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Business Information Systems

01: Fundamentals of Business Information Systems

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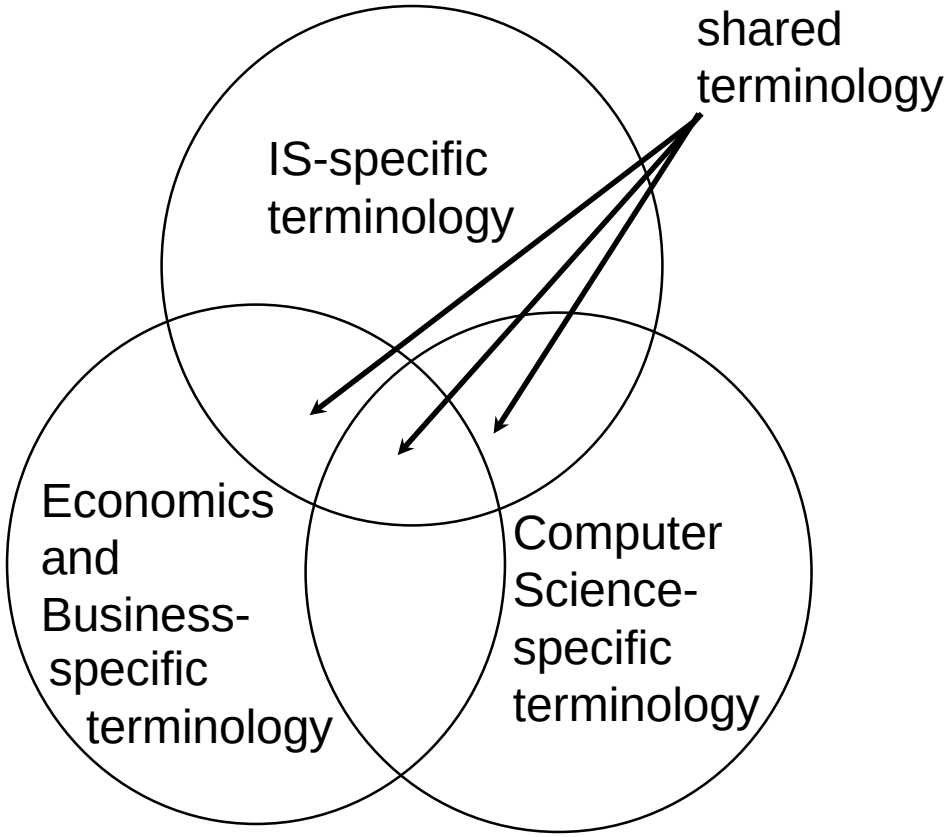
Agenda

- Information Systems
  - The Discipline in the Anglo-American world and the German-speaking countries
  - History
- Business Information Systems
- Modeling

The Discipline "Information Systems"

- Anglo-American world
  - Computer Science, Management Science
  - Information Systems, Management Information Systems
  - mostly departments in Business Schools
- German-speaking countries
  - Wirtschaftsinformatik
  - A discipline that connects findings of e.g., Betriebswirtschaftslehre (Business Administration), Informatik (Computer Science) and Volkswirtschaftslehre (Economics)
  - other applied Informatiken exist, e.g., Bioinformatik (Bioinformatics), Medizininformatik (Health Care Informatics), Rechtsinformatik (Law Informatics)

Terminology in IS



Levels of study in IS

- **Concepts:** e.g., organization, department, work group, role, user, value chain, business process, task, function, work flow, data, information, knowledge, document, content
- **Models**: e.g., enterprise model, business process model, data model, class diagram, use case, data flow diagram, network architecture, reference model, system architecture
- **Systems**: e.g., data base system, document management system, content management system, workflow management system, application system, enterprise-resource-planning system, standard software system, information system

