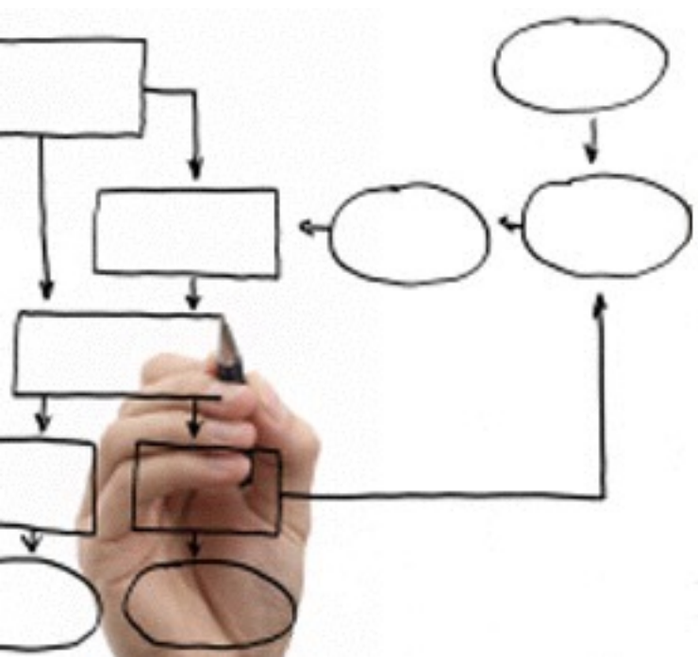
Methods for the specification and verification of business processes

MPB (6 cfu, 295AA)

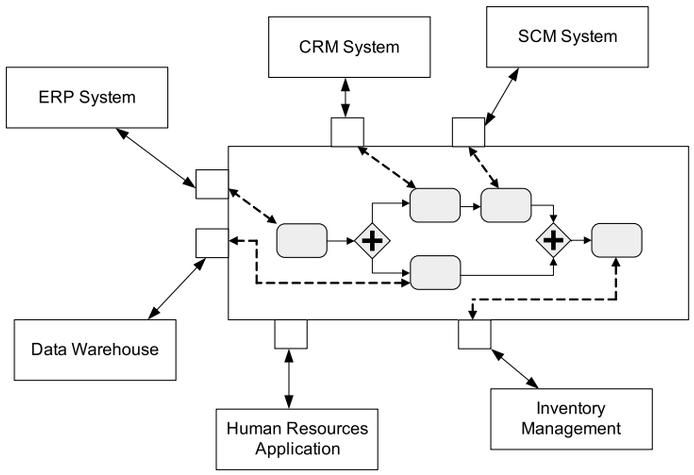


Roberto Bruni

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

06 - Evolution

Object



Overview of the evolution of (Information Systems inside) Enterprise Systems Architectures

Ch.2 of Business Process Management: Concepts, Languages, Architectures

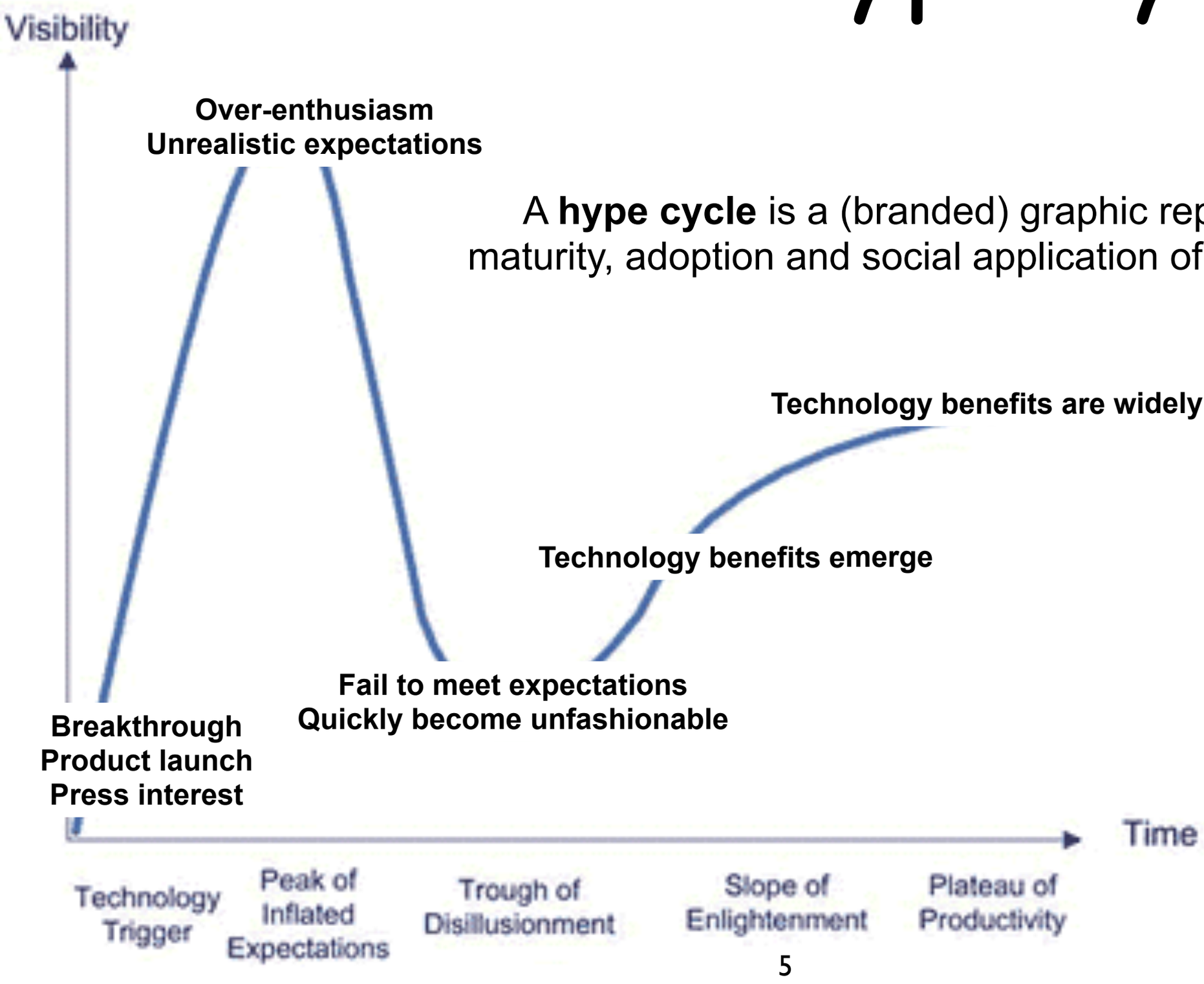
Guiding principles

Modularity and information hiding (encapsulation, interfaces, reuse, maintainability, response to change)

Software Architecture

Definition: A **software architecture** defines a structure that organizes the software elements and the resources of a software system.

Gartner's hype cycle



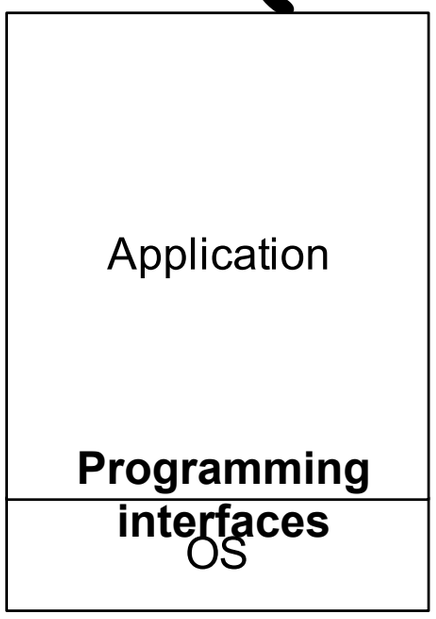
A **hype cycle** is a (branded) graphic representation of the maturity, adoption and social application of specific technologies

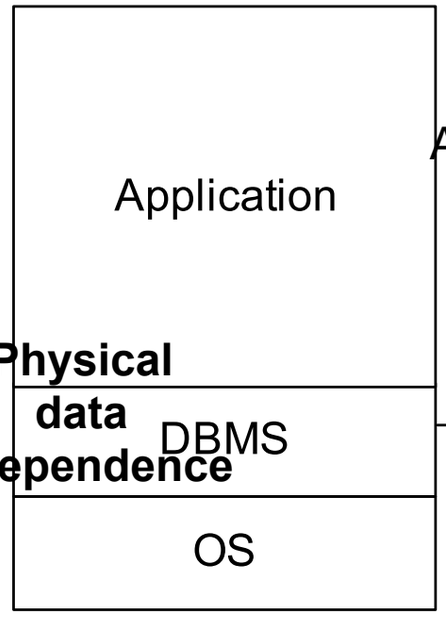
Early systems (architectures)

