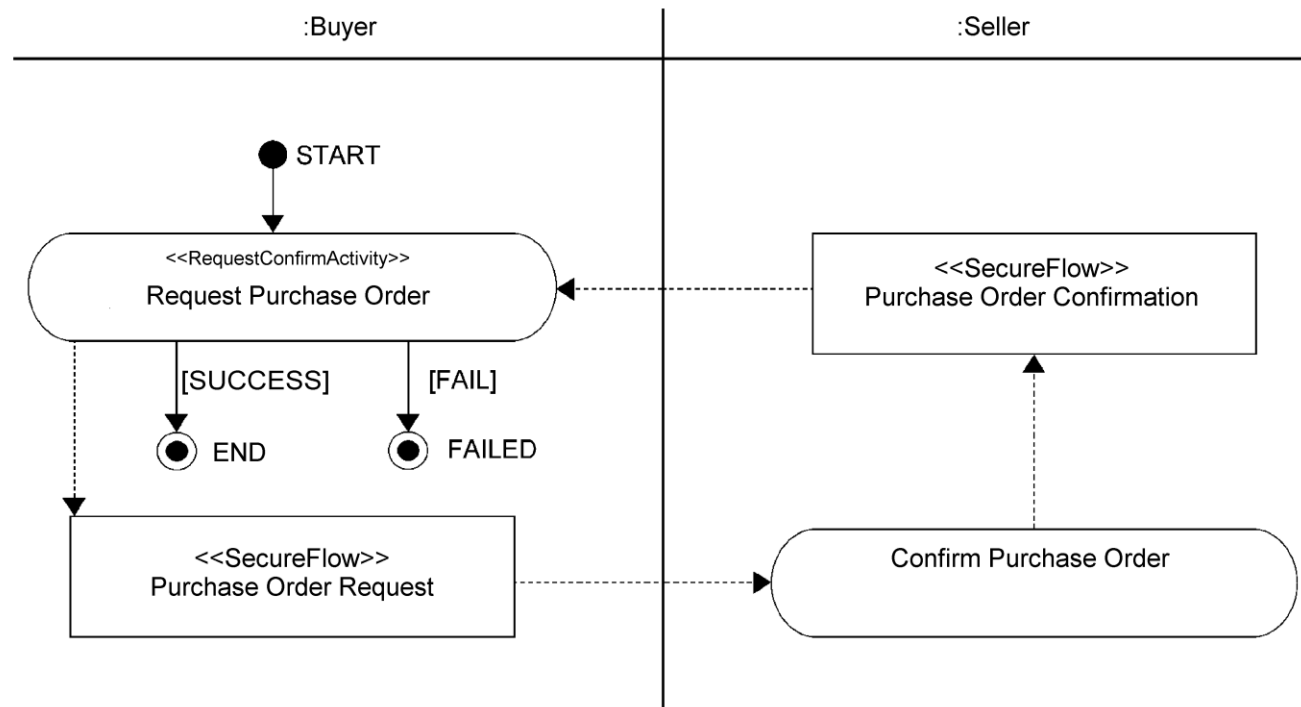


An external business process



Request purchase order - RosettaNet PIP 3A4

Request
purchase
order



[RosettaNet, 2002]

Business process languages



To be able to describe the business processes, there is a need for a (more or less formal) business process modelling language/techniques/diagrams

Examples of business process modelling language:

- PetriNets
- Flowchart diagrams
- UML's Dynamic Diagrams (Activity, State and Interaction Diagrams)
- Event-driven process chain (EPC), that is the process modelling language used in SAP R/3
- IDEF0, IDEF3
- Specification and Description Language (SDL)
- Business Modelling Language (BML)

Basic process language concepts



Four basic process language concepts, which have the following intuitive meaning:

A **time point** is an instant in time, not further decomposable

An **event** is an noteworthy occurrence

A **state** shows the condition of a process and can be represented in several way, e.g. as a set of attribute values

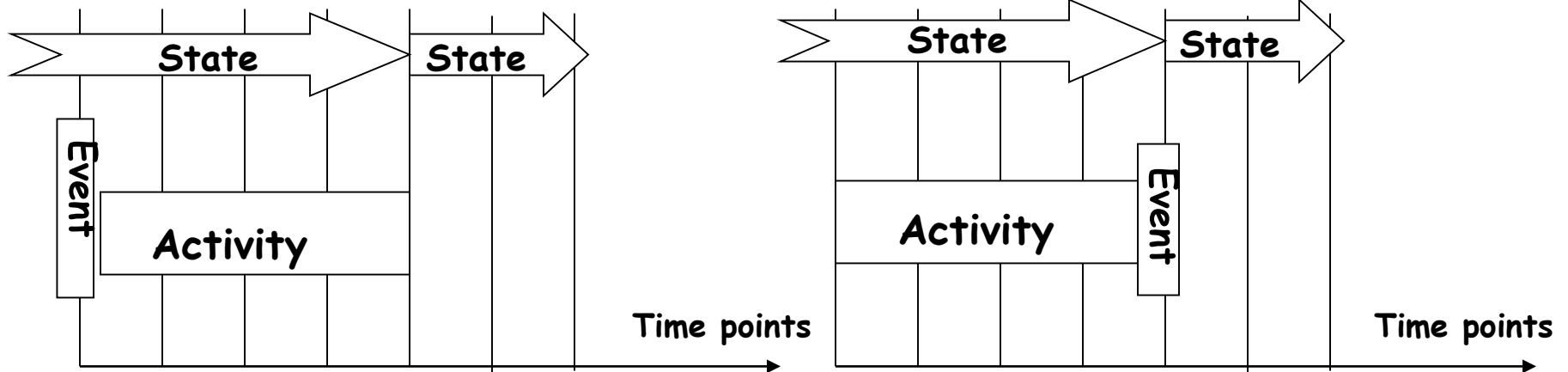
A **activity** is something that is performed in a process

[Söderström et.al., 2002]

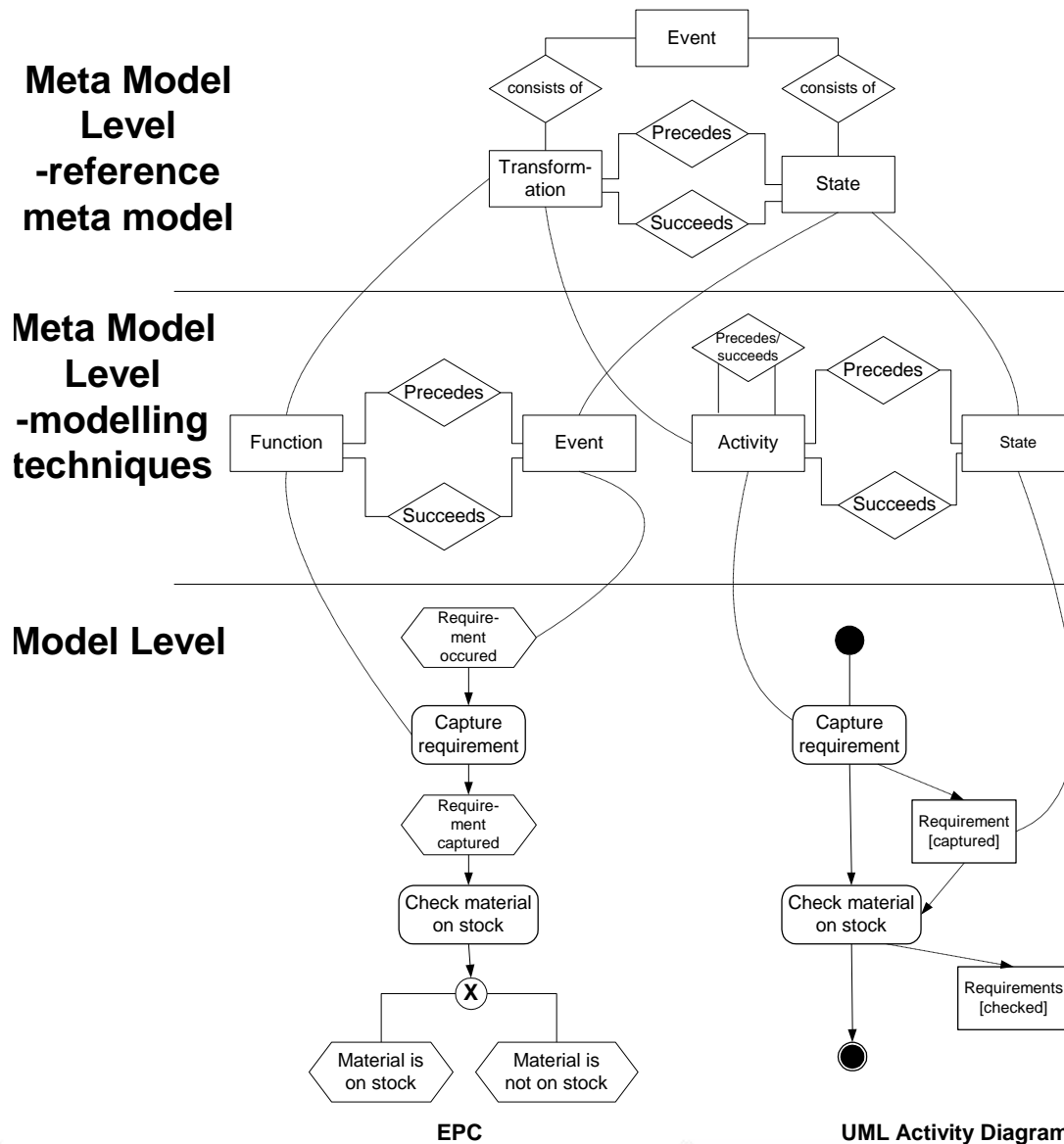
Different meaning of basic terms



Two examples (there are more):



Meta models and reference meta model



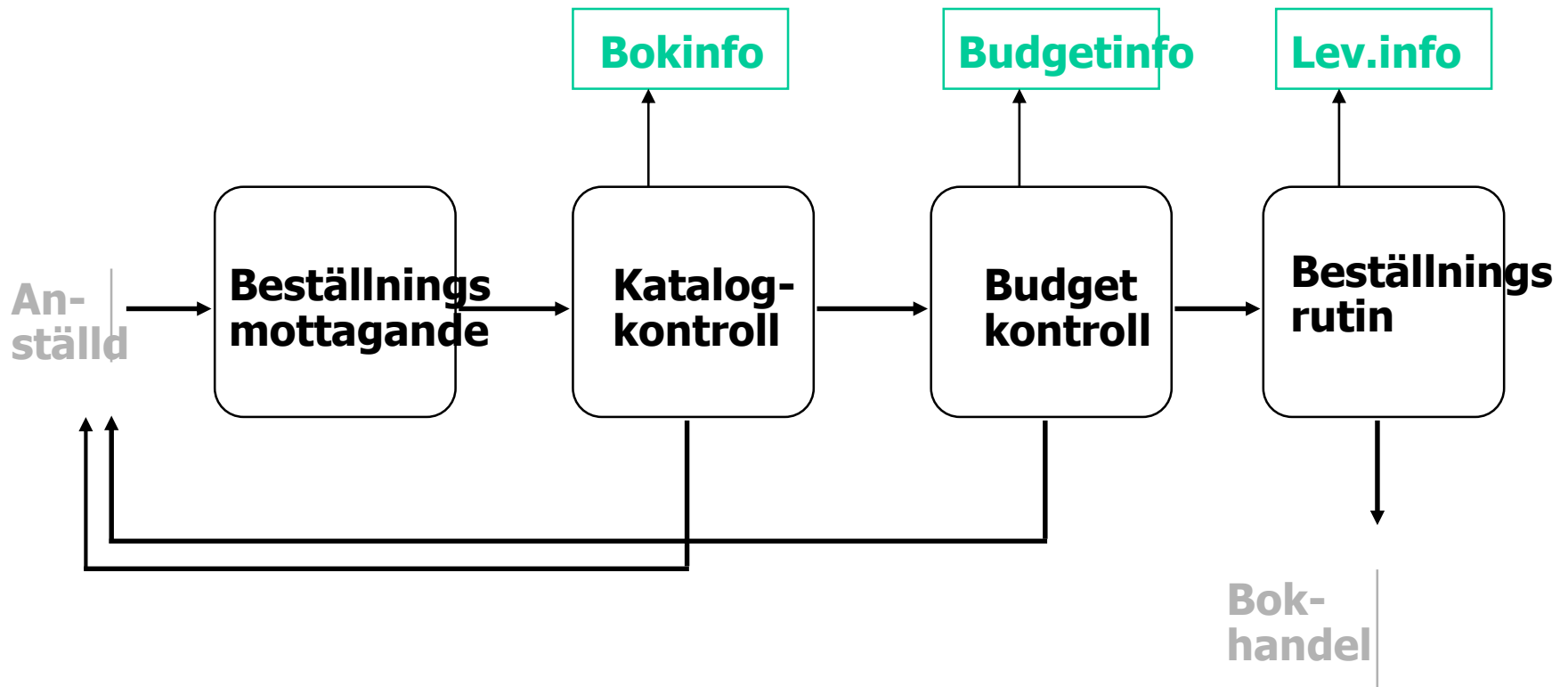
[Rosemann&Green, 2002]