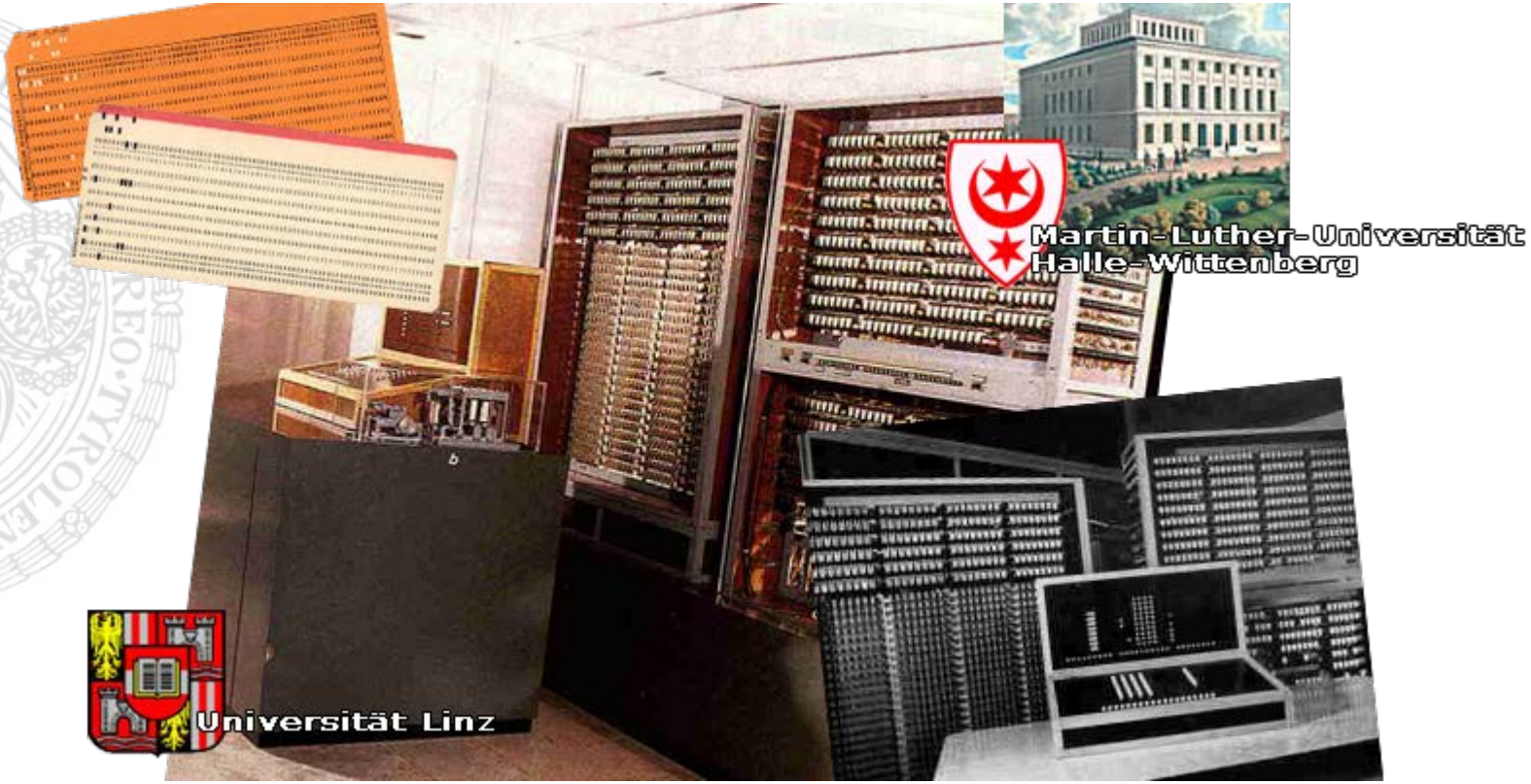
Examples for Business-Relevant Systems

business administration	concepts / processes	systems
management	decision support	decision support systems, prognosis systems
production/ logistics	computer integrated manufacturing, operations research	production planning -/control system, optimization-/simulation systems
marketing	customer relationship management, data base marketing	CRM system, recommender systems, knowledge discovery in data bases
controlling	data warehousing, data mining	executive information systems, online analytical processing, reporting systems
finances accounting	transactions, data management, simulation, prediction	administration systems, spreadsheet program, simulation and prognosis systems
organization	business process management	workflow management systems
human resources	competence management	skill management systems
taxes / auditing	compliance, IT risk management	document management systems
facility management	IT infrastructure for storage, processing and communication	storage systems, application servers, grids, networks
ressource mgmt.	horizontal and vertical integration	enterprise resource planning systems

History of Information Systems

- **Phase 1: Focus on technical knowledge (late 60's)**

  first chairs with an explicit focus on data processing (DP) in business in the German-speaking countries at the Universities of Linz, Austria and Halle-Wittenberg, Germany

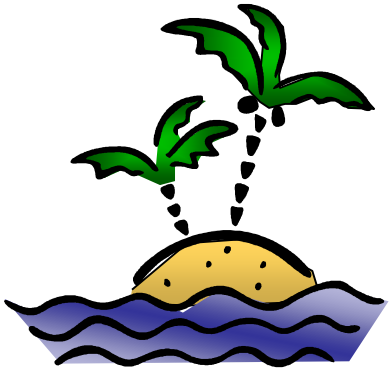


History of Information Systems

- **Phase 2: Extension to application knowledge (70's)**
  - knowledge about the use of DP for business applications, e.g., accounting, order processing