Monolithic applications developed from scratch

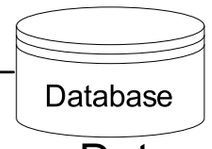
Porting required redevelopment

Data dependency and consistency issues

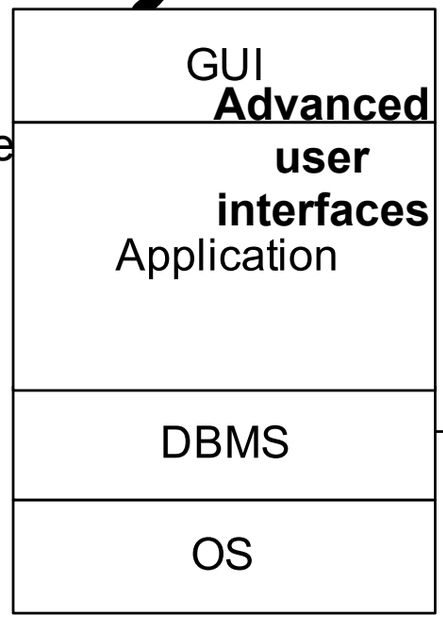




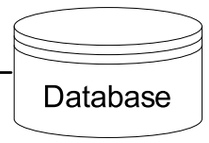
Application code and (textual) user interfaces still entangled



Data management as a primary concern



Human interaction made easier



t

1970

1980

1990

Enterprise Applications

OS + DBMS + GUI + Networking capabilities =
more and more elaborate information systems
could be engineered

Typically hosting enterprise applications
(customers, personnel, products, resources)

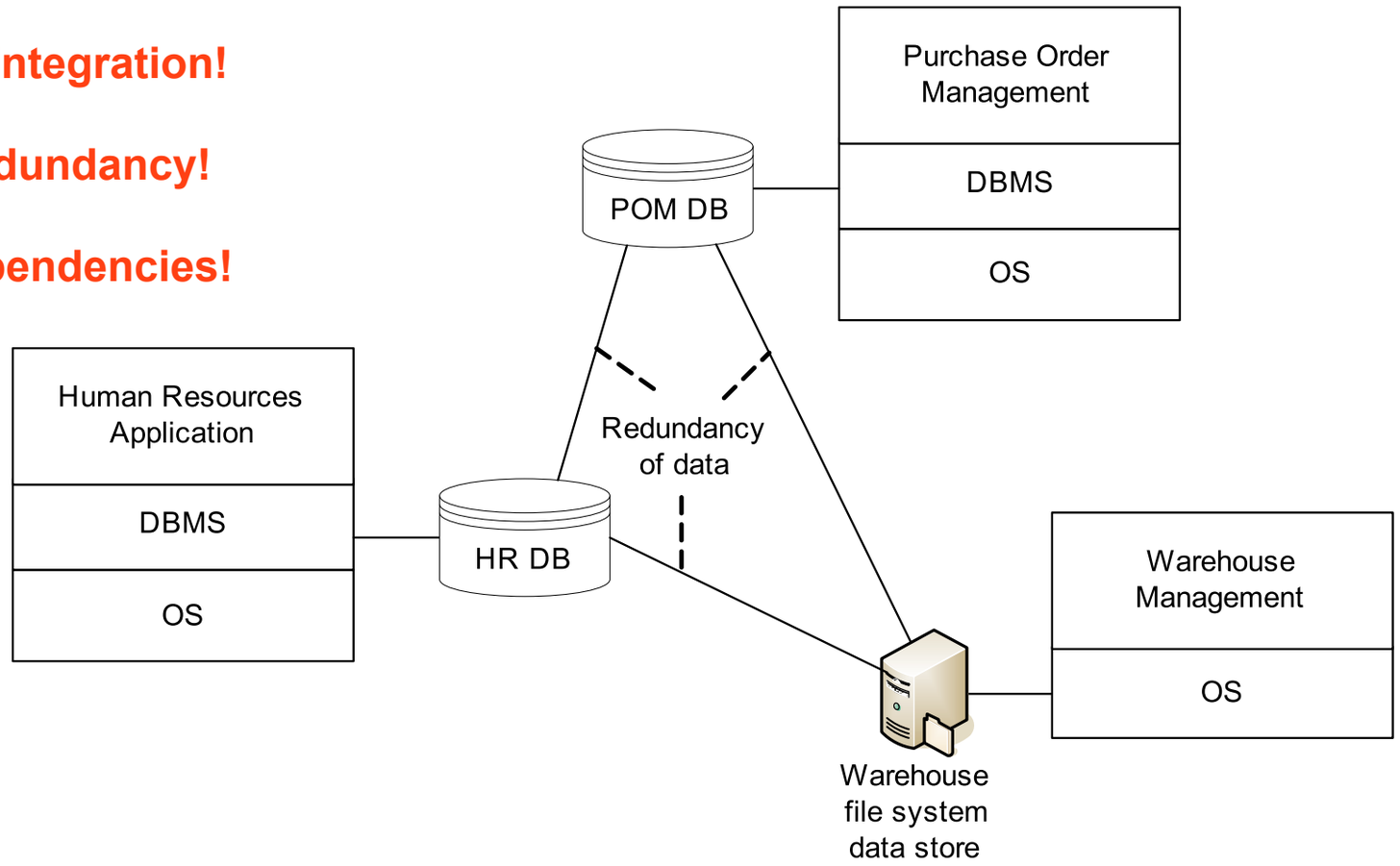
Next steps:
from individual to multiple information systems
(needs integration)

Individual enterprise application

Lack of Integration!

Data redundancy!

Data dependencies!



Changes

Changes were hard to implement!

Hard to track data dependency and replication

Any modification of an application was a complex and error-prone activity, with domino effect
(e.g. change of customer address format)

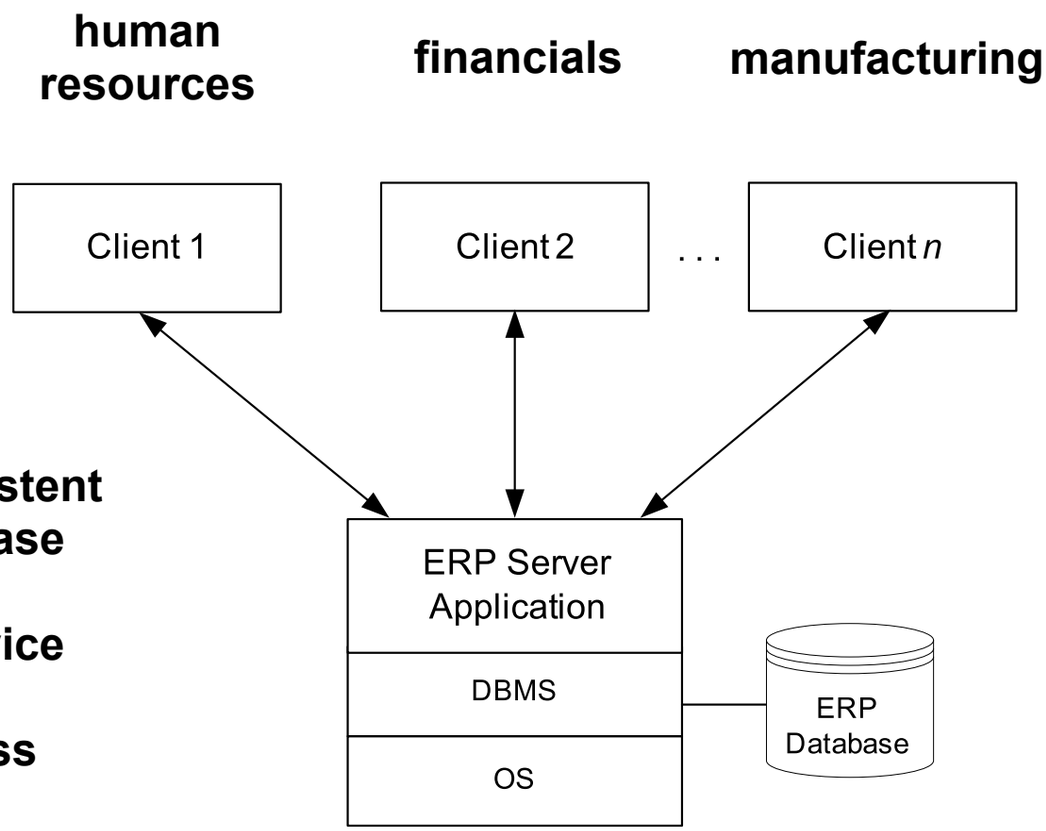
ERP

Enterprise Resource Planning (**ERP**) systems were developed to deal with the increasing complexity of changes