Categorisation of Business process languages

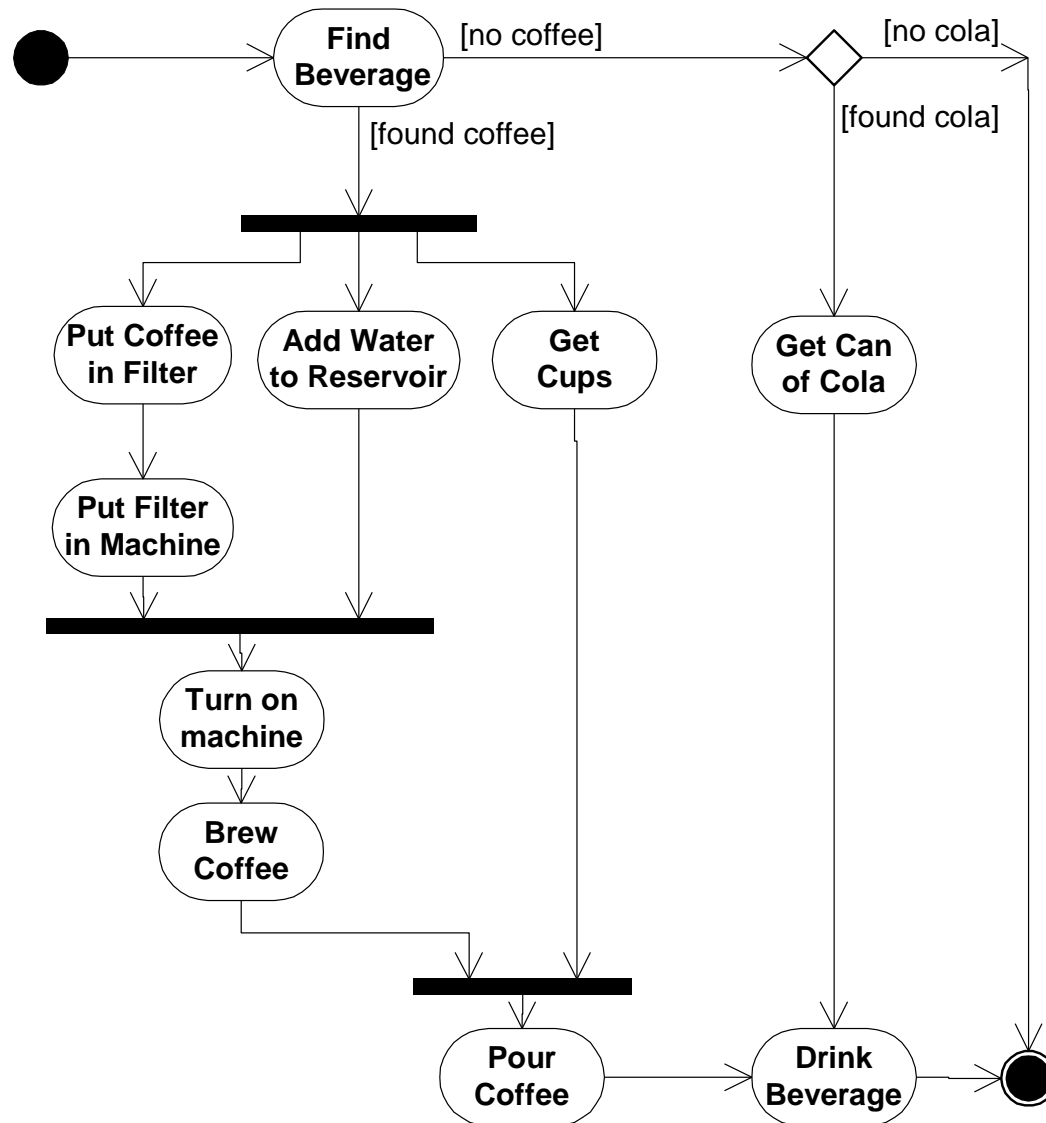


- **Static-oriented languages**
 - visualise the input and output from activities, but not the logical order/time, e.g. IDEF0, **data flow diagram (?)**
- **Activity-oriented languages**
 - describes which activities follows and precede another in a process, e.g EPC, **UML activity diagram**
- **State-oriented languages**
 - describes which states follow and precede another in a process, e.g **UML state diagram**
- **Communication oriented languages**
 - focus on the interaction between people and systems, and between systems, e.g UML sequence diagram, **BML**, SDL

Data flow diagram

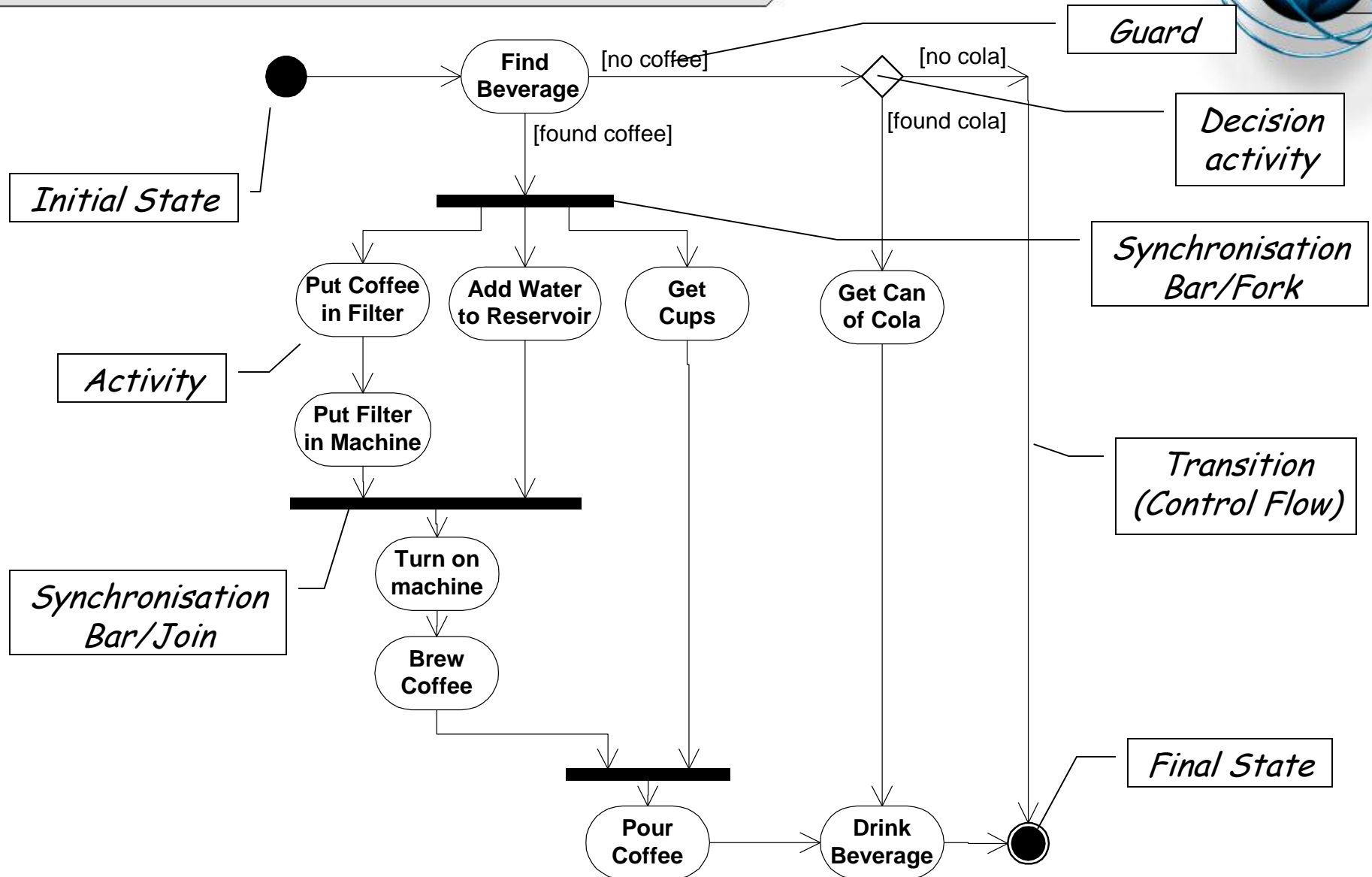


UML Activity Diagram

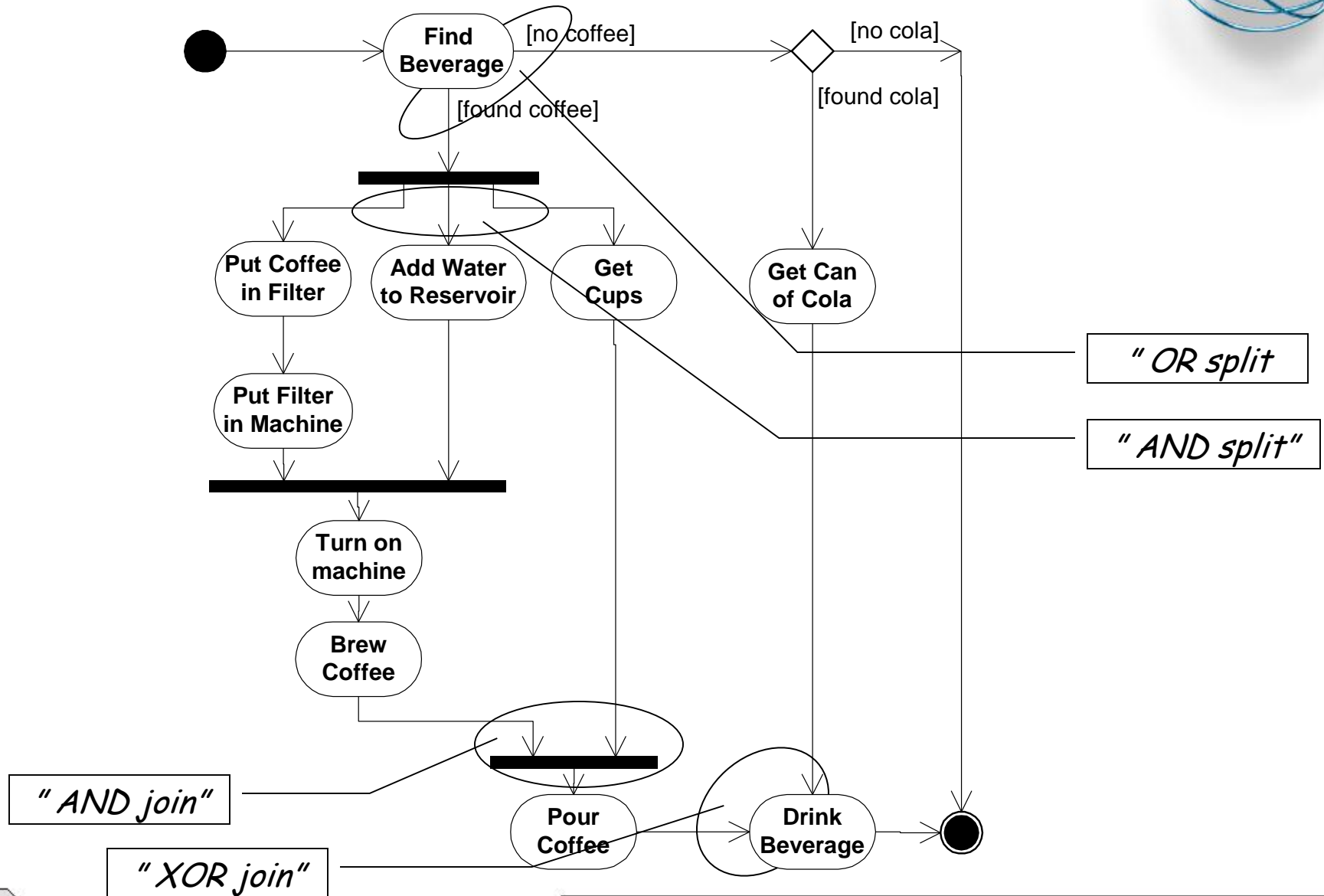


[Fowler&Scott, 1997]