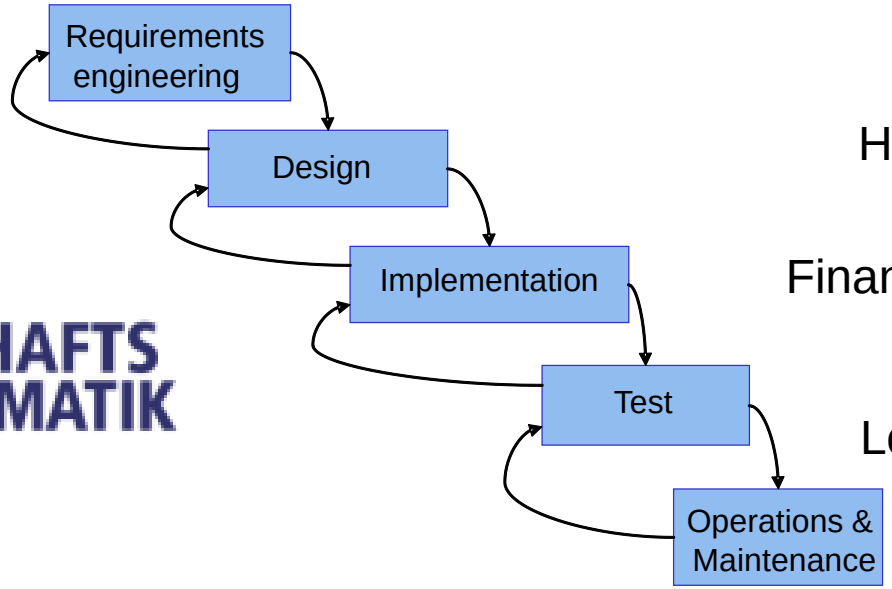


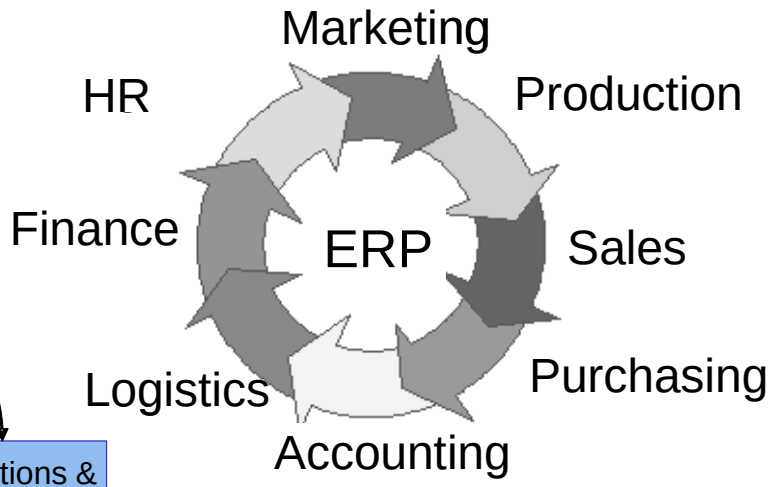





History of Information Systems

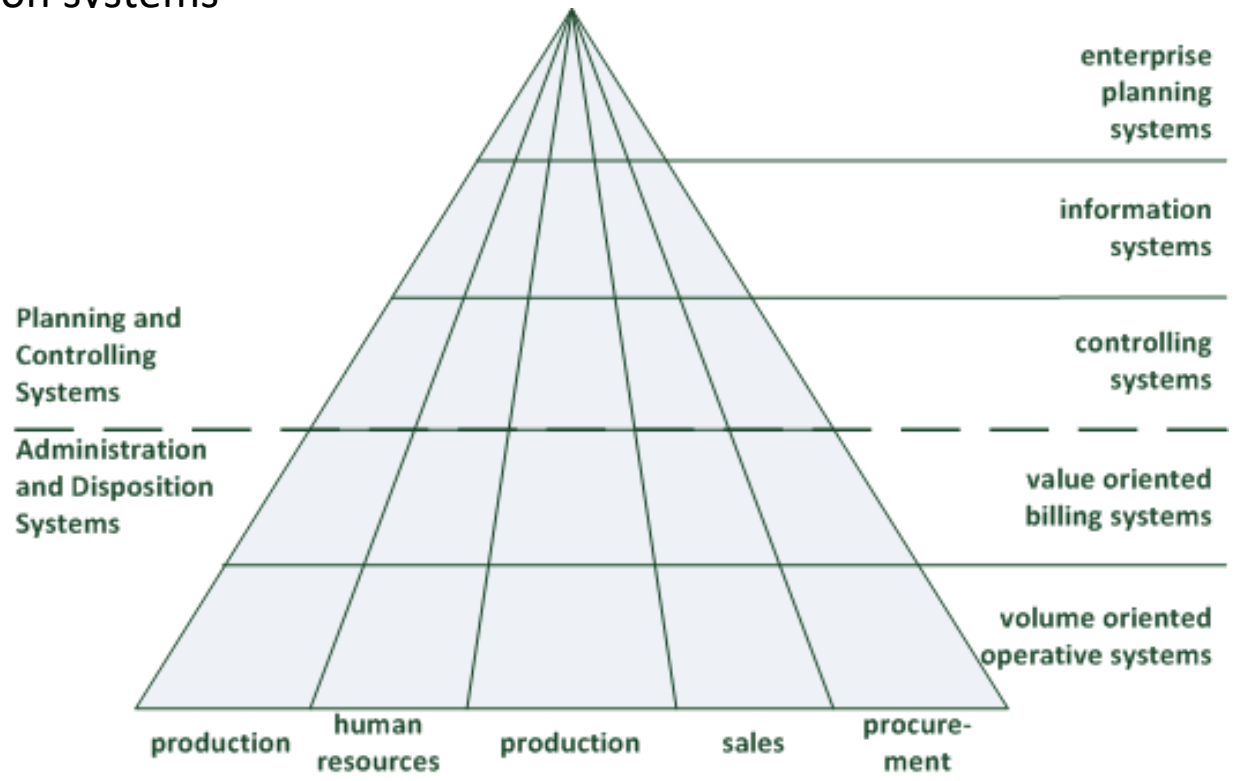
- **Phase 3: Transition from DP to information processing (early 80's)**
  - integration of technical and application knowledge into technology knowledge
  - procedures, methods, tools for the development of information systems
  - the terms "Wirtschaftsinformatik" in the German-speaking countries and "Information Systems" as well as "Management Information Systems" in the Anglo-American world are widely accepted as describing a new discipline





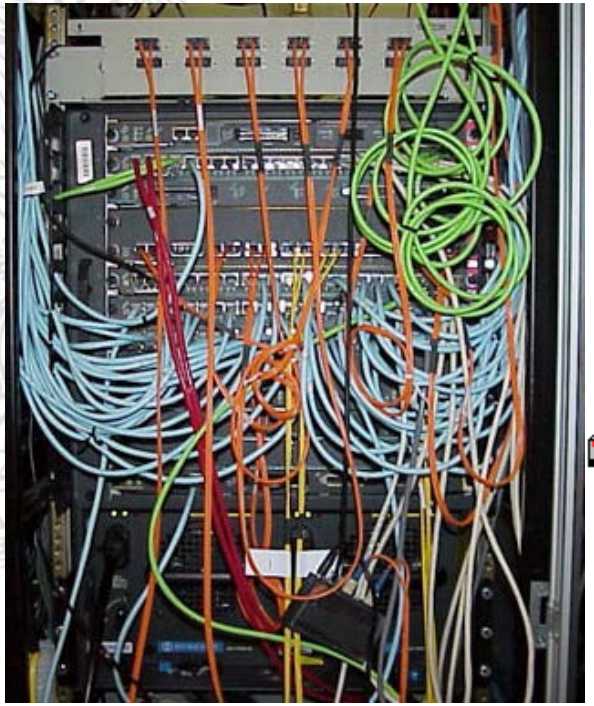
History of Information Systems

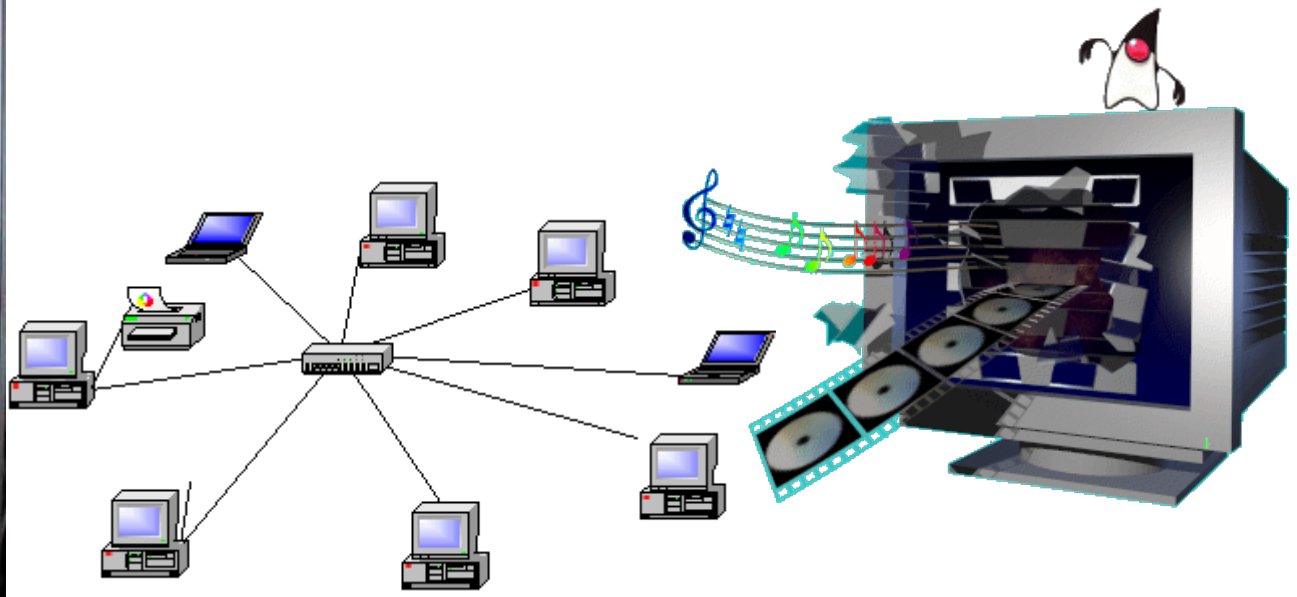
- **Phase 4: Strategic Information Systems (late 80's)**
  - information as competitive factor
  - information management
  - enterprise-wide management of data, enterprise data models
  - integrated application svstems