Basic idea

integrated database that spans most applications,
separated modules provide desired functionalities,
accessed by client applications

Enterprise resource planning systems



Integrated and consistent (centralized) database

Two-tier client-service

remote data access

ERP

CRM and SCM

New types of sw entered the market around 2000

Customer Relationship Management (**CRM**) systems
Supply Chain Management (**SCM**) systems

Goal

to support the planning, operation, and control of supply chains, including inventory management, warehouse management, management of suppliers and distributors, and demand planning

Problem: different vendors, separately developed

Siloed enterprise applications

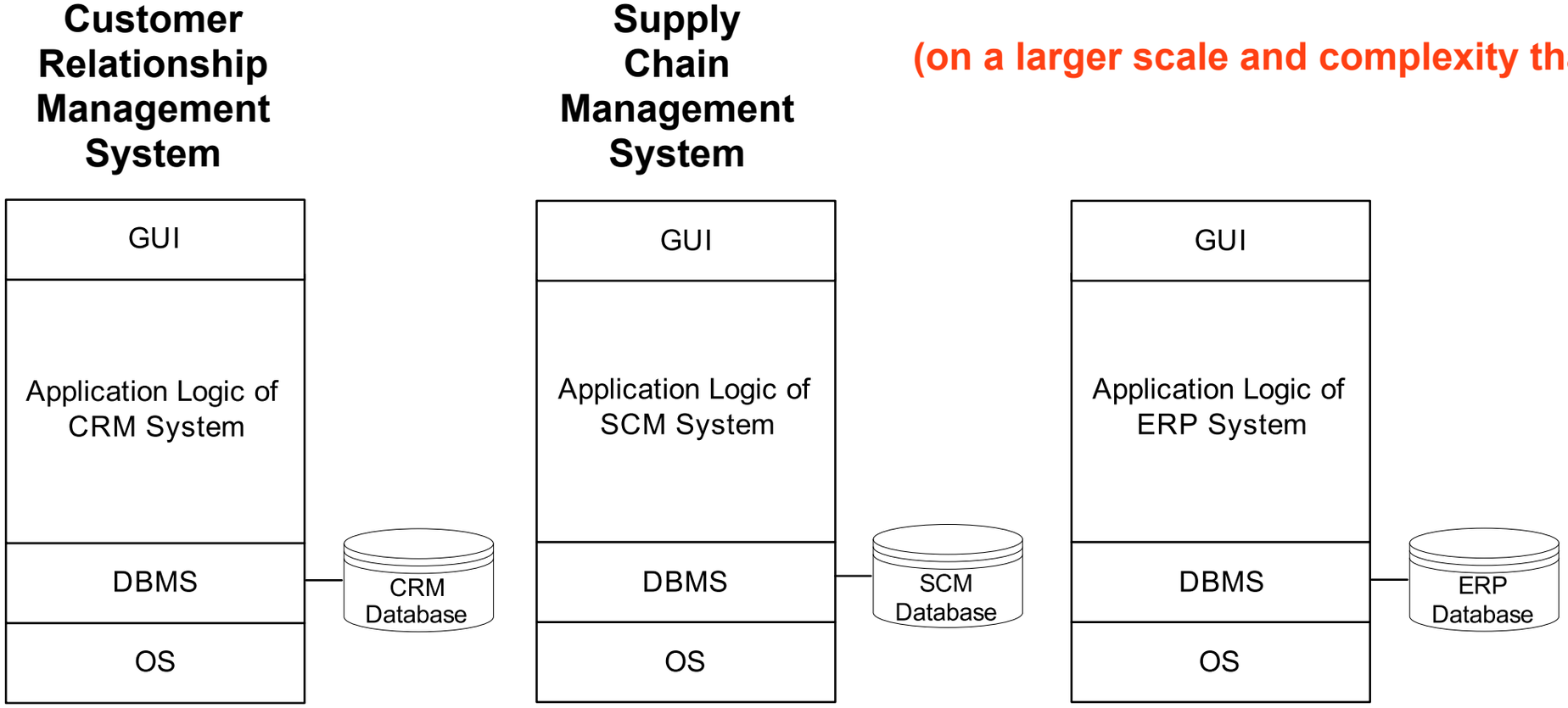
Lack of Integration!

Data redundancy!

Data dependencies!

Data Integration would provide valuable information

(on a larger scale and complexity than before)



Connected on local network, but not logically integrated

A sample scenario

Customer calls

Call centre personnel can only access the information stored in one system

Call centre personnel is not aware of the full status of the customer

Customer (doesn’t care about siloed structure)
does not feel well served,
becomes upset,
expects a better service

Heterogeneity

Heterogeneity of data and their attributes
(syntax and semantics difficulties)
calls for Data Integration

Examples

corresponding data fields with different names
(e.g., CustAddr vs CAstreet),

fields with the same name but different meaning
(e.g. Price: with or without taxes? unitary?)

Integration

Manual integration is possible, but:

it consumes considerable resources

it is error-prone

cannot foreseen all applications in advance
(reimplementing functionalities in an integrated way would just postpone the problem)

Solution

Enterprise Application Integration systems
as a new middleware

Enterprise Application Integration

Definition: **Enterprise Application Integration** (**EAI**) is defined as the use of software and computer systems architectural principles to integrate a set of enterprise computer applications.

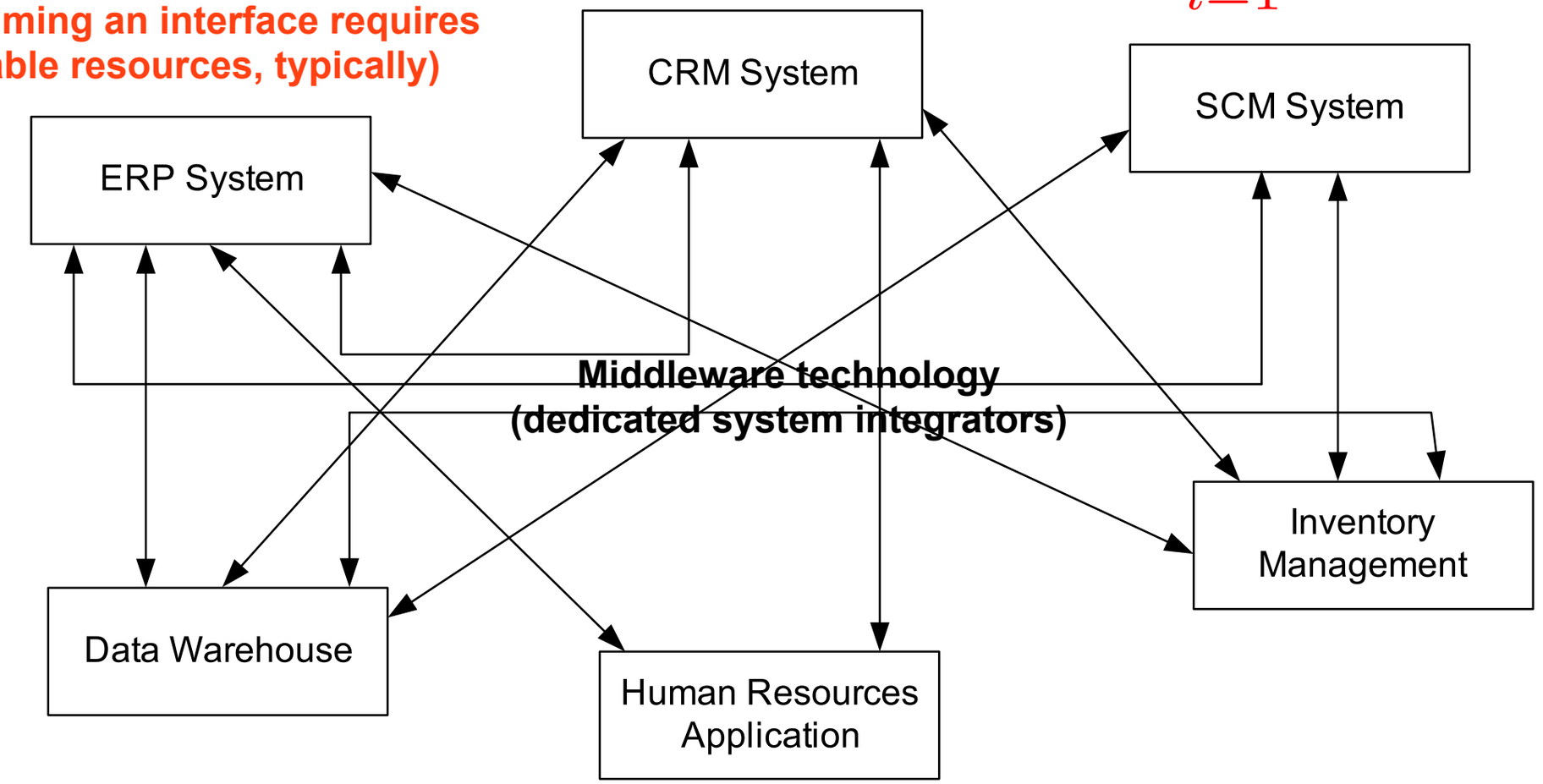
Point-to-point integration (of silos)