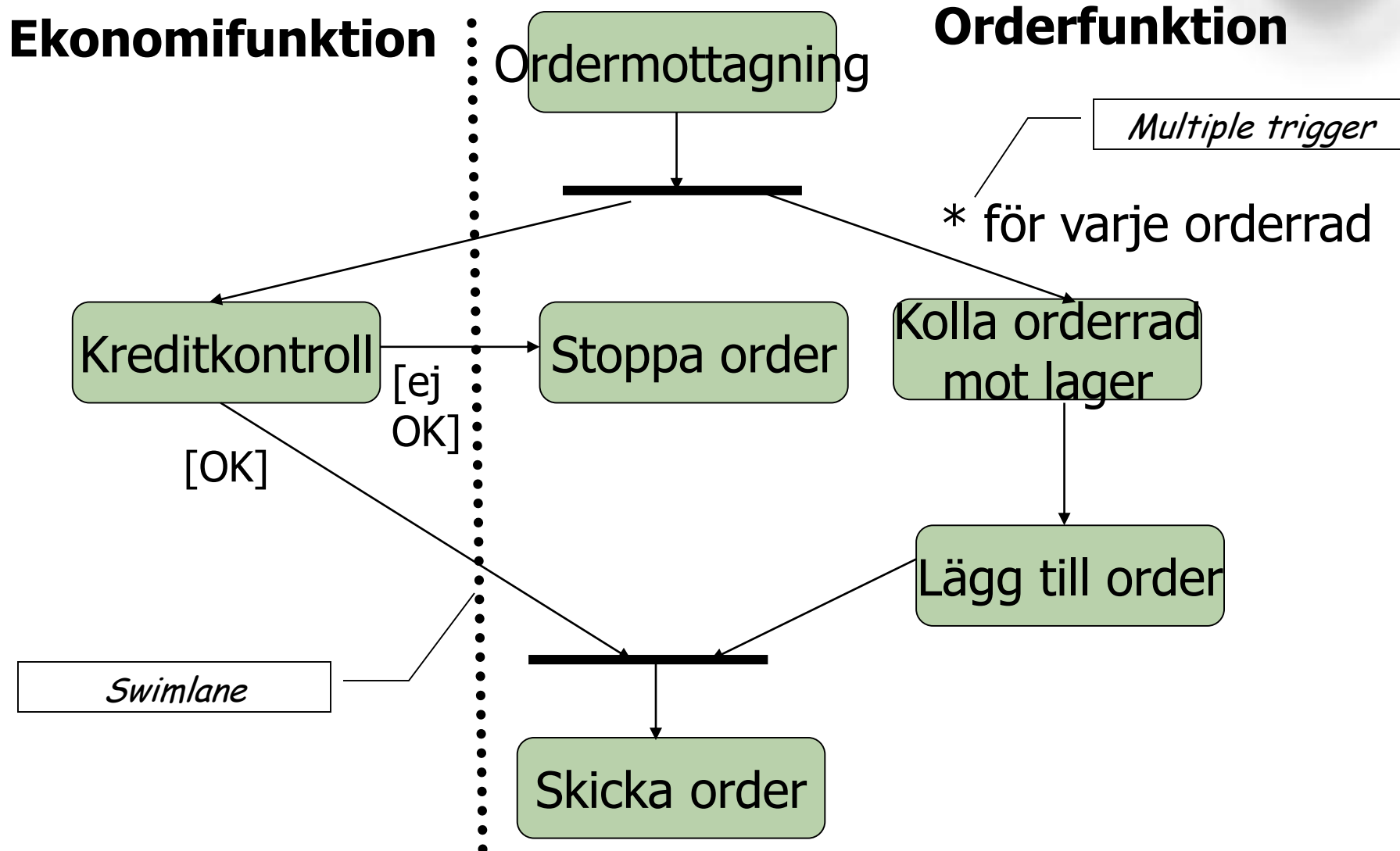
UML Activity Diagram



UML Activity Diagram



UML Activity Diagram



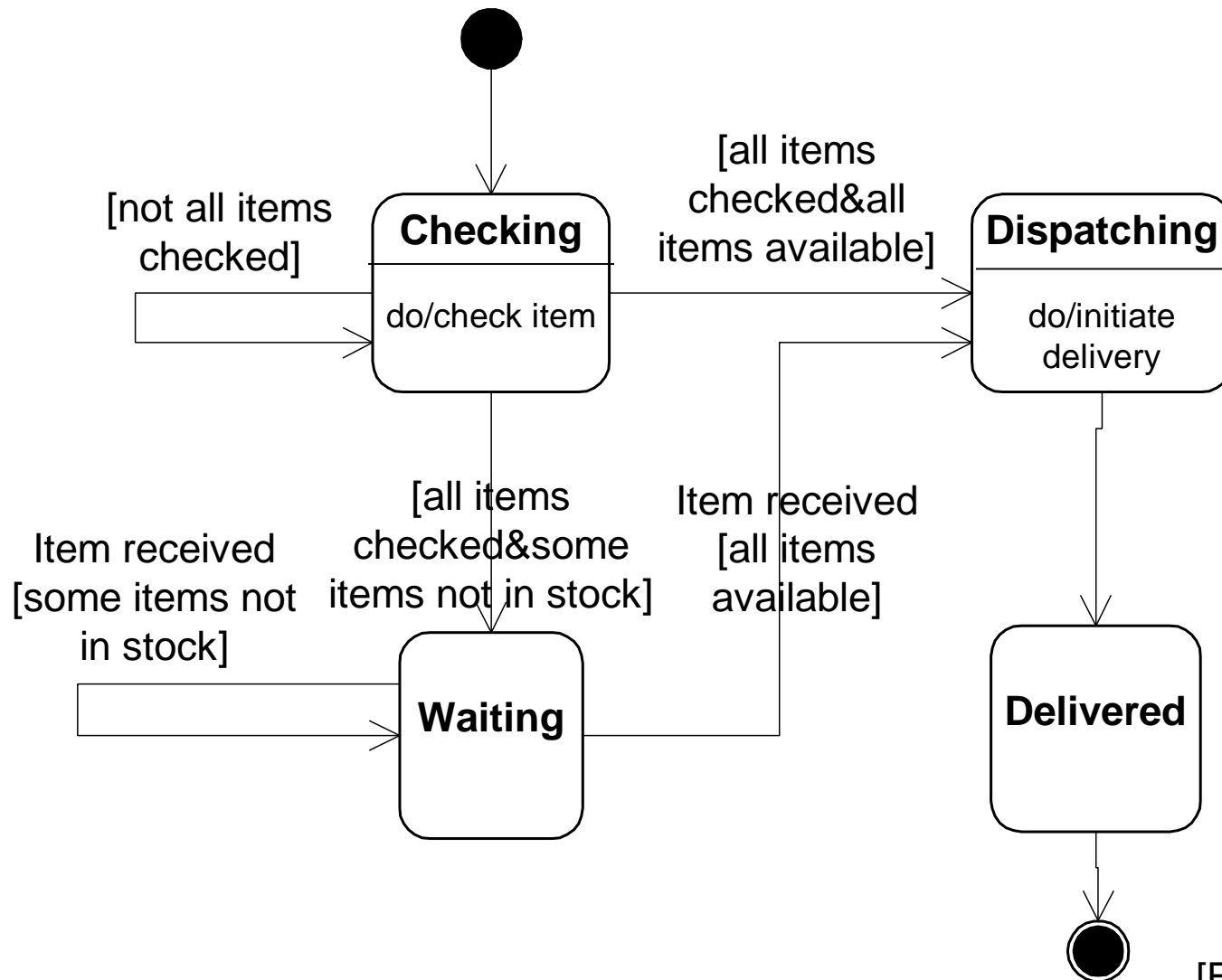
UML Activity Diagram



Aktivitetsdiagram används för att beskriva arbetsflöden

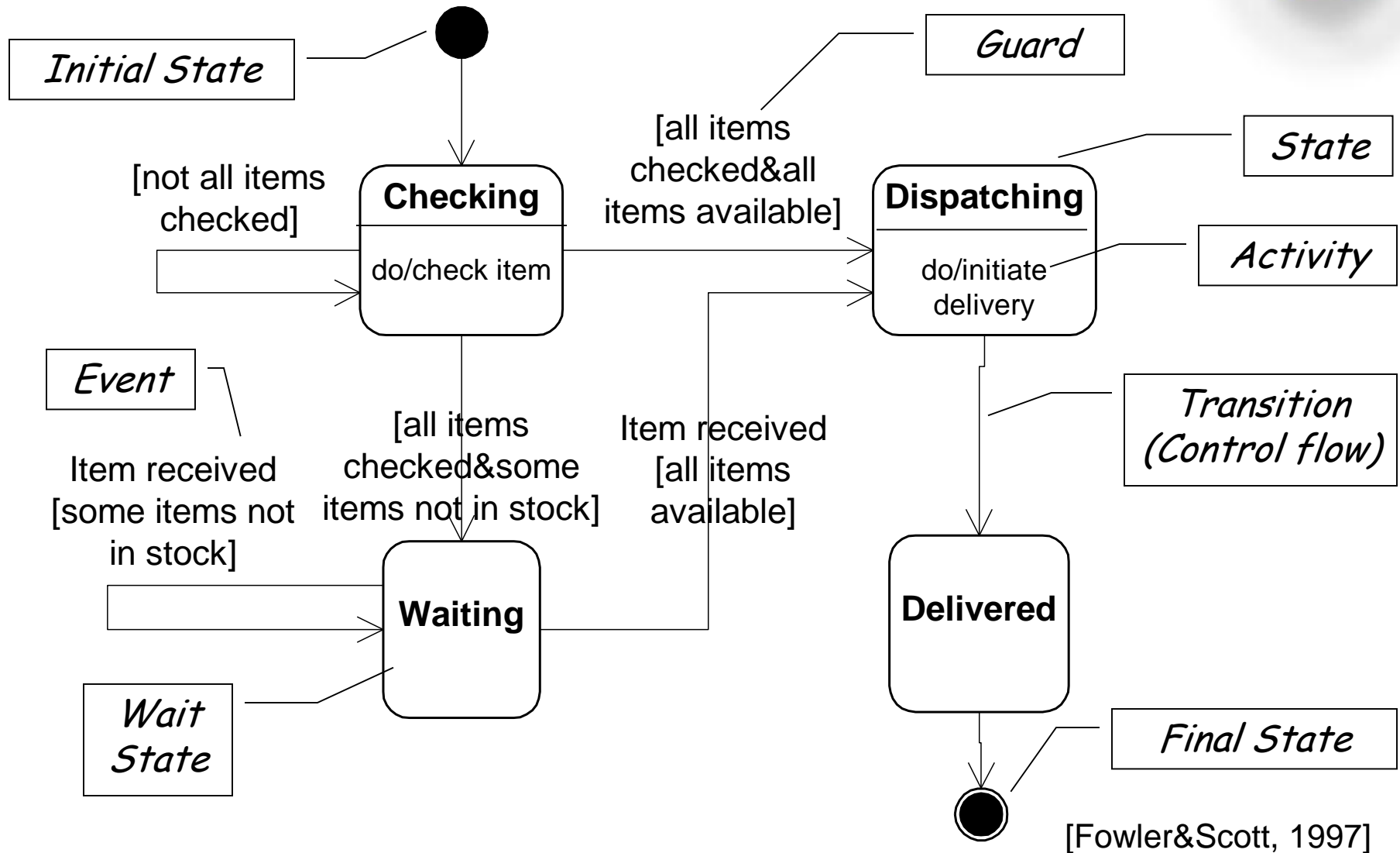
Exempel: Då en order kommit in kontrollerar man kundens kreditvärdighet. Man kontrollerar varje orderrad och ser om varan i fråga finns i lager. Då dessa kontroller utförts skickar man iväg ordern.