History of Information Systems

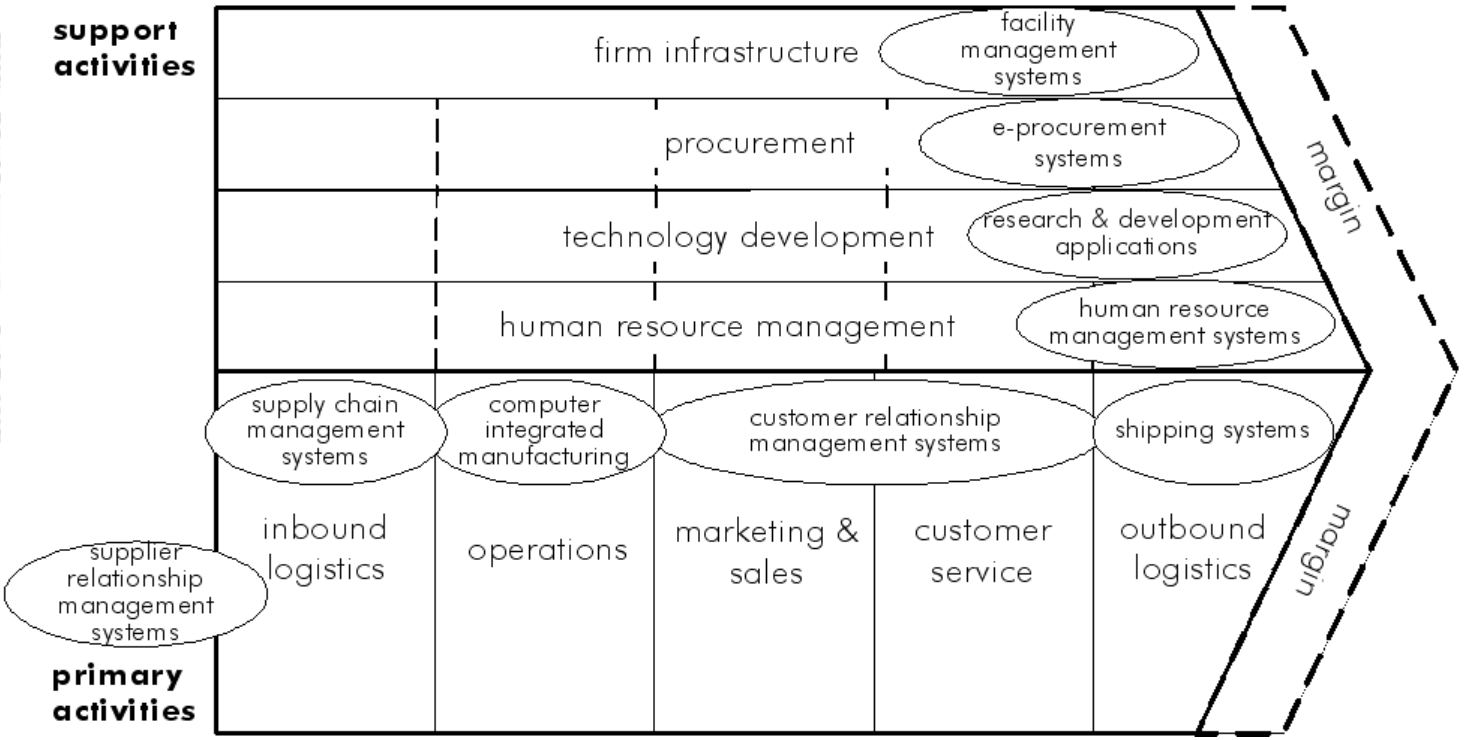
- **Phase 5: Network technologies and multimedia (early 90's)**
  - multimedia applications
  - decentral concepts and systems (LAN)
  - workgroup computing (Groupware)





History of Information Systems

- **Phase 6: Process-orientation (early 90's)**
  - business process reengineering, business process management
  - enterprise modeling
  - standard software to support the value chain (enterprise resource planning systems)