N x N hard-wiring problem!

Too many interfaces to develop!

Does not respond well to changes! (Reprogramming an interface requires considerable resources, typically)

$$\sum_{i=1}^{N-1} i = \frac{N(N-1)}{2}$$



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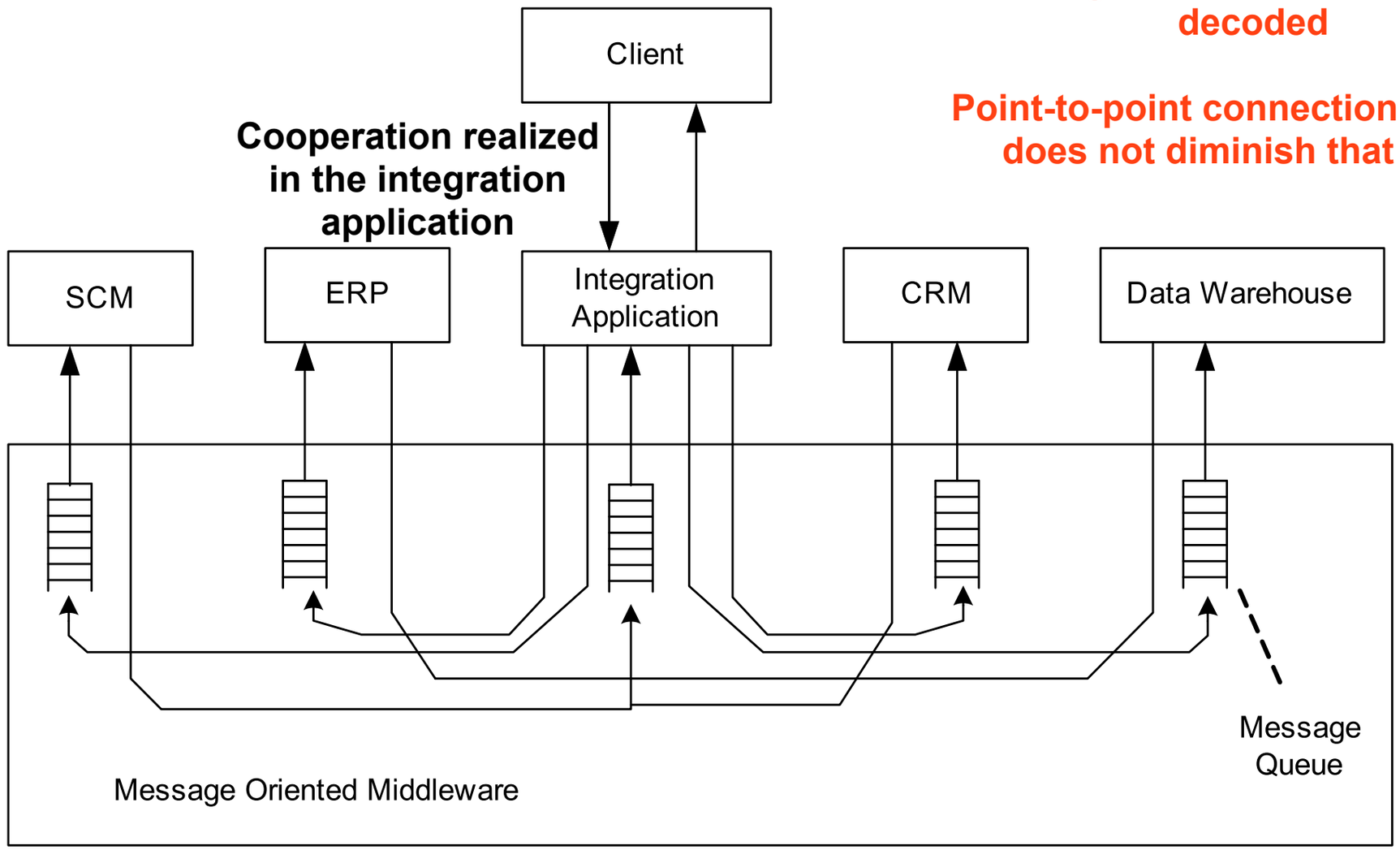
Message Oriented Middleware

Message-Oriented Middleware offers some execution guarantees, such as message delivery (e.g. persistent message queues are used)

Still, the main problem remains:
changes in the application landscape require changes in the communication structure

The Client exploits an **Integration Application** to operate on all systems

Message-oriented middleware



Messages must be encoded and decoded

Point-to-point connection problem does not diminish that much

Response to Change

Message-oriented middleware
reduces in part integration efforts and
gives important run-time guarantees

Still cooperation is hardwired in a particular application (the Integration Application)

No explicit process model that can be documented, communicated, and changed when necessary

In the end, response to change is not improved

Hub-and-Spoke

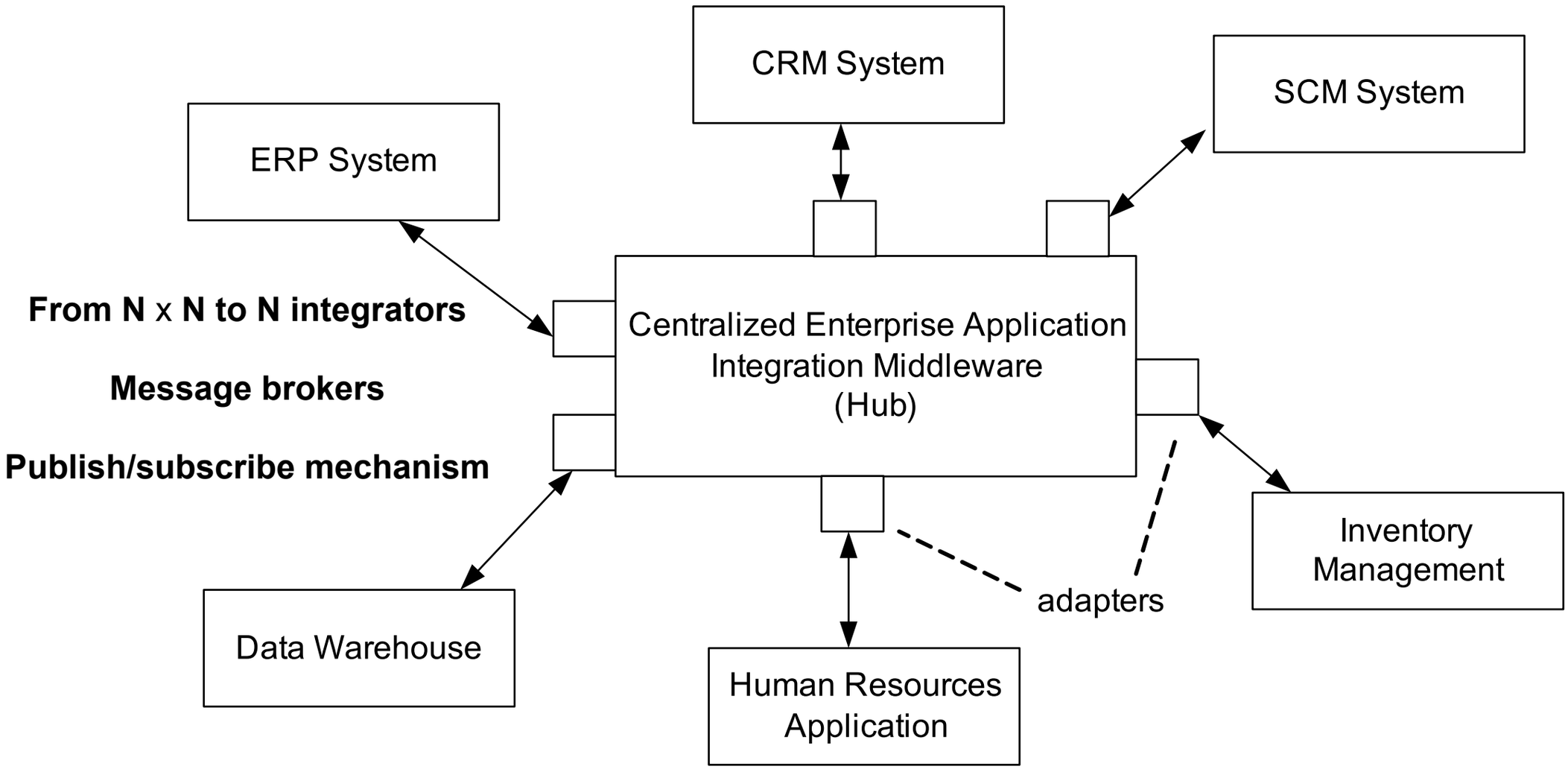
The **Hub-and-Spoke** paradigm is based on a central hub and a number of spokes attached to it