UML State Diagram



[Fowler&Scott, 1997]

UML State Diagram

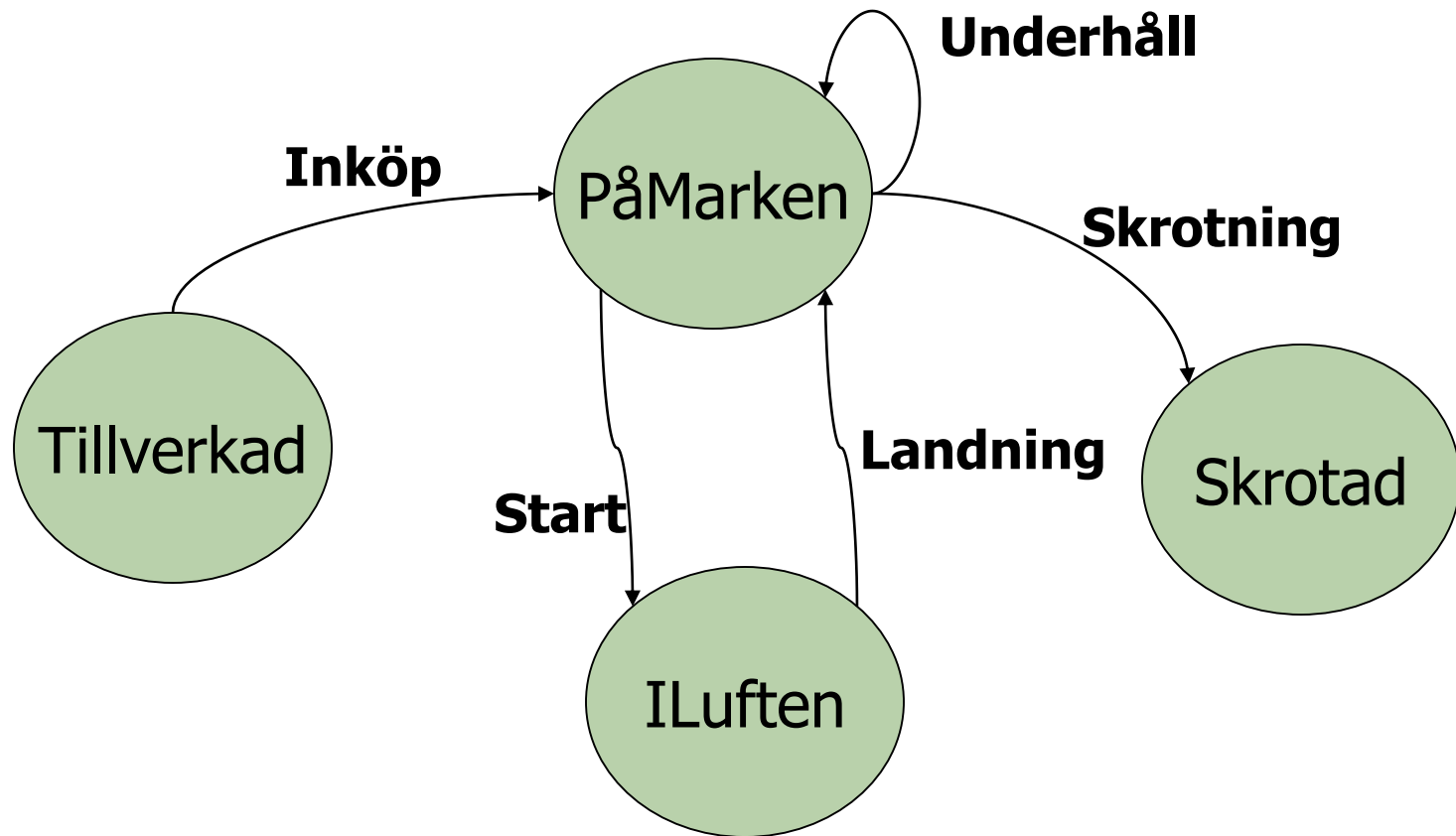


UML State Diagram



- Ett flygbolag har en flotta av flygplan, där följande kan hända med varje plan under dess livstid:
 - Inköp
 - Underhåll
 - Start
 - Landning
 - Skrotning

UML State Diagram



UML Activity vs. State Diagrams



UML Activity Diagram

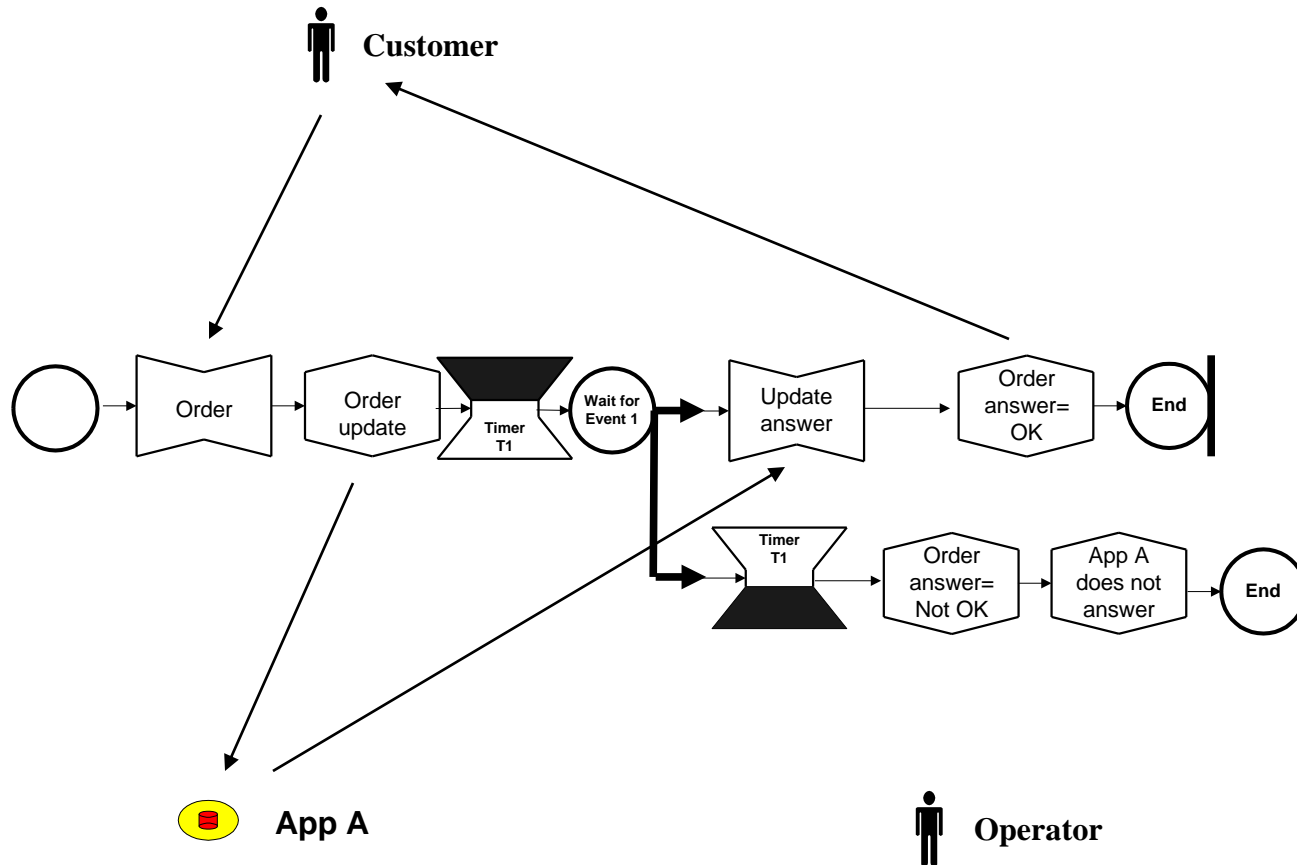
- to understand use cases, workflows
- to describe behaviour with a lot of parallel processing
- to describe the order of activities, i.e. sequencing
- to deal with multi-threaded applications
- an "activity" could be a task by a human or a computer, or an method in a UML Class Diagram

UML State Diagrams

- to understand how objects behave over its lifetime
- state diagrams are sometimes called "life cycle diagrams"
- to describe how the object's states change as a result of events that reach the object
- to describe the order of states

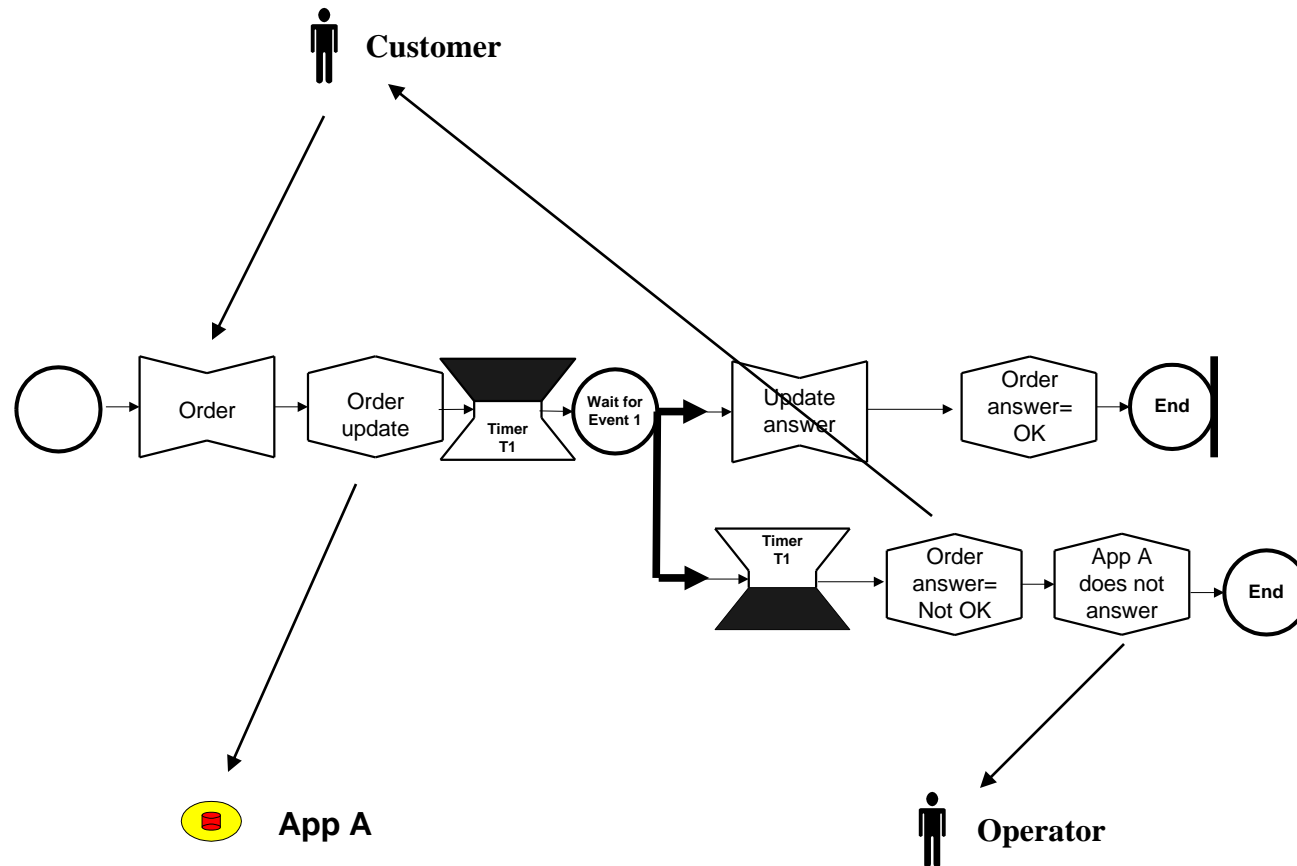
[Fowler&Scott, 1997]

Business Modelling Language (BML)

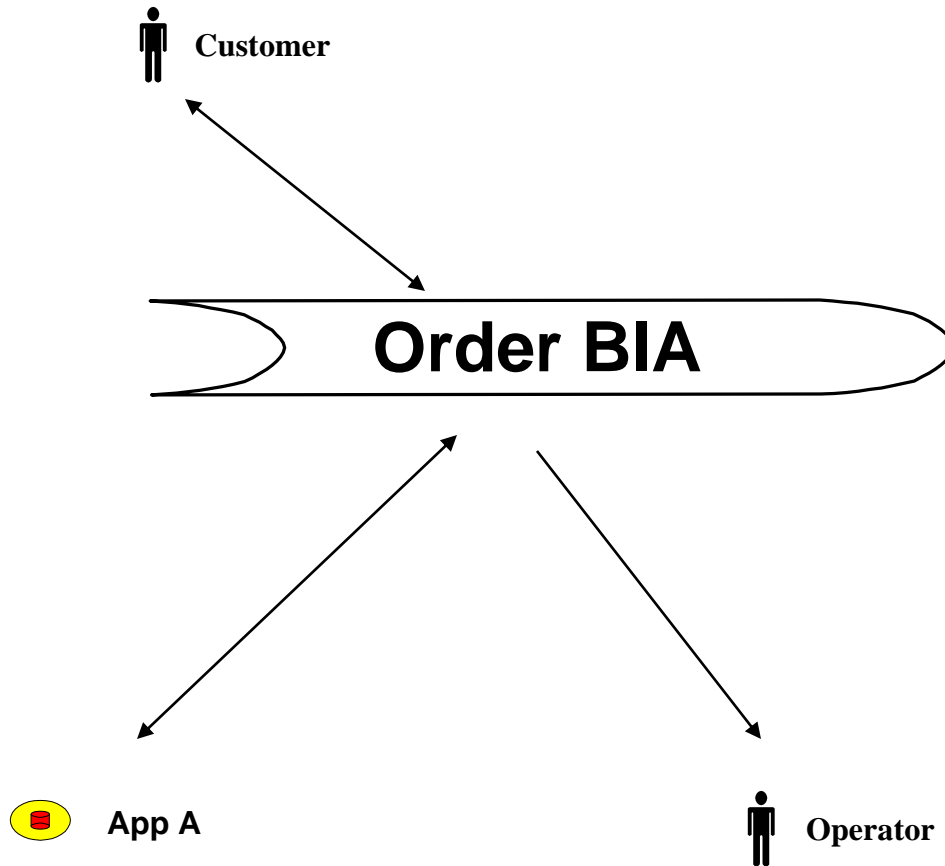


[Johannesson&Perjons, 2002]