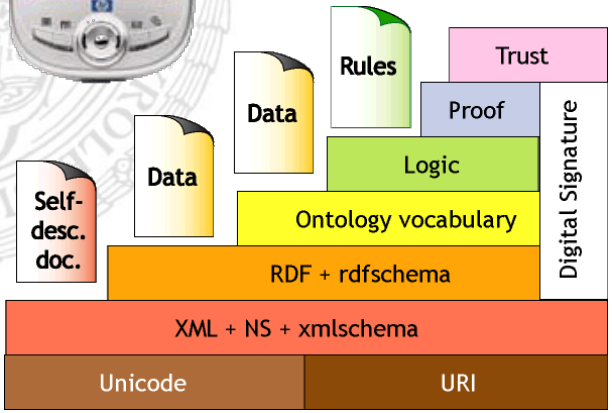


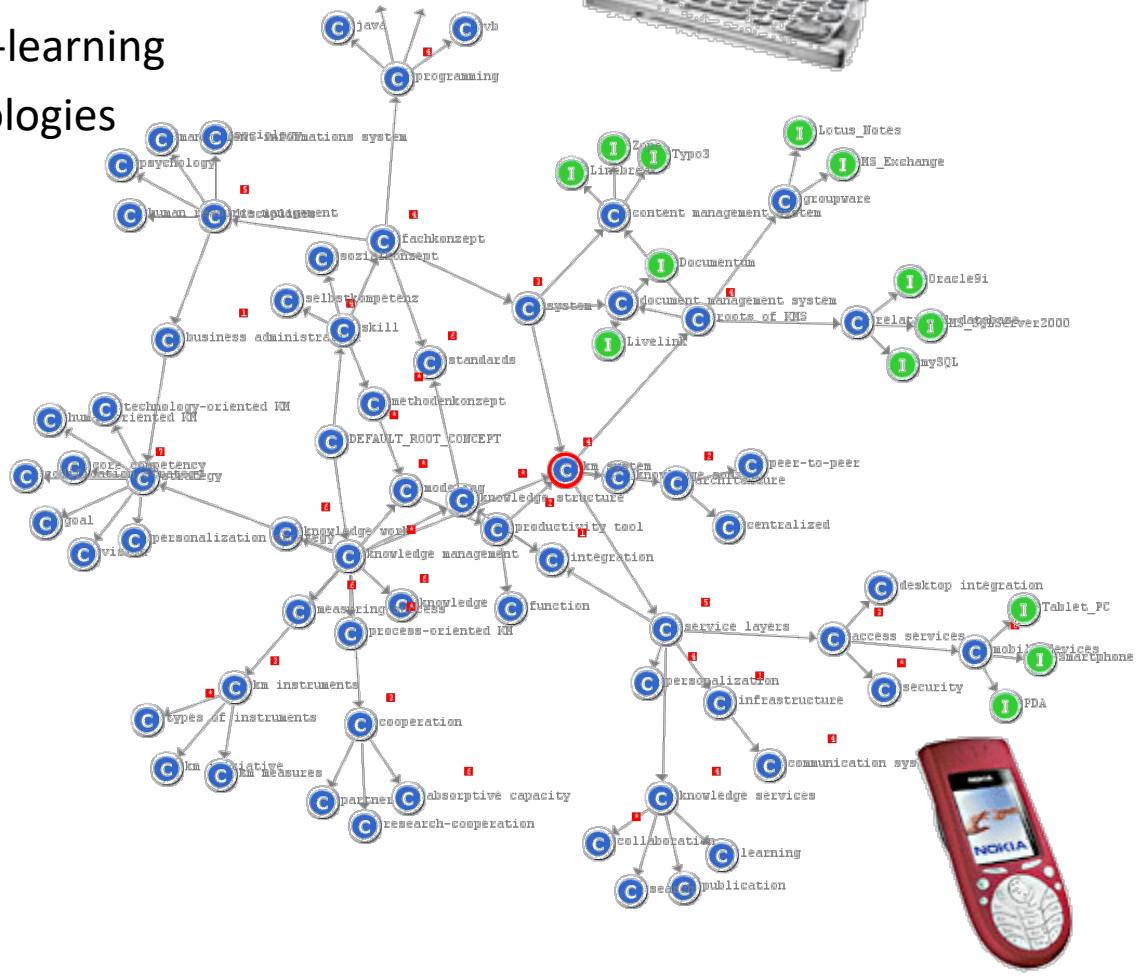
History of Information Systems

- **Phase 7: Network economy and E-Business (mid 90's)**
  - Internet and WWW
  - inter-organizational communication
  - electronic commerce, electronic business (B2A, B2B, B2C, B2E)
  - supply chain management

History of Information Systems

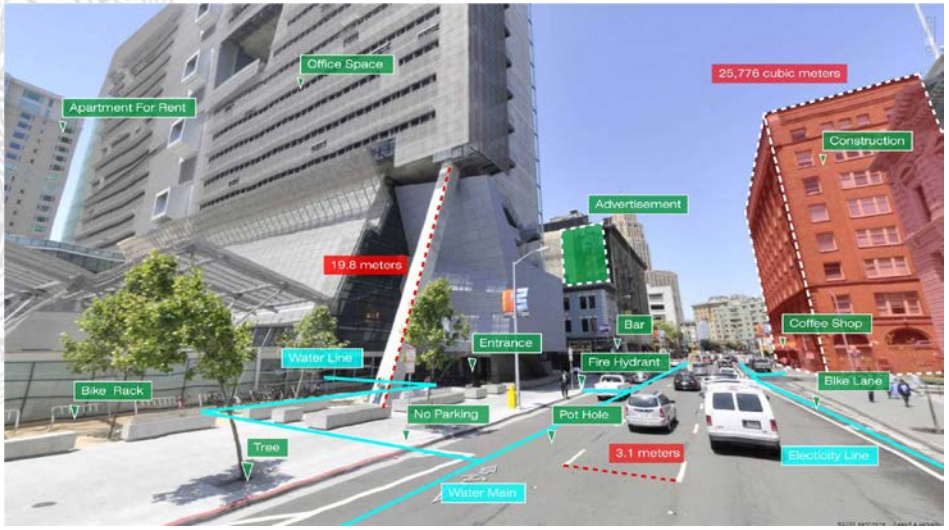
- **Phase 8: Knowledge Work and Economy (00's)**
  - mobile (ubiquitous) computing
  - knowledge management and e-learning
  - Web 2.0, Semantic Web technologies





History of Information Systems

- **Phase 9: Connectivity and digital transformation (10's)**
  - digital life, organisations, markets and society
  - big data, cognitive computing, deep learning
  - sensors, smart products, Internet of things
  - cloud computing, social media, crowdsourcing
  - IS for a better world vs. cyberwar and fake news