The Application Integration middleware represents the hub, and the applications to be integrated represents the spokes

Interactions between any two applications must pass through the hub

Hub-and-spoke integration

Configuration and management of adapters and message brokers can become cumbersome



From N x N to N integrators

Message brokers

Publish/subscribe mechanism

EAI implementation pitfalls

70% of all EAI projects fail (2003).
Most of these failures are not due to technical difficulties, but due to management issues:

Constant change

Shortage of EAI experts

Competing standards

Loss of detail: Information unimportant at an earlier stage may become crucial later

Conflicting and emerging requirements

Data protectionism

From (data-models and)
data-integration

To (process-models and)
process-integration

Value Chains and Process Orientation

Two major factors fuelled business process management

Value chains

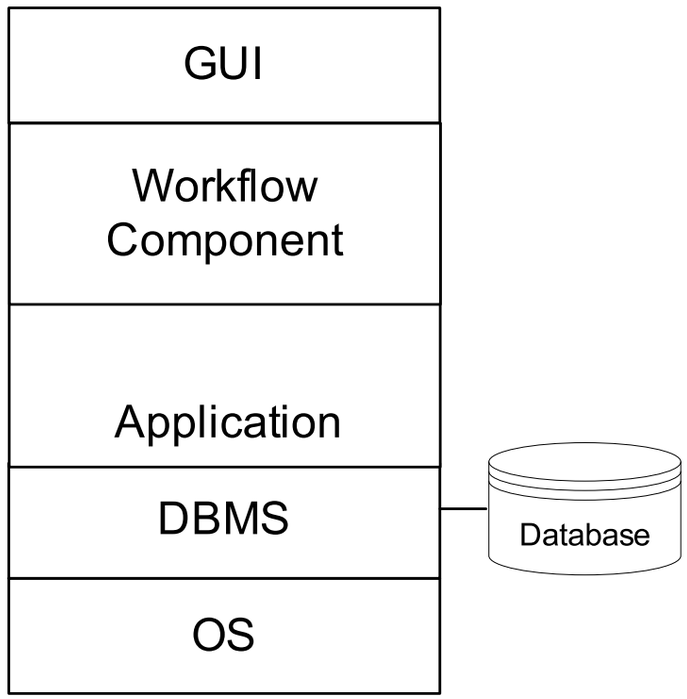
as a means to functionally break down the activities a company performs

Process orientation

as the way to organize the activities of enterprises

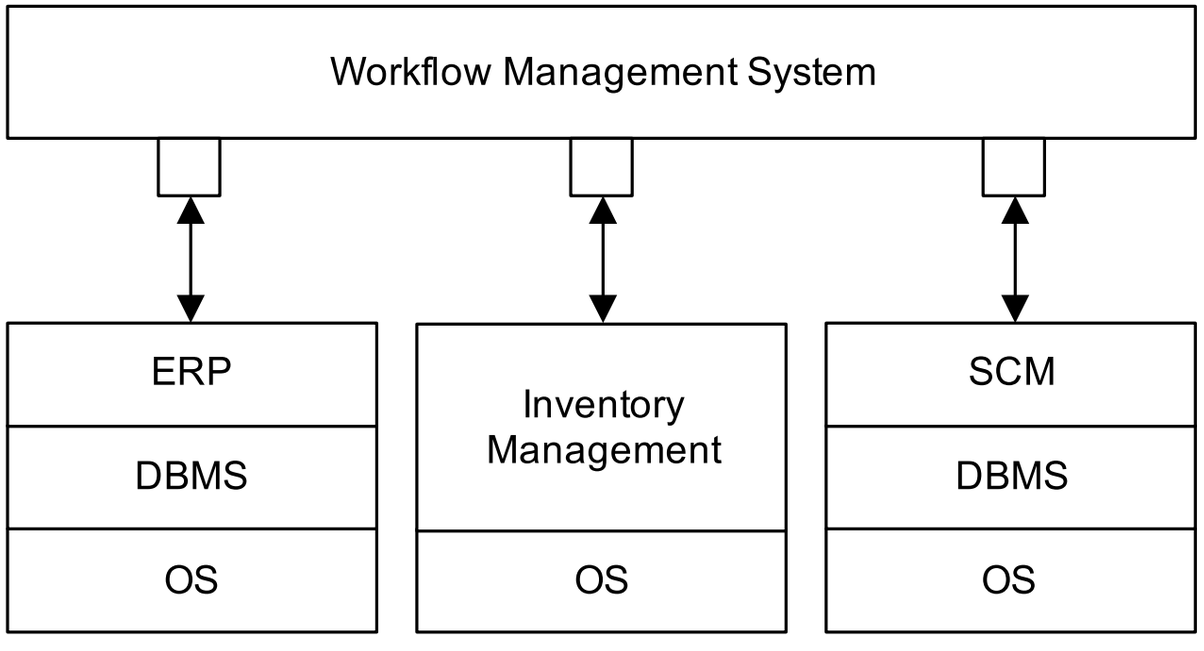
Workflow component

Definition: a **single-application workflow** consists of activities and their causal and temporal ordering that are realized by one common application system.