Business Modelling Language (BML)



Business Modelling Language (BML)



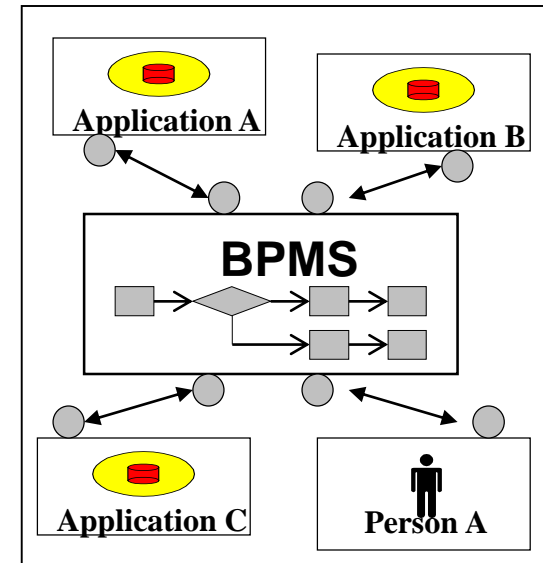
Business Process Management Systems



Business Process Management Systems (BPMS)

- also called Process Brokers, Process Automation Systems, Workflow Management Systems

- directly executable business models
- support process design (modelling), execution, analysis, simulation and optimisation of business processes
- automate the business processes, or the information flow to the activities in the business processes



Demonstration of a BPMS



Demo of Visuera Process Manager

- using BML as a process modelling language
- execute the BML models
- has two main components: a modeller and a manager
- automate the electronic information flow
- monitor and track instances



Data warehousing and DSS

data warehousing, star-join schemas, decision support system (DSS), OLAP, business intelligence tools

DIRECTION

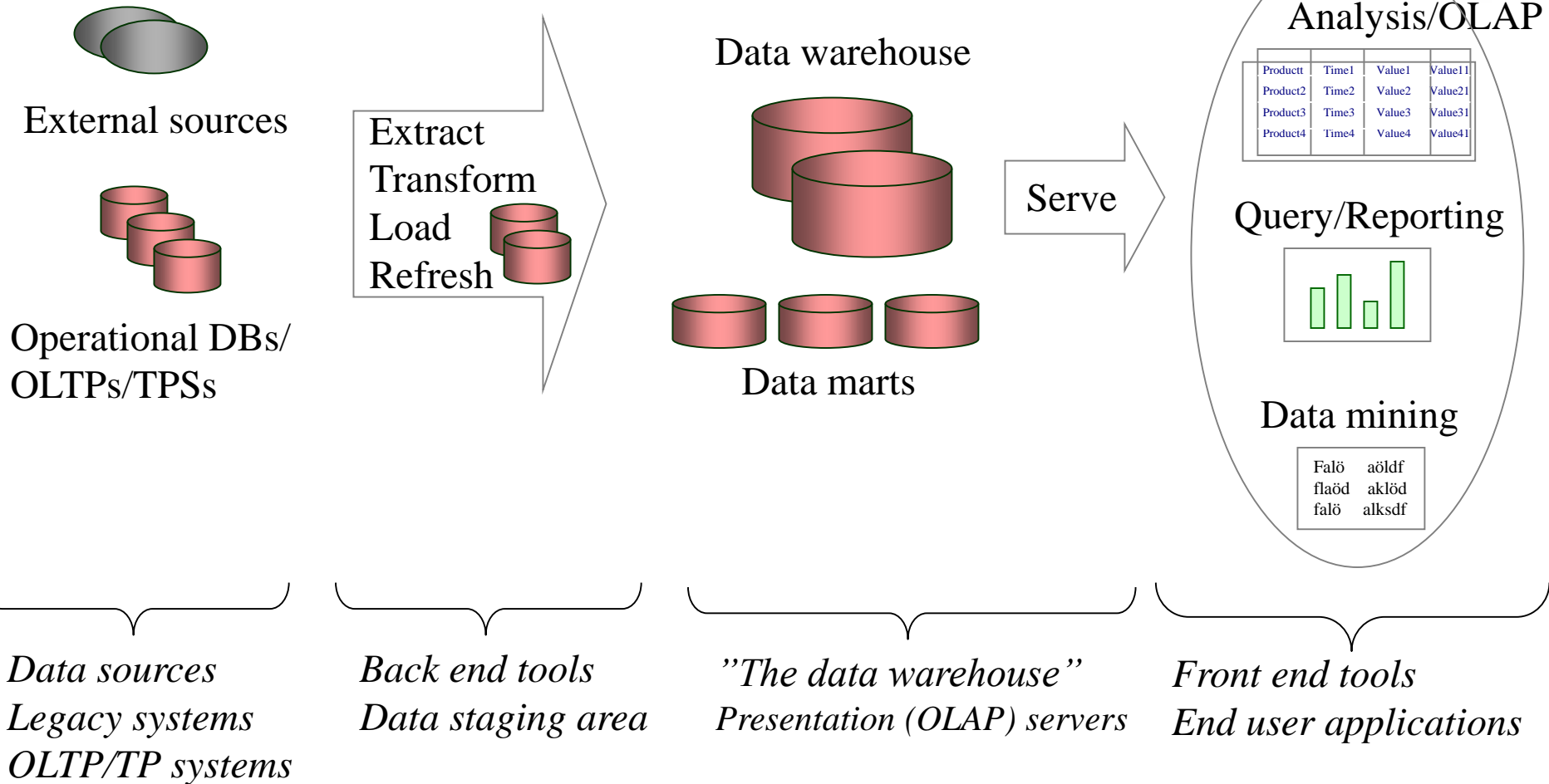
NORTHEAST EAST SOUTHEAST SOUTH SOUTHWEST WEST



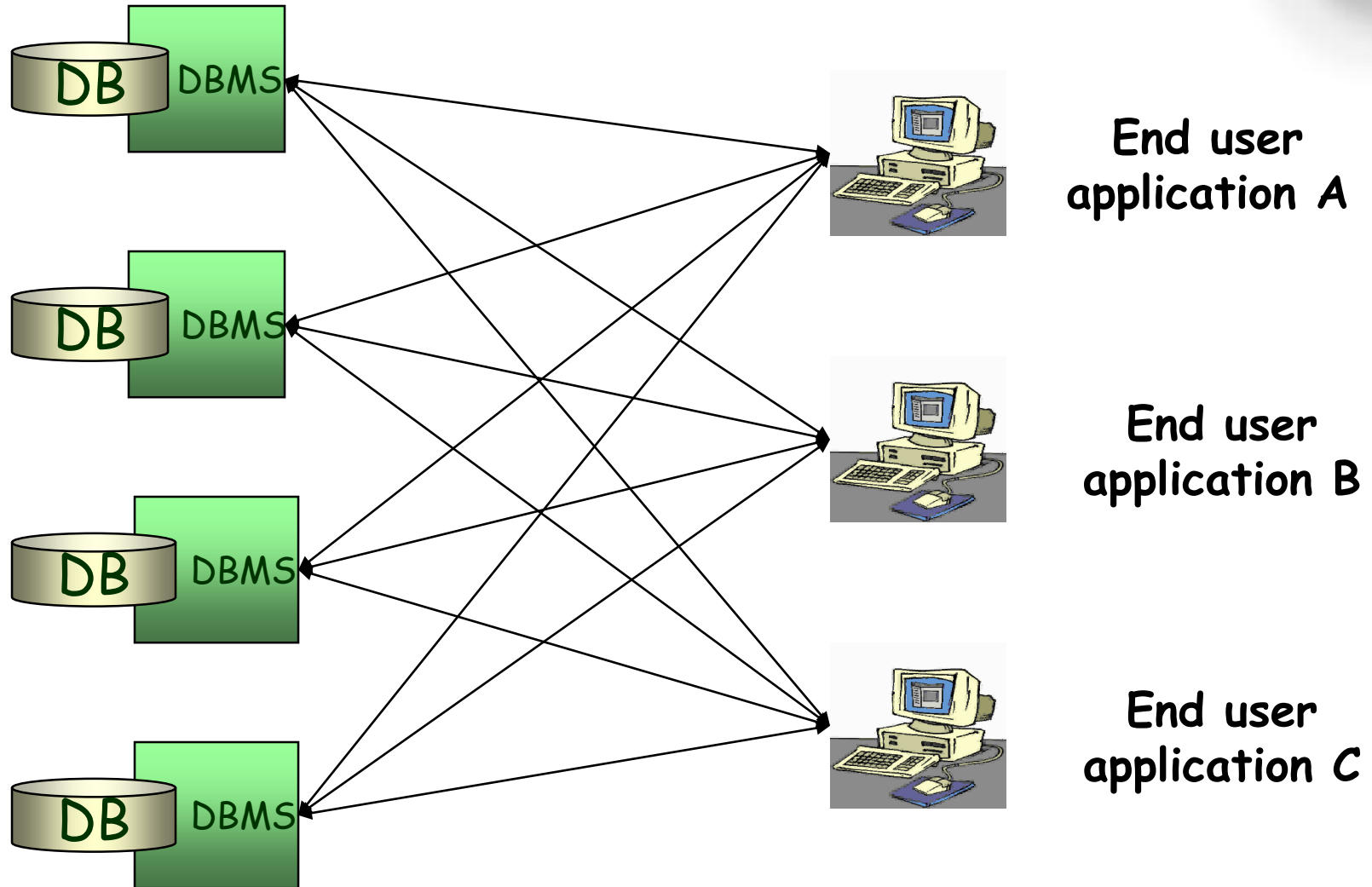
The data warehousing architecture

The back room

The front room



Why a data warehouse?



A data warehousing definition



Chaudhiri & Dayal:

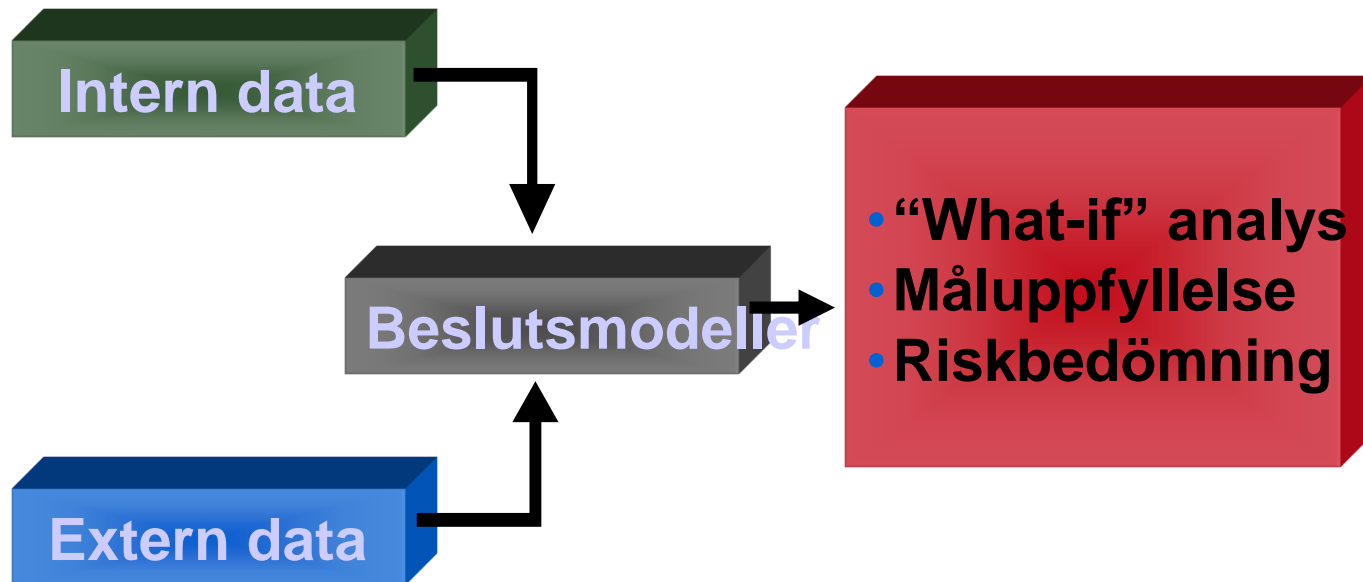
"Data warehousing is a collection of decision support technologies, aimed at enabling the knowledge worker (executive, manager, analyst) to make better and faster decisions."