A VUCA World

Bennet, Lemoine 2014

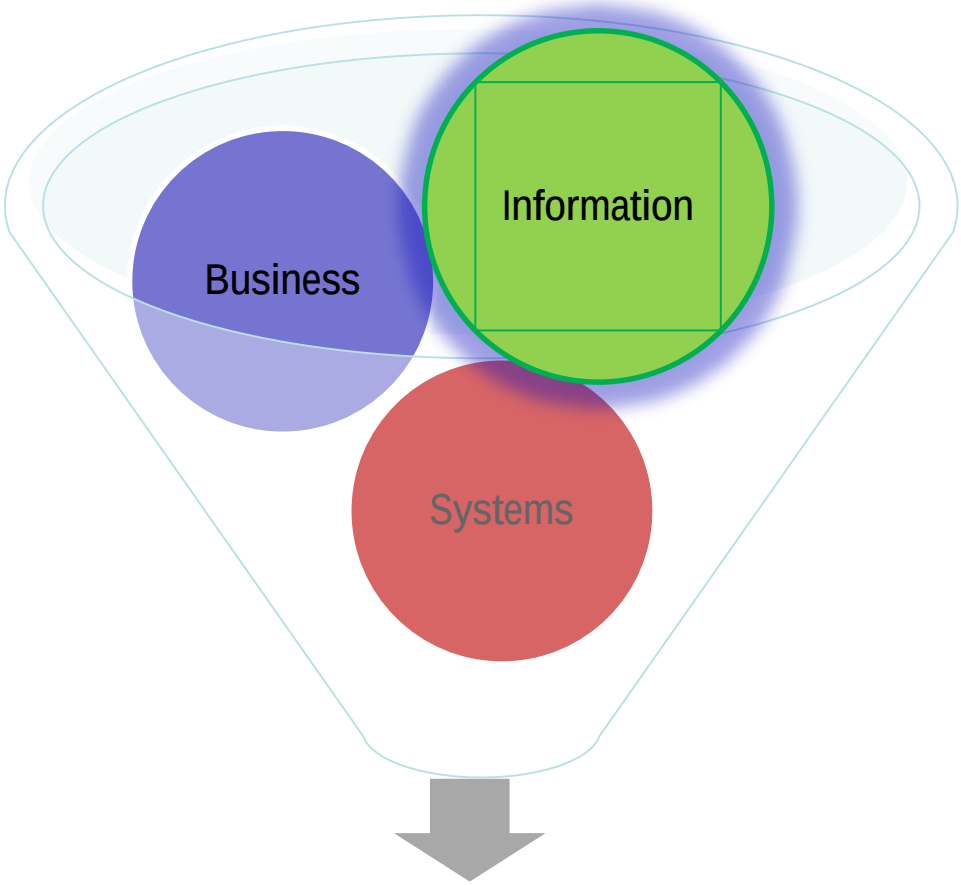
Did You Know?

https://youtu.be/bTM06NZOyDQ

Agenda

- Information Systems
- Business Information Systems
  - Information
  - Business
  - System
  - BIS – Definition, Examples, ERP
  - Impact on Value Chain
- Modeling

Basic Structure



Business Information Systems

Where is the emphasis?

Information **Technology**

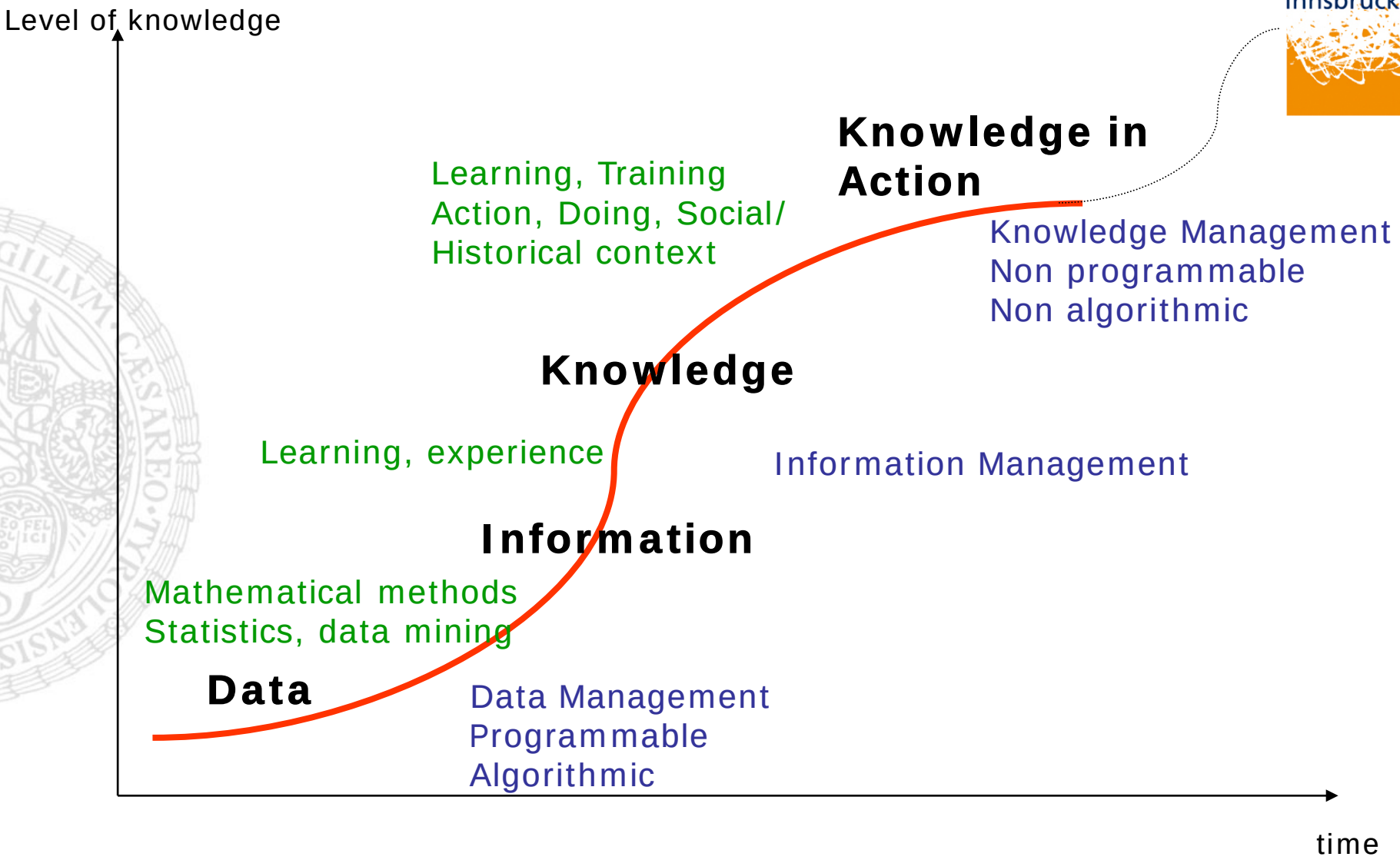
Information Technology

The stress should be on the ‘I’ rather than the ‘T’ in ‘IT’ (Davenport, 2000).