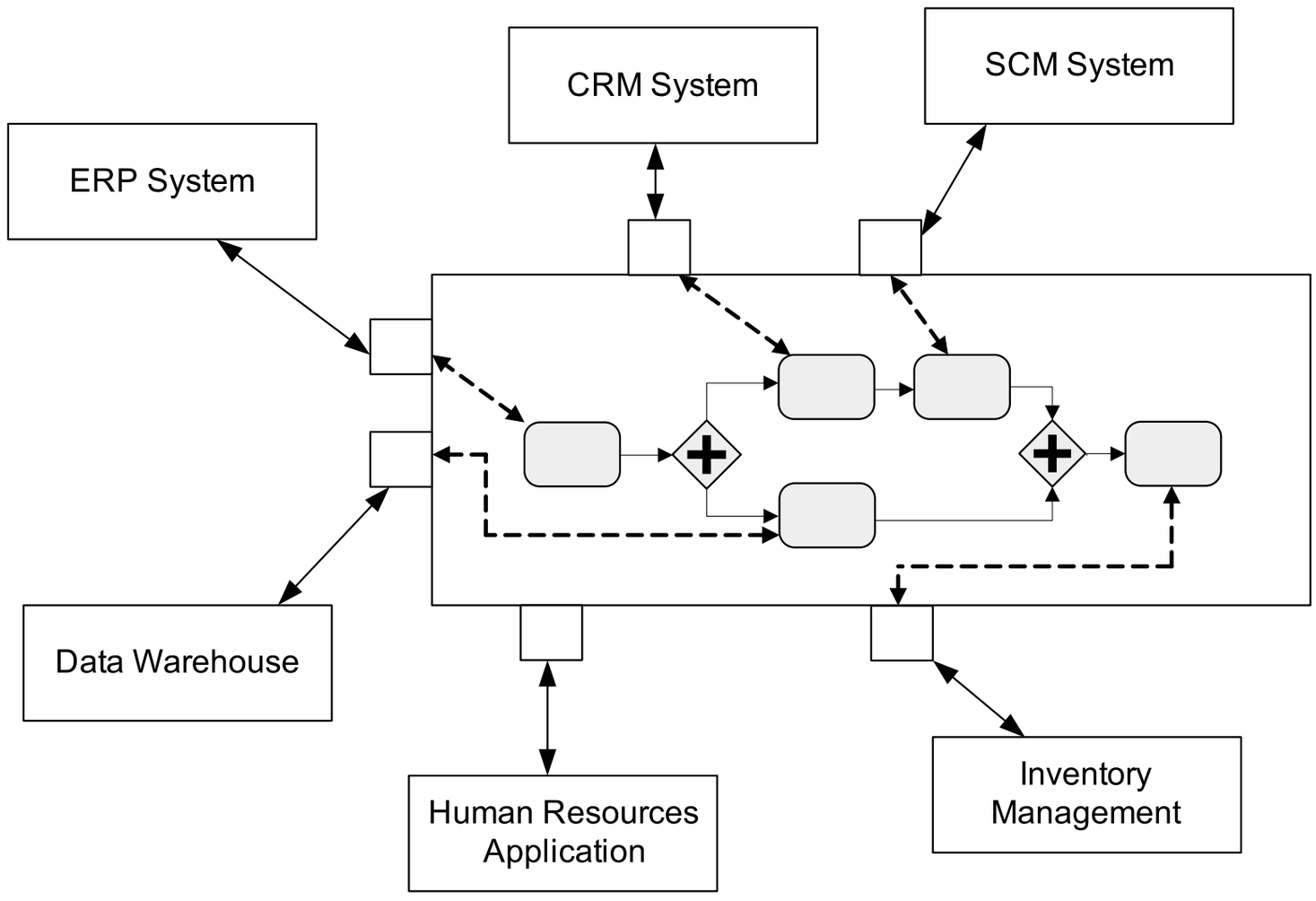
Multiple-application workflow system

Definition: a **multiple-application workflow** contains activities that are realized by multiple application systems, providing an integration of these systems.



System workflow

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



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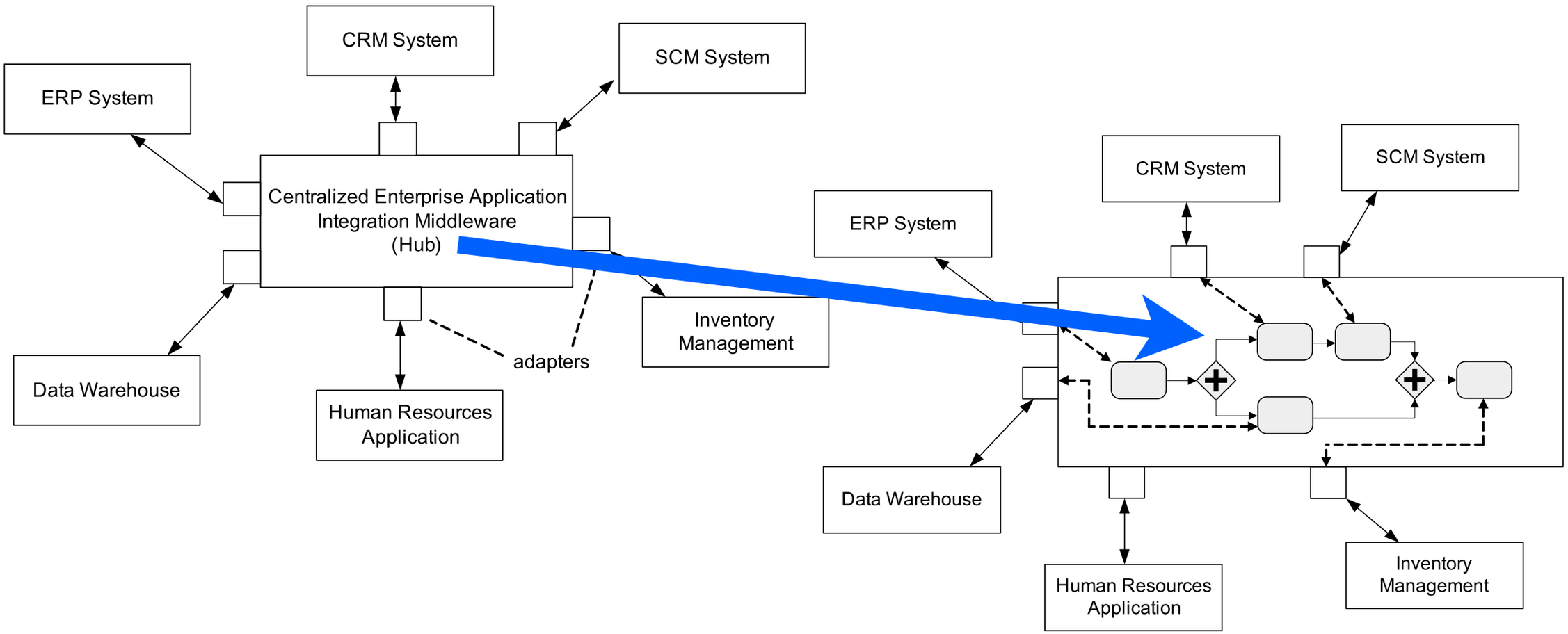
Workflows fit well with hub-and-spokes EAI



Limitations in workflow management

Technical integration problems:

Scarcely documented applications

Different levels of granularity

Tight coupling of applications
(direct invocation)

Enterprise service computing

Main idea:

Business functionalities exposed as services

Services are equipped with usage information

Customers can find services and use them

Services

Definition: **Services** are loosely-coupled computing tasks that can be dynamically **discovered** and **invoked** over the network.

Each service comes with a **service description** that can be published in **service registries** by the **service provider**.

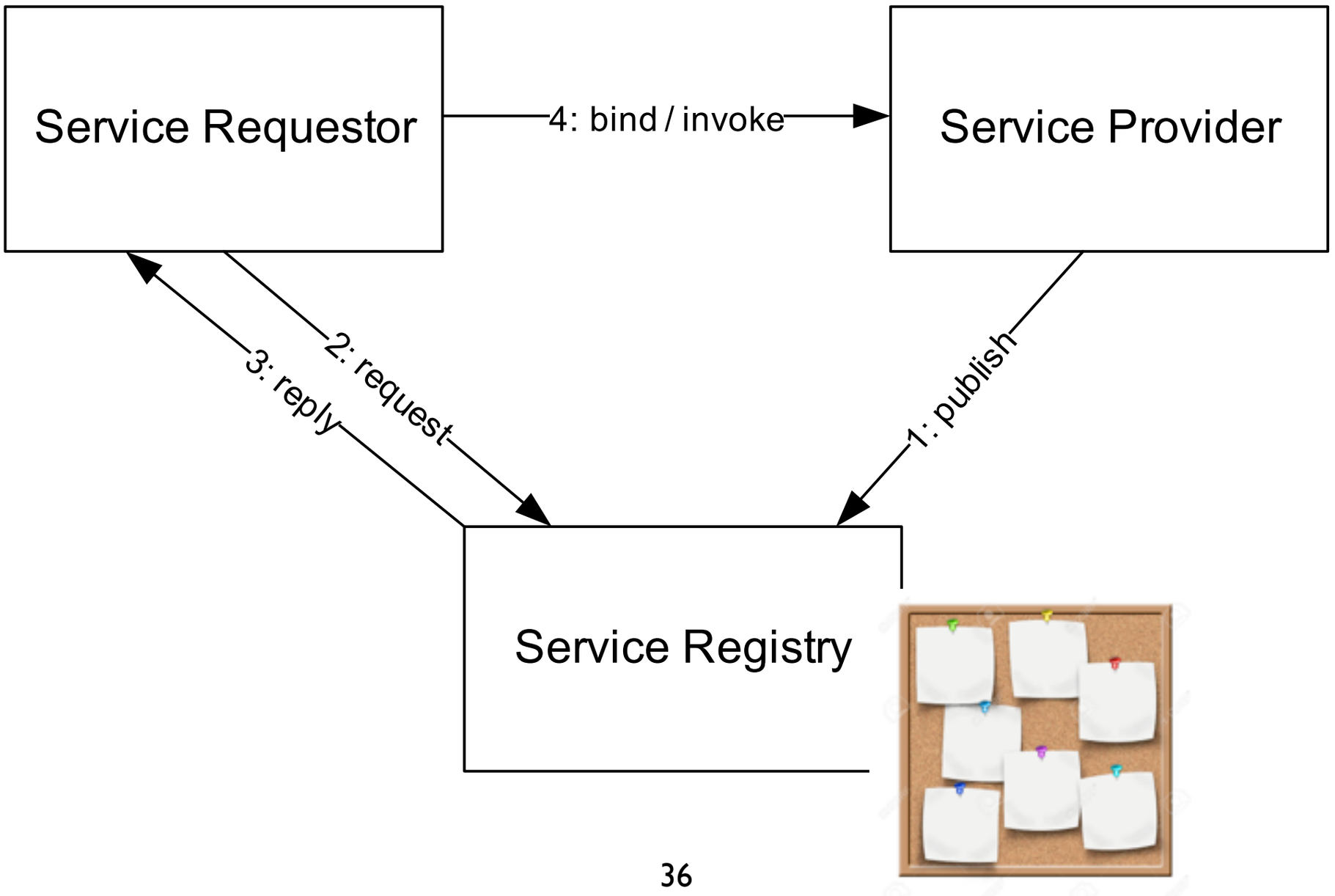
Service registries can be **queried** by **service requestors**.