[Chaundhuri&Dayal, 1997]

A data warehouse is a decision support system (DSS)
according to Chaudhri&Dayal and Kimball

[Kimball, 1998]

DSS model for decision support



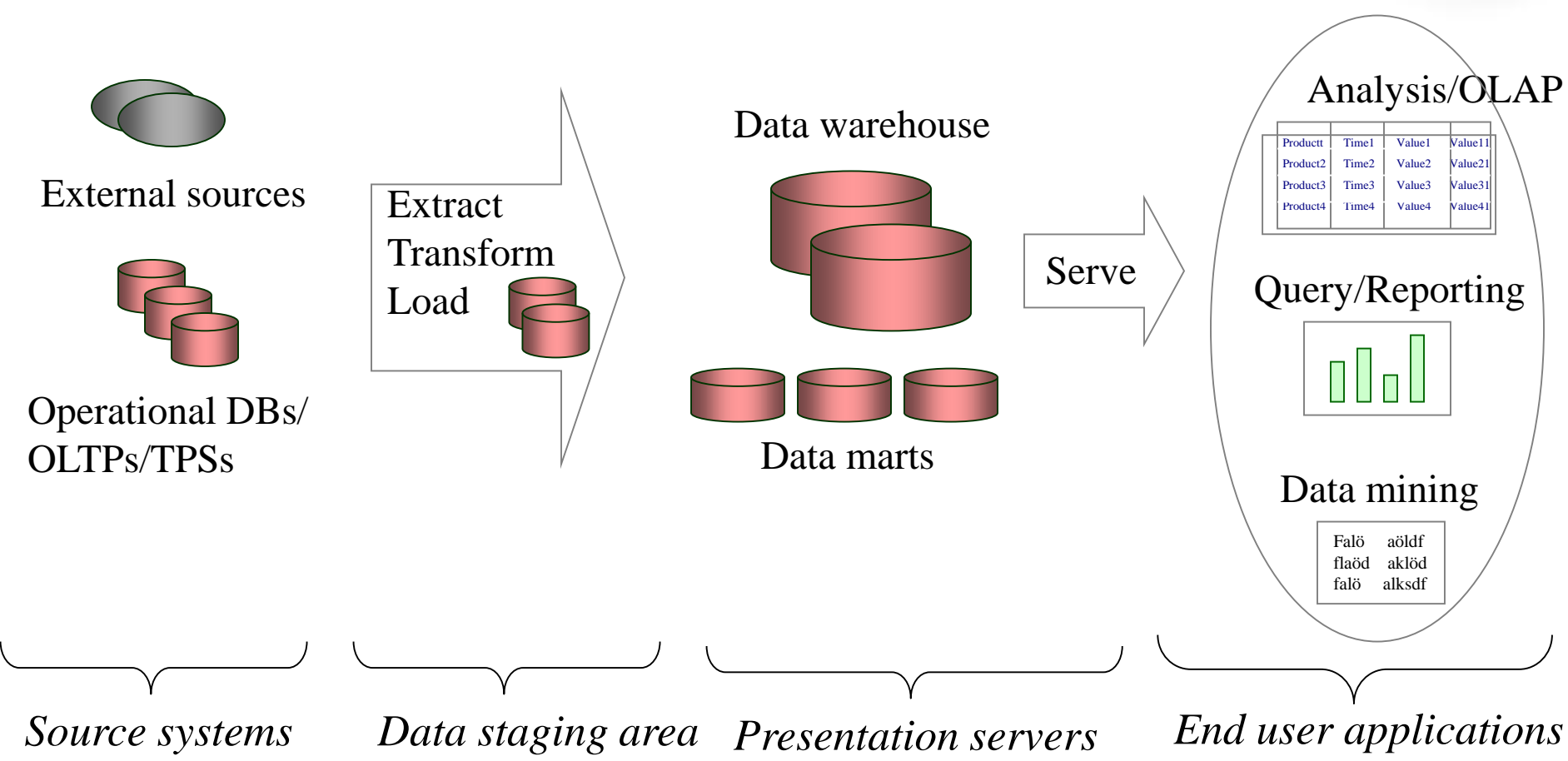
Typical DSS/DW queries



- Which customer groups are most profitable?
- How much is the total sale by month for each sales office?
- Are some sales offices failing to sell some otherwise popular products?
- Is there a correlation between promotion campaigns and sales growth?
- Do we have adequate production capacity and stocks to meet anticipated demand?



The data warehousing architecture



OLTP (=TPS) handling and store transactions

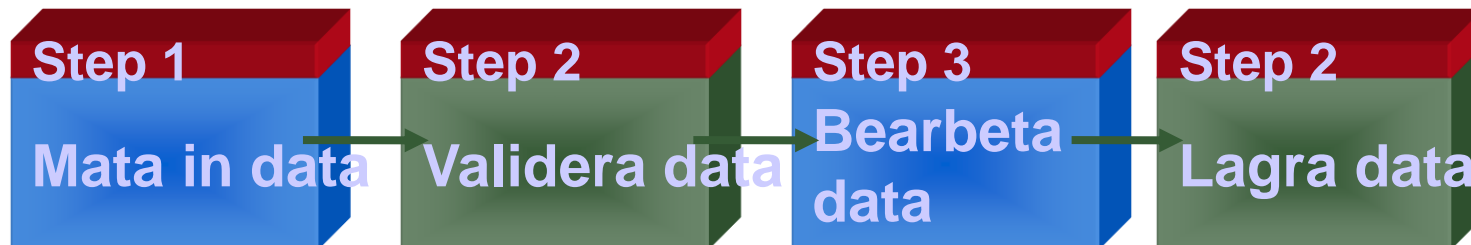


Operational DBs/
OLTPs/TPSs

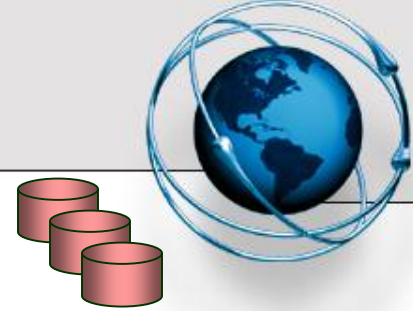
Transaktion: ett utbyte mellan två parter

- Uttag från bankkonto
- Förfrågan om pris på en produkt
- Beställning av en vara

Hur ett TPS hanterar en transaktion



Source systems characteristics



Operational DBs/
OLTPs/TPSs

- the source data often in OLTP (Online Transaction Processing) systems, also called TPS (Transaction Processing Systems)
- high level of transaction throughput
- already occupied by the normal operations of the organisation
- a OLTP system may be reliable and consistent, but there are often inconsistencies between different OLTP systems
- different types of data format and data structures in different OLTP systems

OLTP vs. DSS (Decision Support Systems)

The data staging area

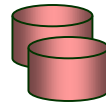
Often the most complex part in the architecture, and involves...

- Extraction (E)
- Transformation (T)
- Load (L)
- indexing

ETL-tools can be used

Scripts for extraction, transformation and load are implemented

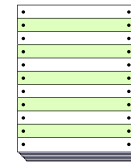
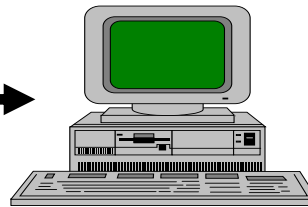
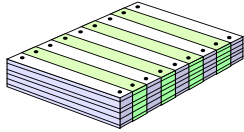
Extract
Transform
Load



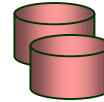
Transformations system



**TRANSFORMATIONS
SYSTEM**



Extract
Transform
Load



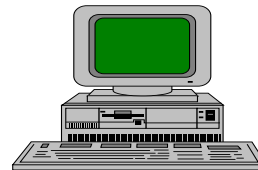
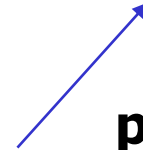
**REAKTIVA
SYSTEM**



signalerar
till



påverkar



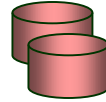
Data staging area



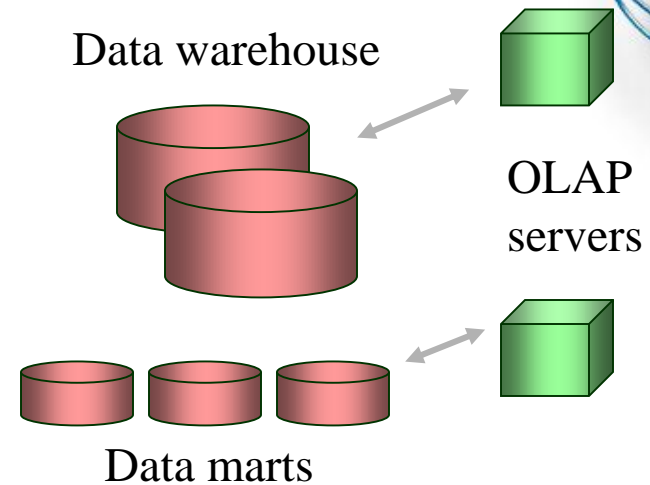
Transformation involves...

- data conversion (to a common format)
- data cleaning
 - data scrubbing (use domain-specific knowledge (e.g postal addresses) to check the data)
 - data migration (specify transformation rules, "replace the string gender by sex")
 - data auditing (discover suspicious pattern, discover violation of stated rules)
- data aggregation
- data enrichment

Extract
Transform
Load



Presentation/OLAP servers



- What is OLAP?
- Star-join schemas/dimensional modelling
- Pre-aggregations
- ROLAP/MOLAP servers

What is OLAP?



- Acronym for "On-line analytical processing"
- A decision support system (DSS) that support ad-hoc querying, i.e. enables managers and analysts to interactively manipulate data. The idea is to allow the users to easy and quickly manipulate and visualise the data through multidimensional views, i.e. different perspectives.
- "An OLAP session takes place online in real time, with rapid responses to manager's or analyst's queries, so that analytical or decision-making process is unsturbed" [O'Brien, 2002]
- An OLAP system from 1970s: "Express", today part of Oracle 9i. Wellknown OLAP system today: Hyperion "Essbase", Cognos "PowerPlay", IBM "DB2 OLAP Server", Microsofts "Analysis service"
- *Multidimensional view* of data is the foundation for OLAP

Spreadsheet output of OLAP tool



product
product group

mounth
quarter

office
region

Column headers
(join constraints)

Column header
(application constraint)

Answer set representing
focal event

Product Group	Region	First Quarter - 1997
Group A	ABC	1245
Group A	XYZ	34534
Group B	ABC	45543
Group B	XYZ	34533

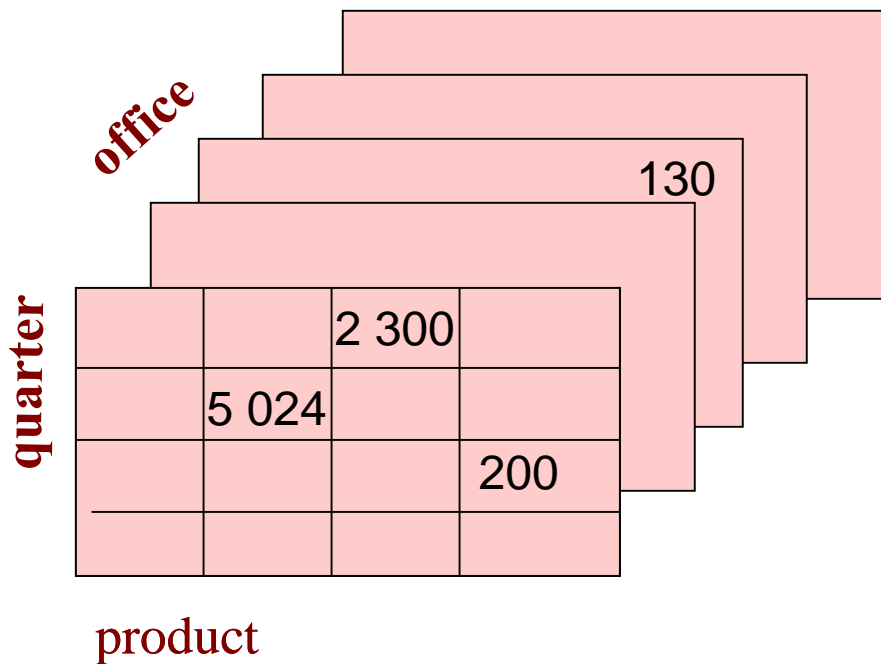
Row headers

"Multidimensional" view of the data

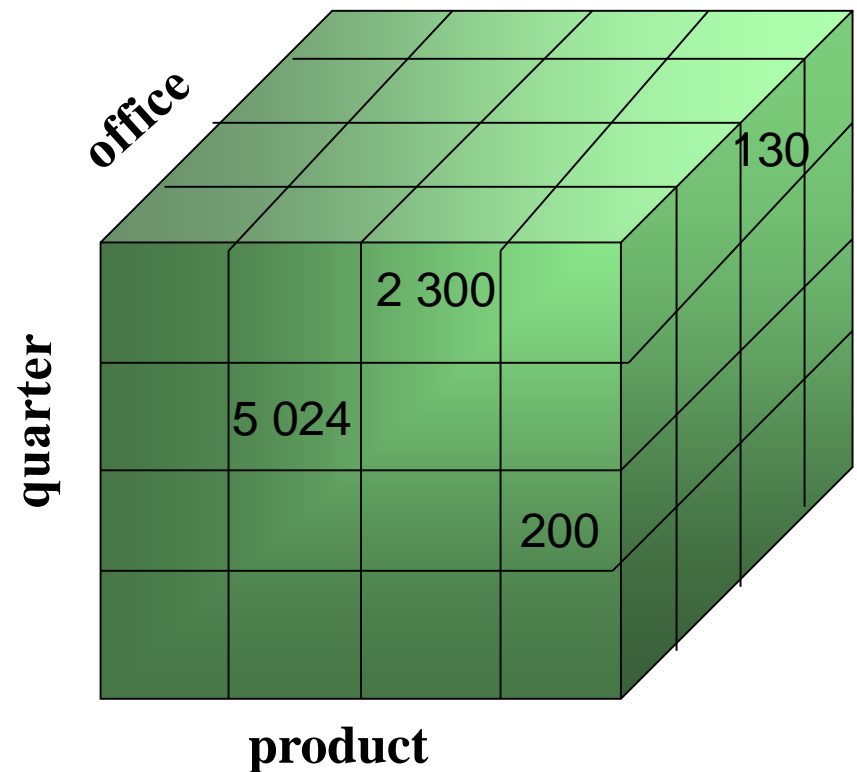


- a popular conceptual model that influenced front-end tools, database design, and the query engine for OLAP
- numeric measures/facts (e.g. number of, sum, total sales) depends on a set of dimensions