Peter Drucker highlighted the importance of information for competitiveness in 1993:

‘*The industries that have moved into the center of the economy in the last forty years have as their business the production and distribution of knowledge and information rather than the production and distribution of things’.*

Data-Information-Knowledge



Data

- Data is a set of discrete, objective facts about events. Data are unorganized and unprocessed facts.
- Organizations usually store data in some sort of technology systems. Quantitatively, companies evaluate data management in terms of cost, speed, and capacity. Some industries are heavily dependent on data.
- Data are symbols that are ordered to an elementary description of a person, thing, event, activity, transaction or state in the perceived reality or imagination of persons.
- Data can be recorded, classified, and stored, but are not organized to convey any specific meaning. Data items can be e.g., numeric, alphanumeric, figures, sounds, images, moving images, 3D or holographic visualizations.
- *Data describes only a part of what happened; it provides no judgments or interpretation and no sustainable basis for action. While the raw material of decision making may include data, it cannot tell you what to do. Data is the essential material for creation of information.*

source: Tiwana 2000, Nonaka 2005, Maier 2009

Information

- Is described as a message, usually in the form of a document or an audible or visible communication. As with any message, it has a sender and a receiver.

- Information is the result of a person's interpretation of signals from his or her environment, whereby the result depends on the person's knowledge and the context of the interpretation.
- Information is data that have been organized so that they have meaning and value to the recipient. The recipient interprets the meaning and draws conclusions and implications

- Quantitative measures of information management tend to include connectivity and transactions: How many e-mail accounts or users of collaboration systems do we have? How many messages do we send in a given period?

- Qualitative measures measure informativeness and usefulness: Did the message give some new insights? Does it help me make sense of a situation and contribute to a decision or a solution of the problem? Date becomes information when its creator adds meaning.

source: Nonaka 2005, Maier 2009

Knowledge

- Most people have an intuitive sense that knowledge is broader, deeper, and richer than data or information.

- Knowledge derives from minds at work. Knowledge is a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of knowers.

- In organizations, it often becomes embedded not only in documents or repositories, but also in organizational routines, processes, practices, and norms. Knowledge is a mixture of various elements.

- *Bob Sternhill the CEO of CTL defines know-how as "the ability to transform knowledge into profit". One of the reasons that we find knowledge valuable is that it is close to action, closer than data or information.*

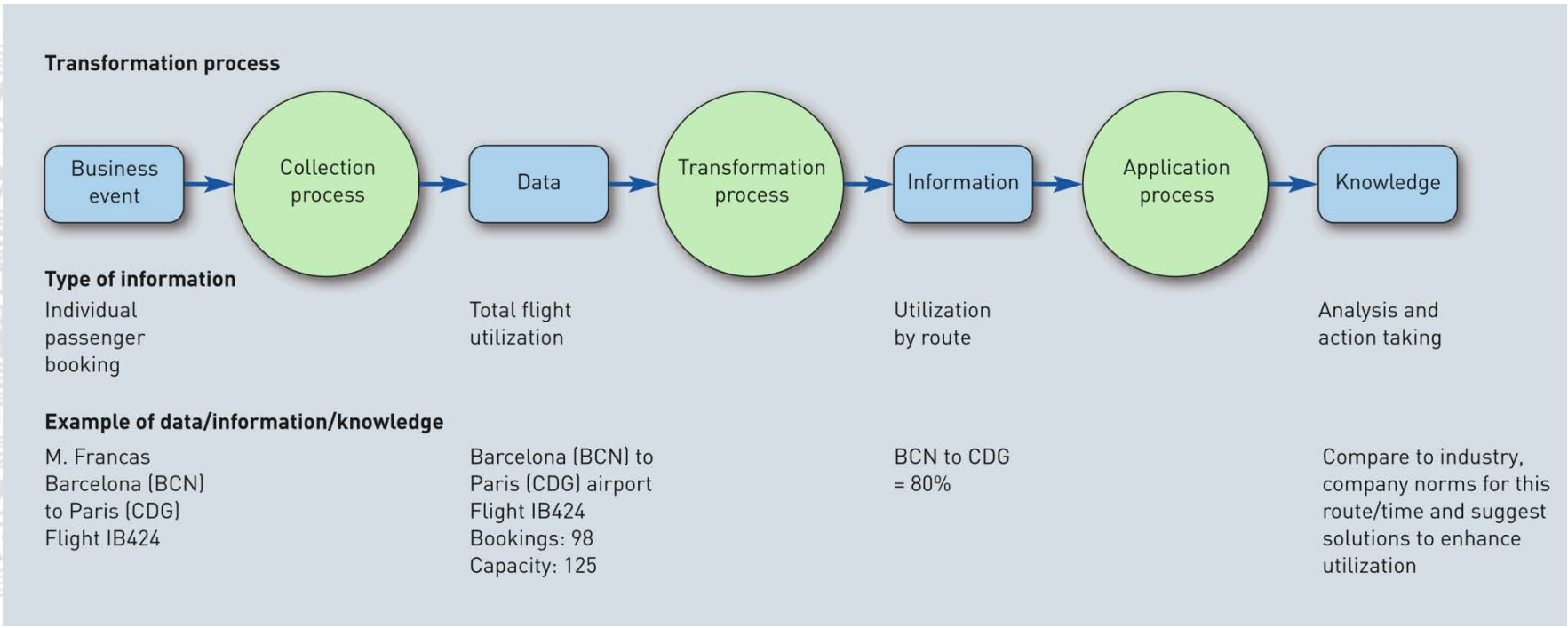
source: Davenport 1998, Nonaka 2005,

Knowledge in Action: Ground Truth

- Experience changes ideas about what should happen into knowledge of what does happen. Knowledge has “ground truth”,” to borrow the phrase the U.S. Army´s Center for Army Lessons Learned (CALL) uses to describe the rich truths of real situations experienced close up: on the ground, rather than from the heights of theory or generalization. For obvious reasons, effective knowledge transfer is a critical issue for the army. Knowing what to expect and what to do in military situations can be literally a life-or-death matter.
- Experts from CALL take part in real military operations as learning observers and disseminate the knowledge they gather through photos, video tapes, briefings, and simulations. Lessons learned in Somalia and Rwanda in the early ´90s, were passed on the troops involved in the 1994 Haitian mission. The experiences of the first units in Haiti were also videotaped to provide guidance to those who followed.
- A key aspect of the army's success at knowledge management was its “After Action Review” program. This exercise involves an examination of what was supposed to happen in a mission or action, what actually happened, why there was a difference between the two, and what can be learned from the disparities.