Service descriptions provide a level of detail that facilitates service requestors to **bind** and **invoke** them.

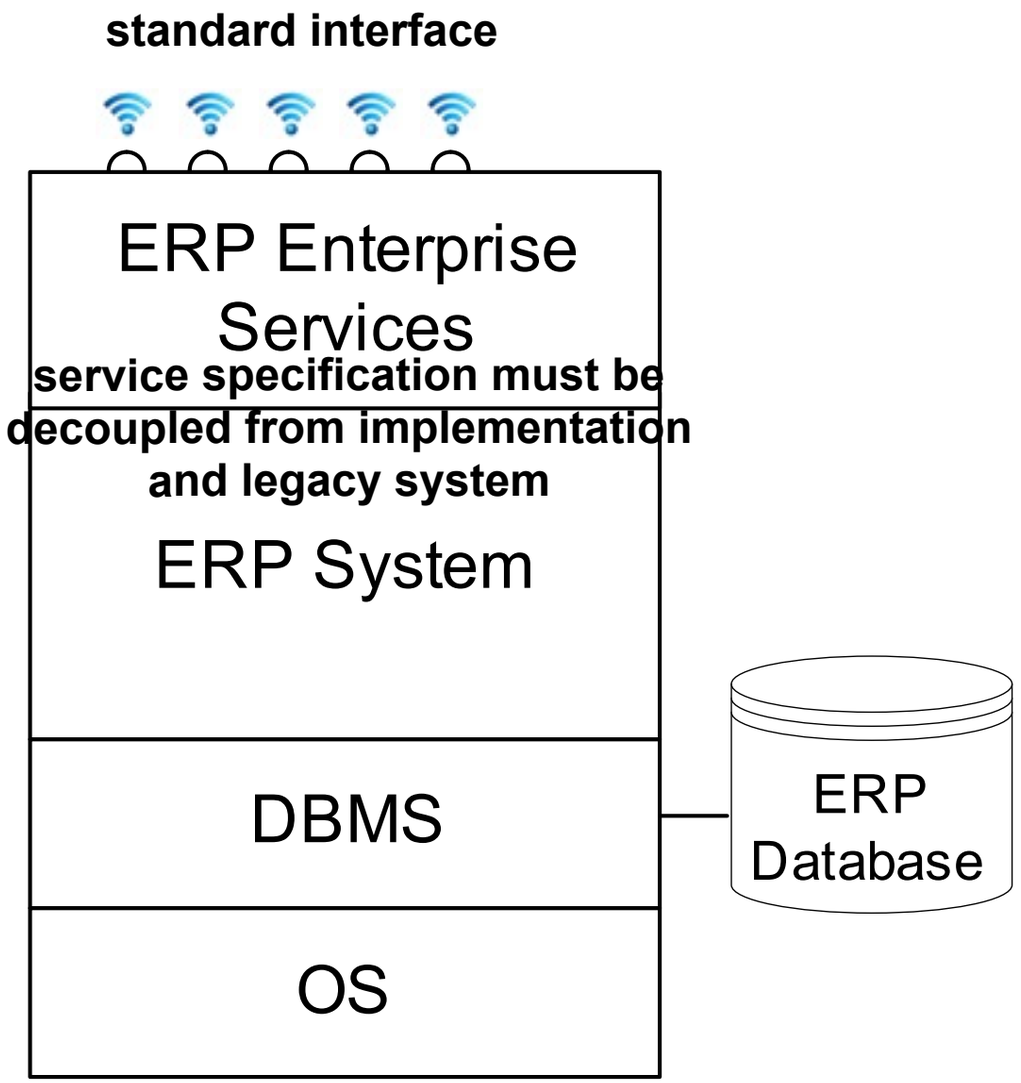
Service-oriented architectures

Definition: **Service-oriented architectures** (**SOA**) are software architectures that provide an environment for describing and finding software services, and for binding to services.

Service-oriented architectures



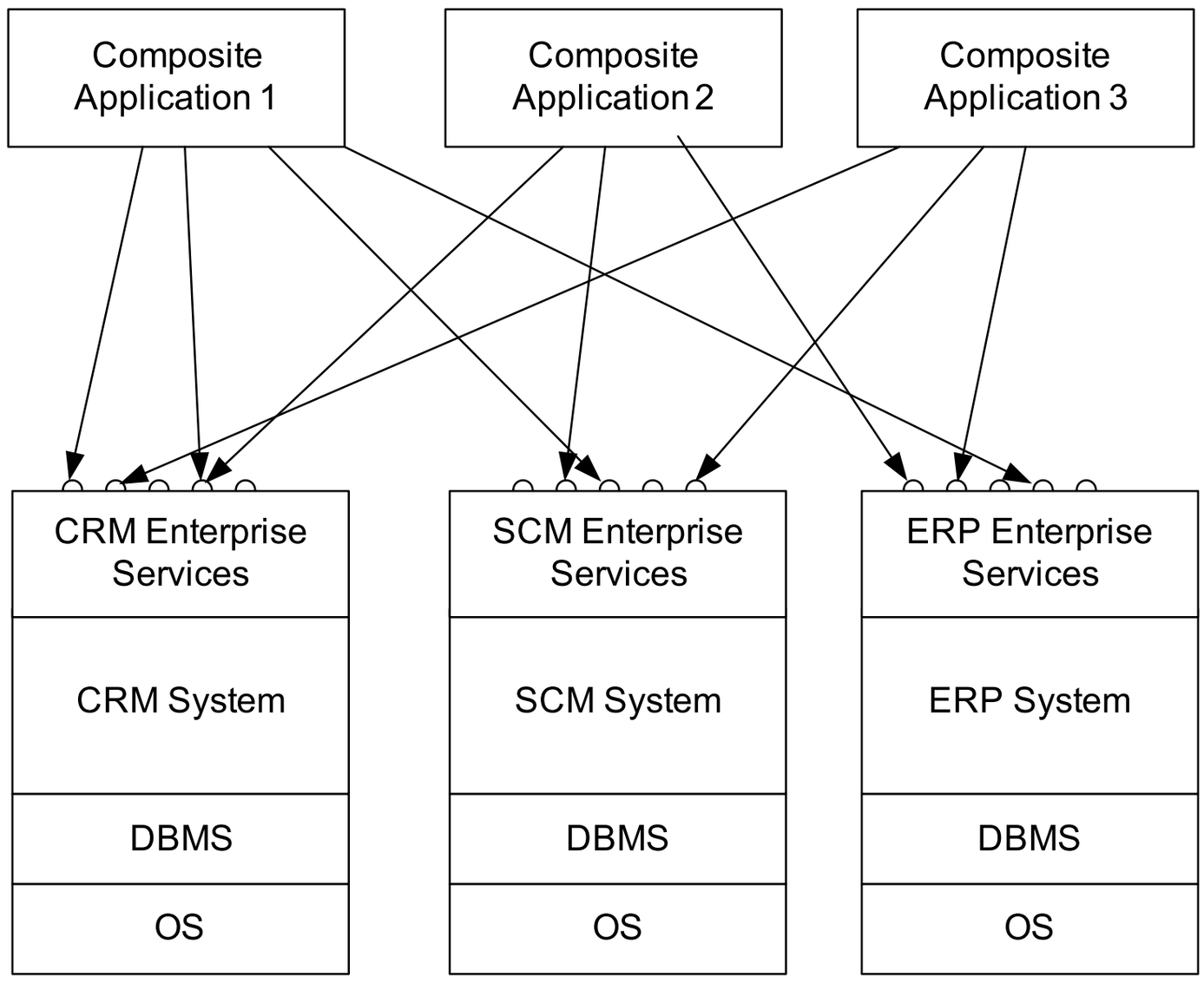
Service enabled application system



Composite service based application

Intra-company

well-expressed as business processes



Local registry

Manual search (absence of dynamic matchmaking)