Spreadsheets:



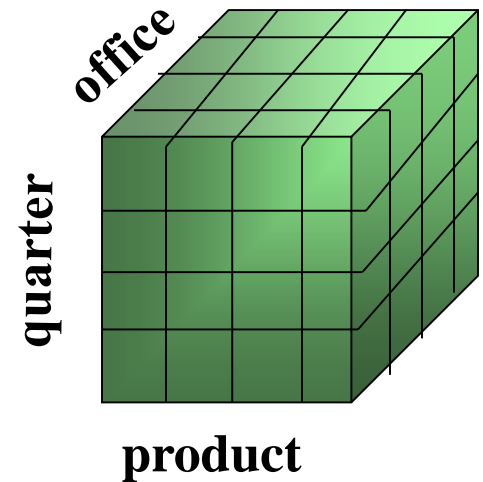
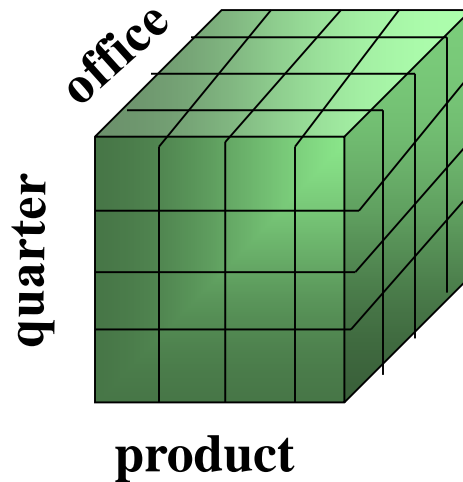
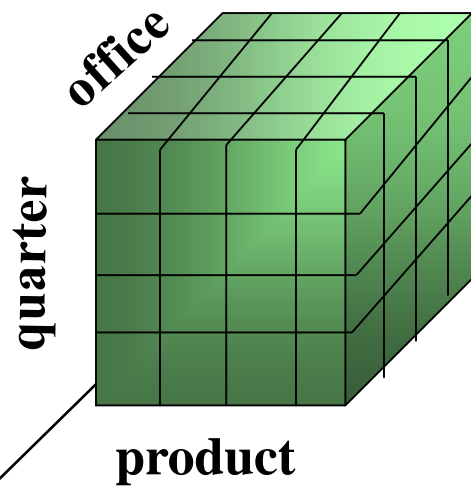
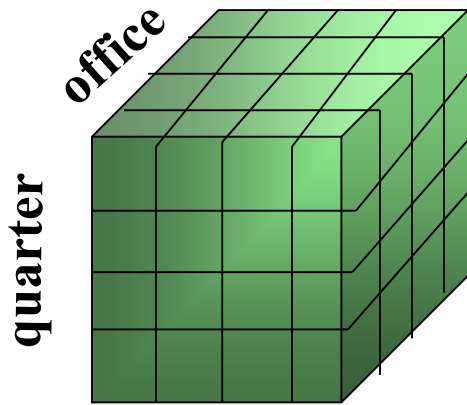
A data cube:



"Multidimensional" view of the data

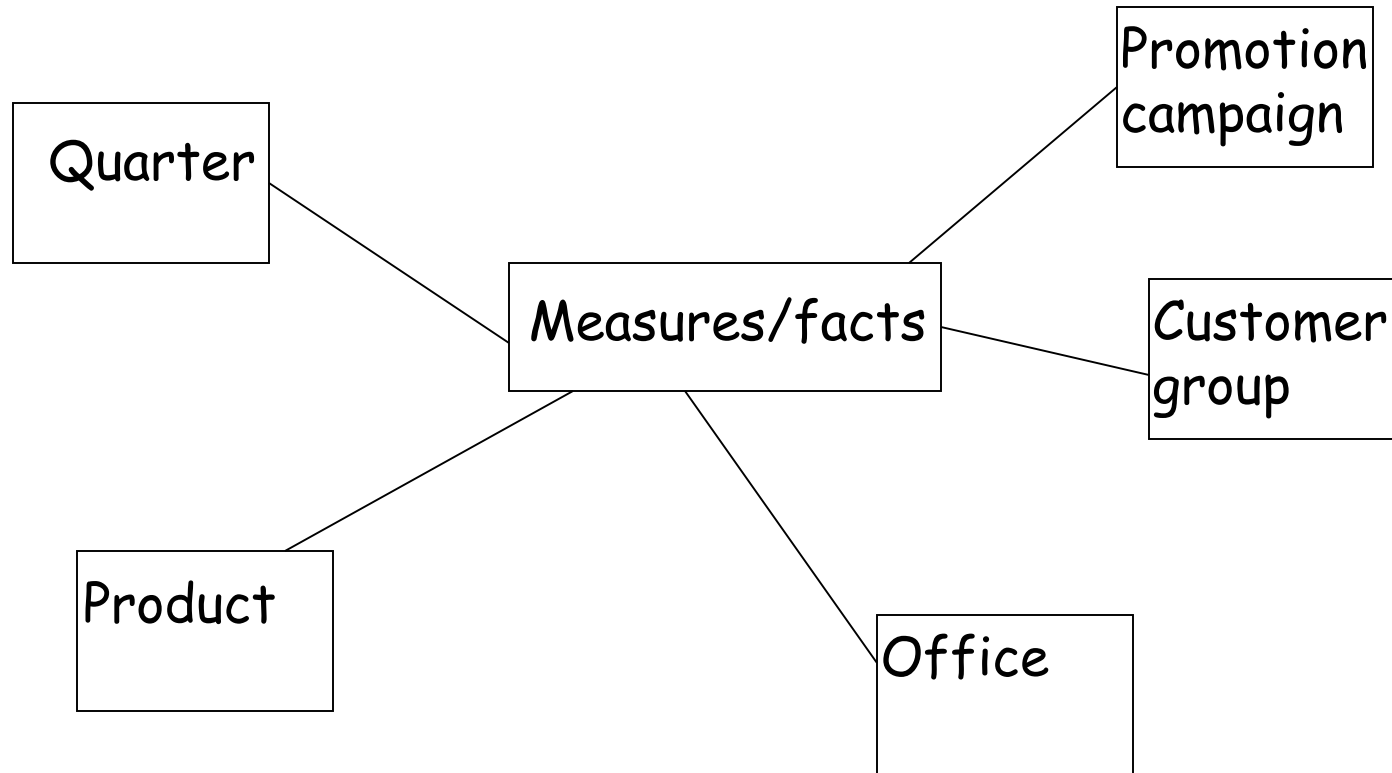


**promotion
campaign**



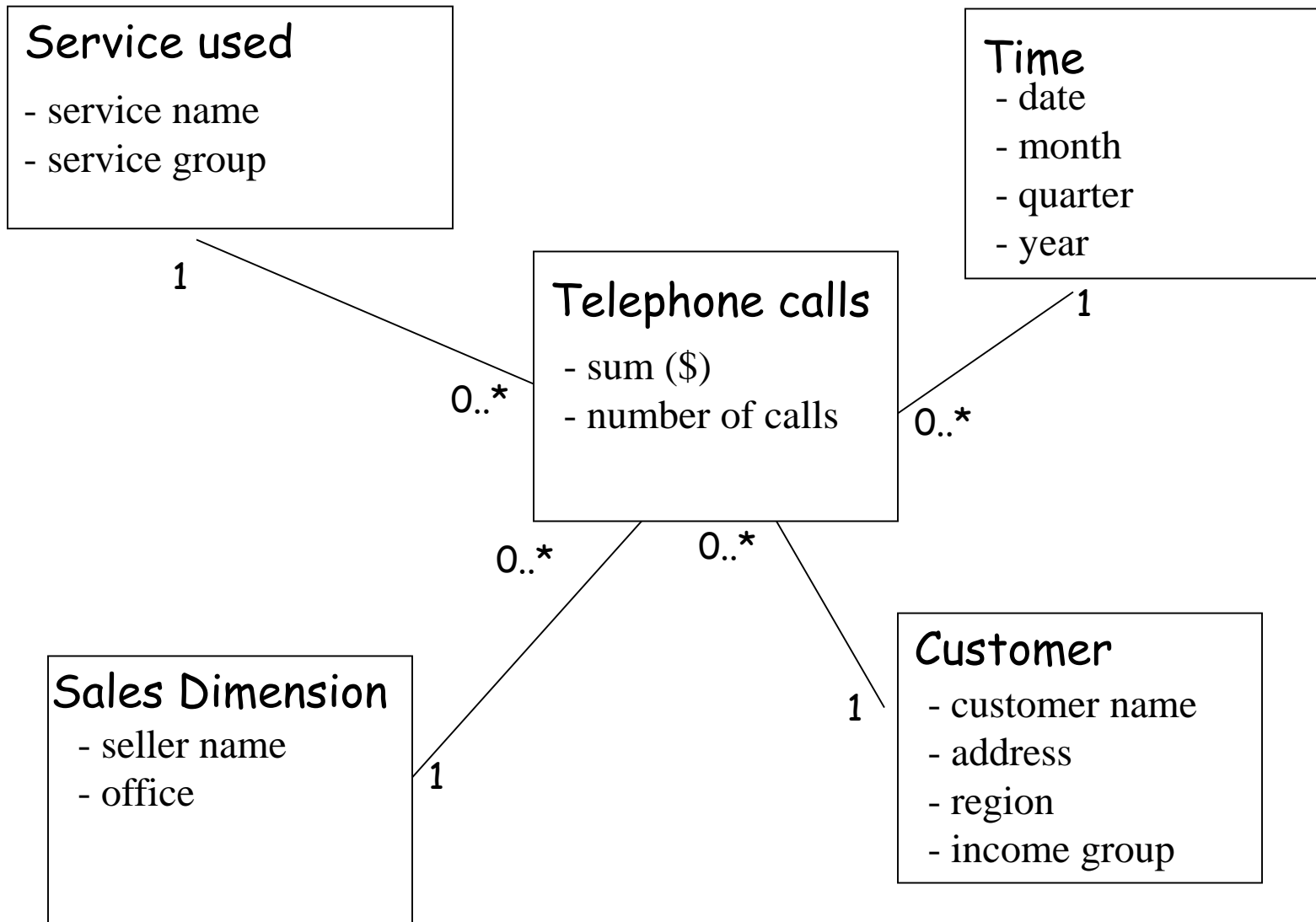
customer group

"Multidimensional" view of the data

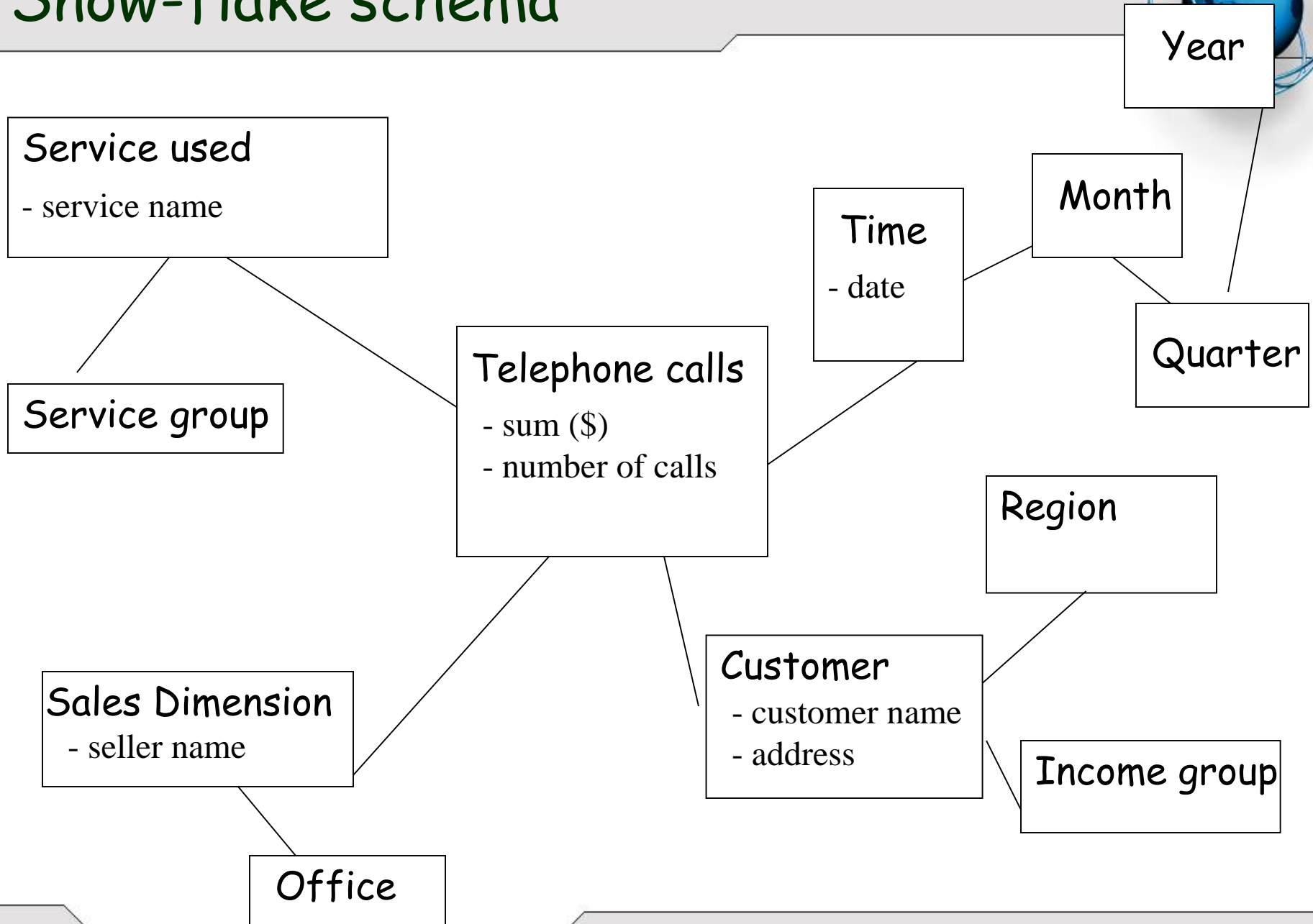




Dimensional modelling - Star-join schema



Snow-flake schema





Dimensional modelling - Star-join schema

Service Dimension

Key	Service	Service group
S1	Local call	Group A
S2	Intern. call	Group A
S3	SMS	Group B
S4	WAP	Group C

Time Dimension

Date/Key	Month	Quarter	Year
991011	9910	4 - 99	99
991012	9910	4 - 99	99

Fact table - Transactions

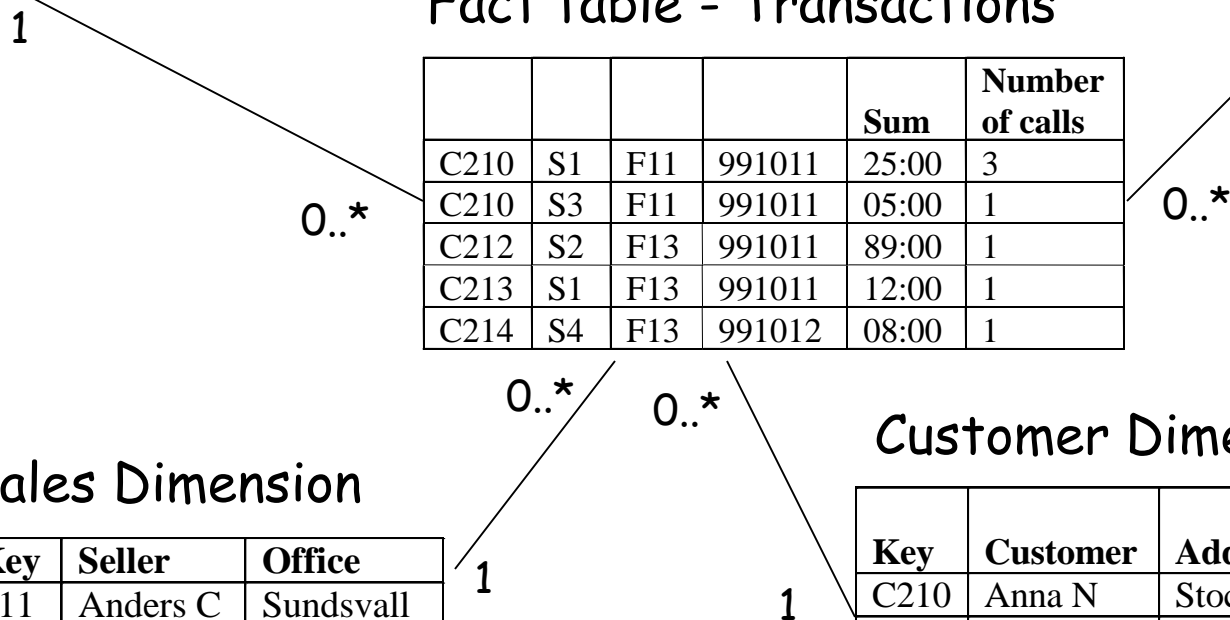
				Sum	Number of calls
C210	S1	F11	991011	25:00	3
C210	S3	F11	991011	05:00	1
C212	S2	F13	991011	89:00	1
C213	S1	F13	991011	12:00	1
C214	S4	F13	991012	08:00	1

Sales Dimension

Key	Seller	Office
F11	Anders C	Sundsvall
F12	Lisa B	Sundsvall
F13	Janis B	Kista

Customer Dimension

Key	Customer	Address	Region	Income group
C210	Anna N	Stockholm	Stockholm	B
C211	Lars S	Malmö	Skåne	B
C212	Erik P	Rättvik	Dalarna	C
C213	Danny B	Stockholm	Stockholm	A
C214	Åsa S	Stockholm	Stockholm	A





Dimensional modelling - Star-join schema

Service Dimension

Key	Service	Service group
S1	Local call	Group A

Time Dimension

Date/Key	Month	Quarter	Year
991011	9910	4 - 99	99
991012	9910	4 - 99	99

Fact table - Transactions

				Sum	Number of calls
C210	S1	F11	991011	25:00	3
C213	S1	F13	991011	12:00	1

*Query:
For how much
did customers in Sthlm
use service "Local call"
in october 1999?*

$\Sigma=37:00$

Sales Dimension

Key	Seller	Office
F11	Anders C	Sundsvall
F12	Lisa B	Sundsvall
F13	Janis B	Kista

Customer Dimension

Key	Customer	Address	Region	Income group
C210	Anna N	Stockholm	Stockholm	B
C213	Danny B	Stockholm	Stockholm	A
C214	Åsa S	Stockholm	Stockholm	A

Normalised ER vs. Dimensional modelling



Normalised entity-relationship (ER) modelling

- a logical design technique to eliminate data redundancy to keep consistency and storage efficiency
- makes transaction simple and deterministic
- ER models for enterprise are usually complex, e.g. they often have hundreds, or even thousands, of entities/tables

Dimensional modelling

- a logical design technique that present data in a intuitive way and that allow high-performance access
- aims at model decision support data
- easier to navigate for the user and high performance

[Kimball, 1998]

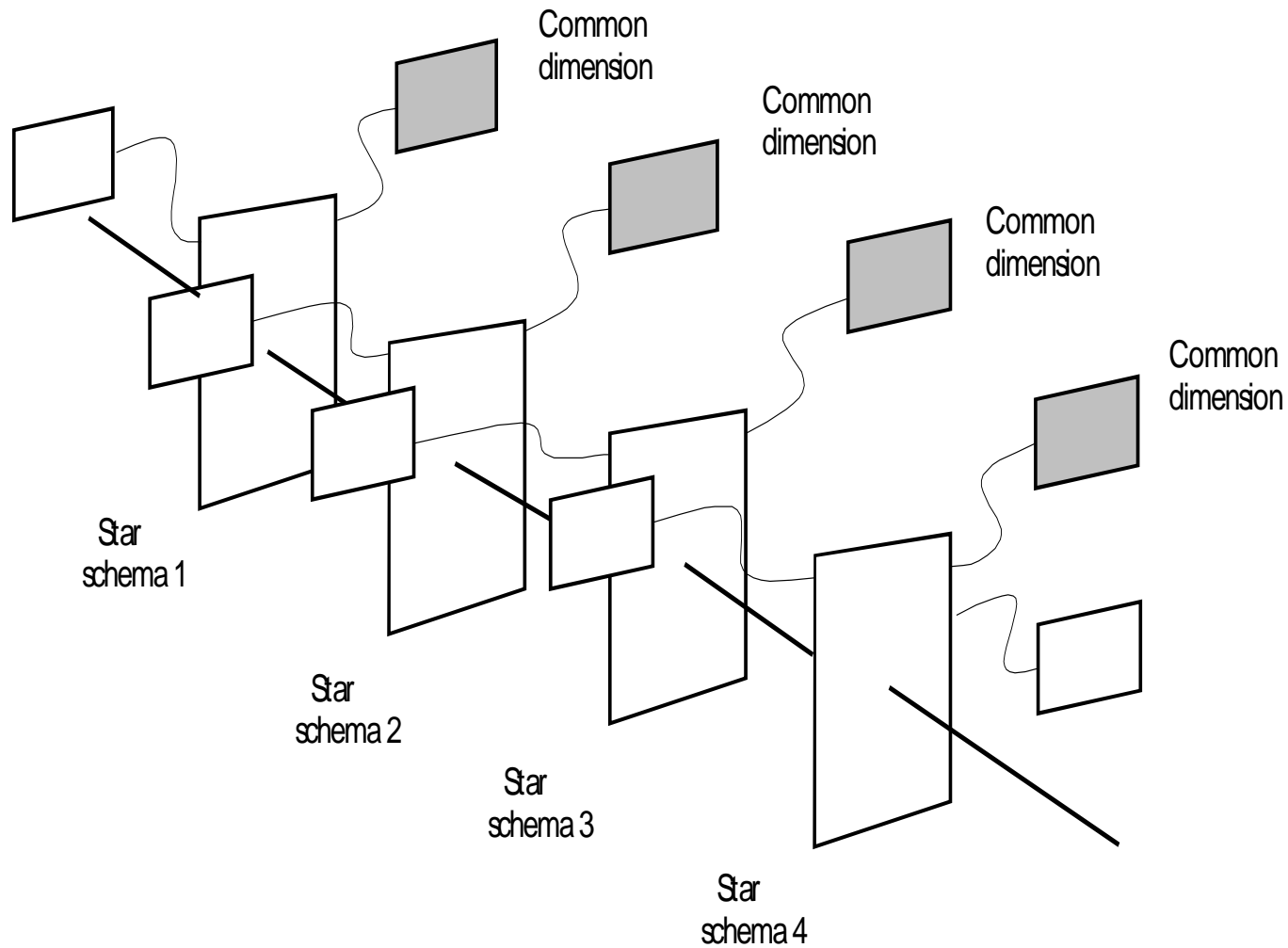
Why dimensional modelling?



- high performance by eliminating joins (denormalisation) and make use of special indexes
- the logical model is easy understand
- strategy to handling aggregates, e.g. summery records that are logical redundant with base table to enhance query performance

[Kimball, 1998]

A family of stars



A family of stars

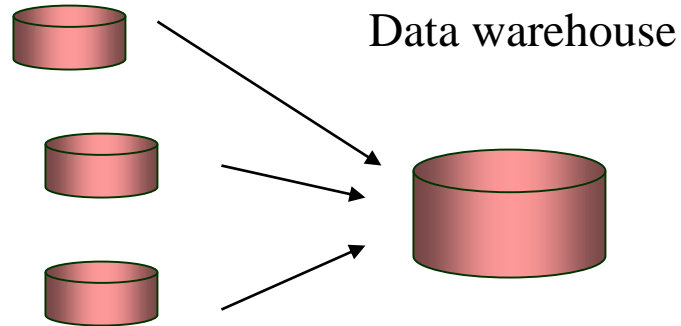


- A dimensional model of a data warehouse for a large data warehouse consists of between 10 and 25 similar-looking star-join schemas. Each star join will have 5 to 15 dimensional tables.
- Conformed (shared) dimensions for drill-across. A Conformed dimension is a dimension that means the same thing with every possible fact table to which it can be joined.

Dependent vs. Independent data marts



Independent Data marts



Dependent Data marts