Advantages of SOA

Reuse of functionality at coarse level of granularity

New applications can be built with less effort

Existing applications can be efficiently adapted to changing requirements

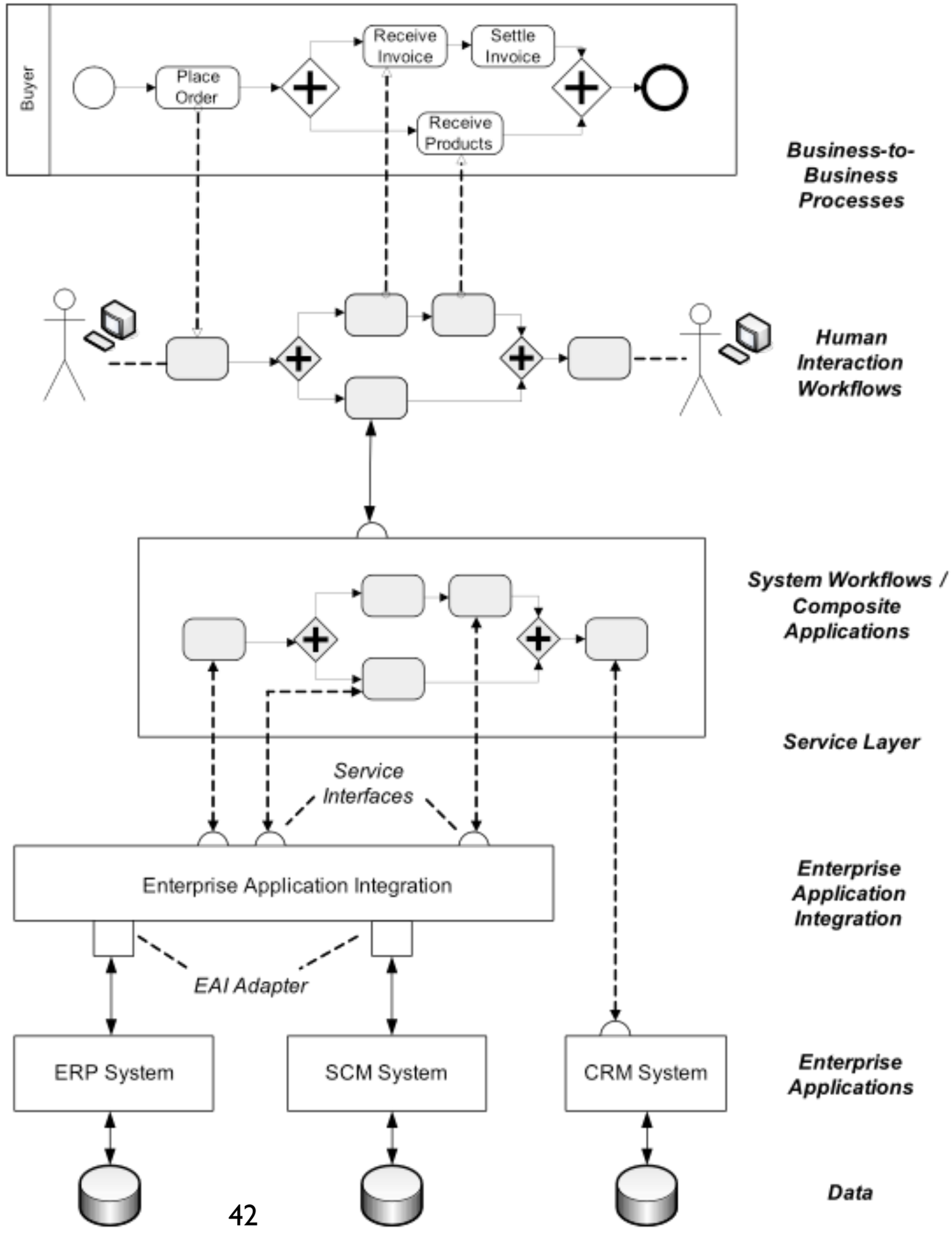
Reduced maintenance and development costs

Products as services

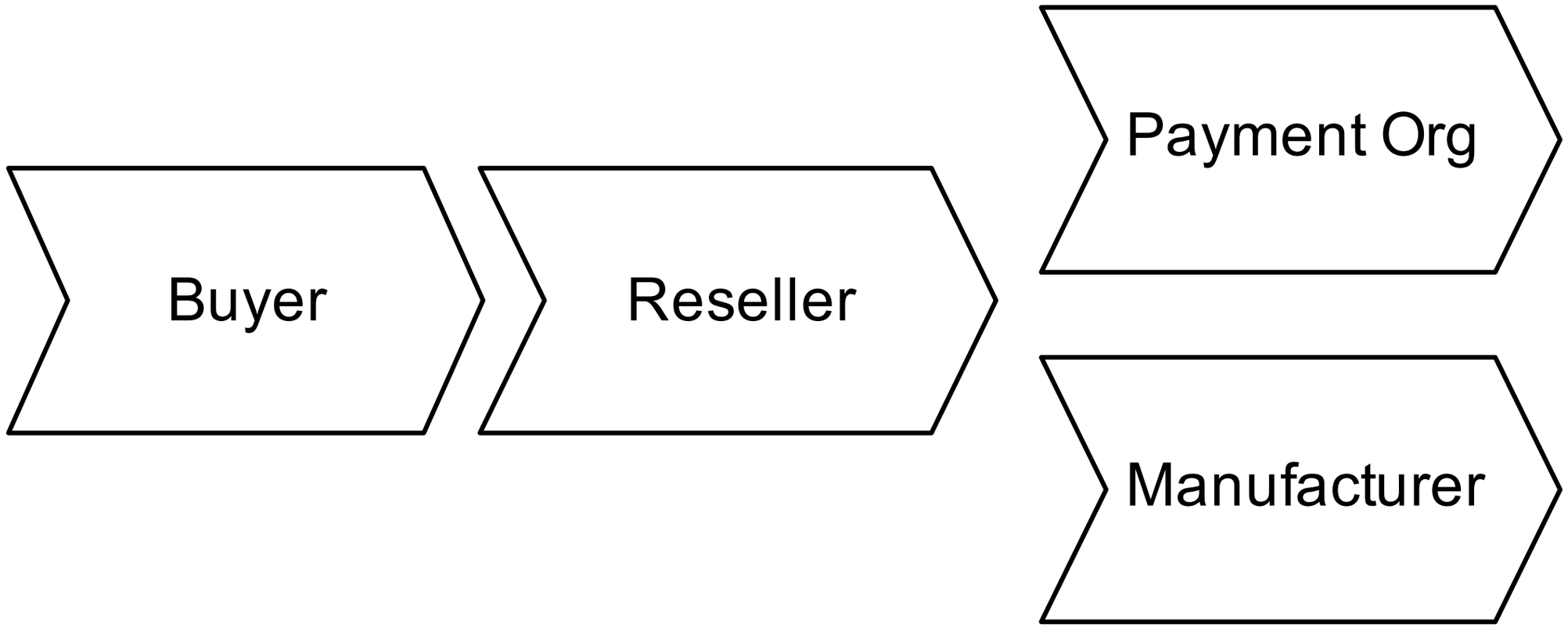
Corporations are increasingly perceived by the set of services they provide

These services exposed to the market can be realized by enterprise services
(provided by the back-end application system)

Also services provided by third parties can be integrated so that better end used services can be provided to the customer



Business-to-business value system



Business-to-business processes