→ *Key components of knowledge in action: Experience, Ground Truth, Complexity, Judgment, Rules of Intuition, Values and Beliefs (Davenport/Prusak)*

Transformation Process: Data-Information-Knowledge (Chaffey 2005)



Objects in Data, Information and Knowledge Management

Knowledge

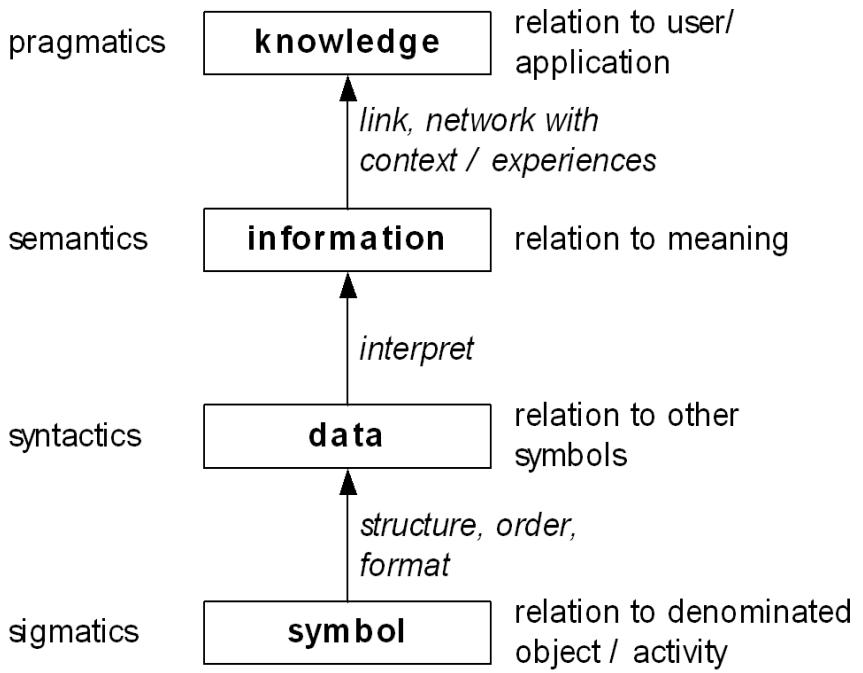
- intellectual capital (Wiig 1997), knowledge capital (Sveiby 1997), org. capability (Grant 1996), know-how (Sveiby/Lloyd 1987), (core) competence (Prahalad/Hamel 1990), experiences, lessons learned (Probst et al. 1998), expertise (Ackerman et al. 2003),
- capability, competence, conviction, discovery, evidence, explanation, idea, intelligence, invention, observation, opinion, proof, research result, testimonial, understanding, wisdom

Information

- information source, resource
- information quality, system, infrastructure
- interpretation, communication, message

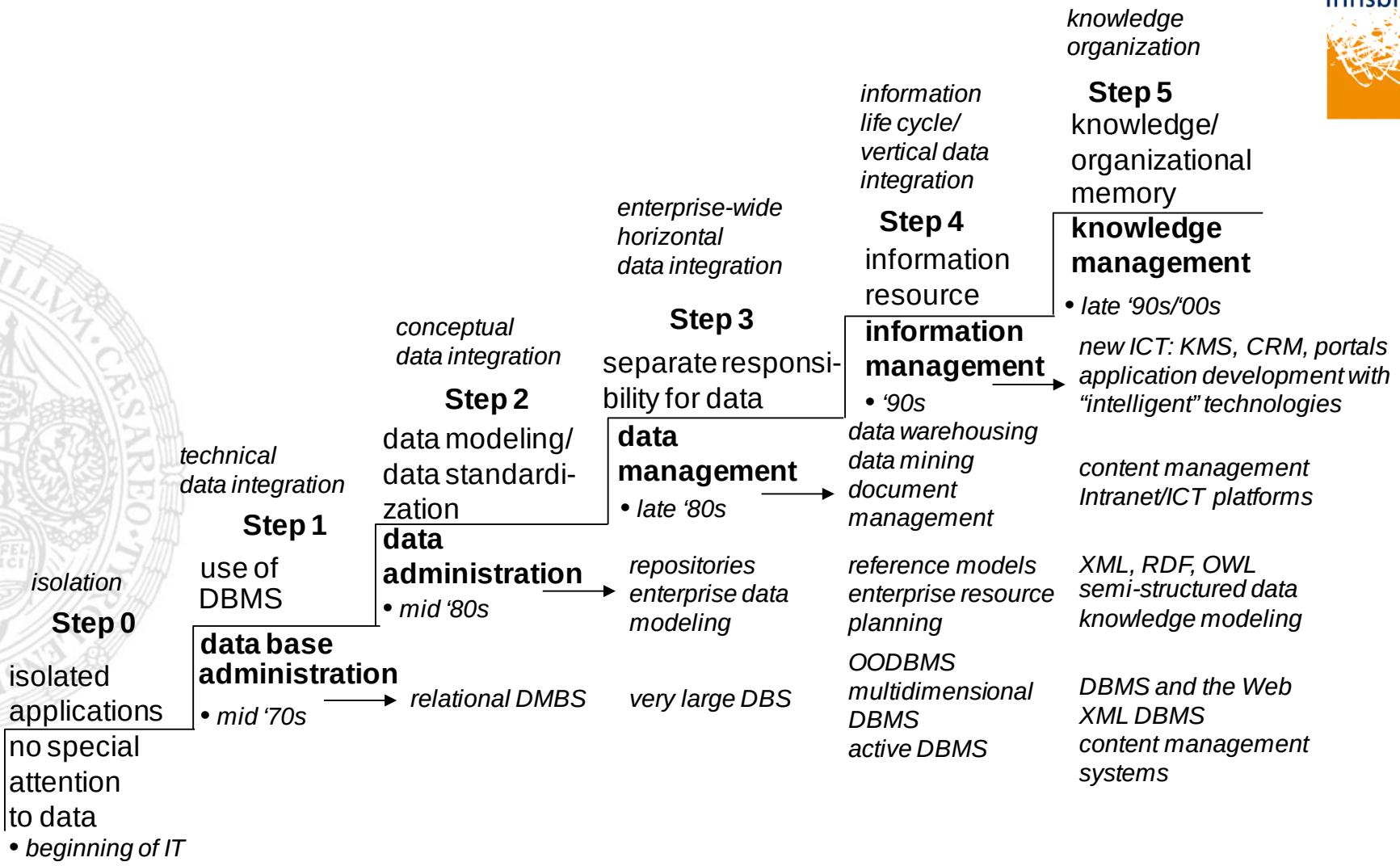
Data

- file, data resource, data base system
- structured: attribute, record, field, form, entity, relationship, table, tuple, value
- semi-structured: content, digital asset, document



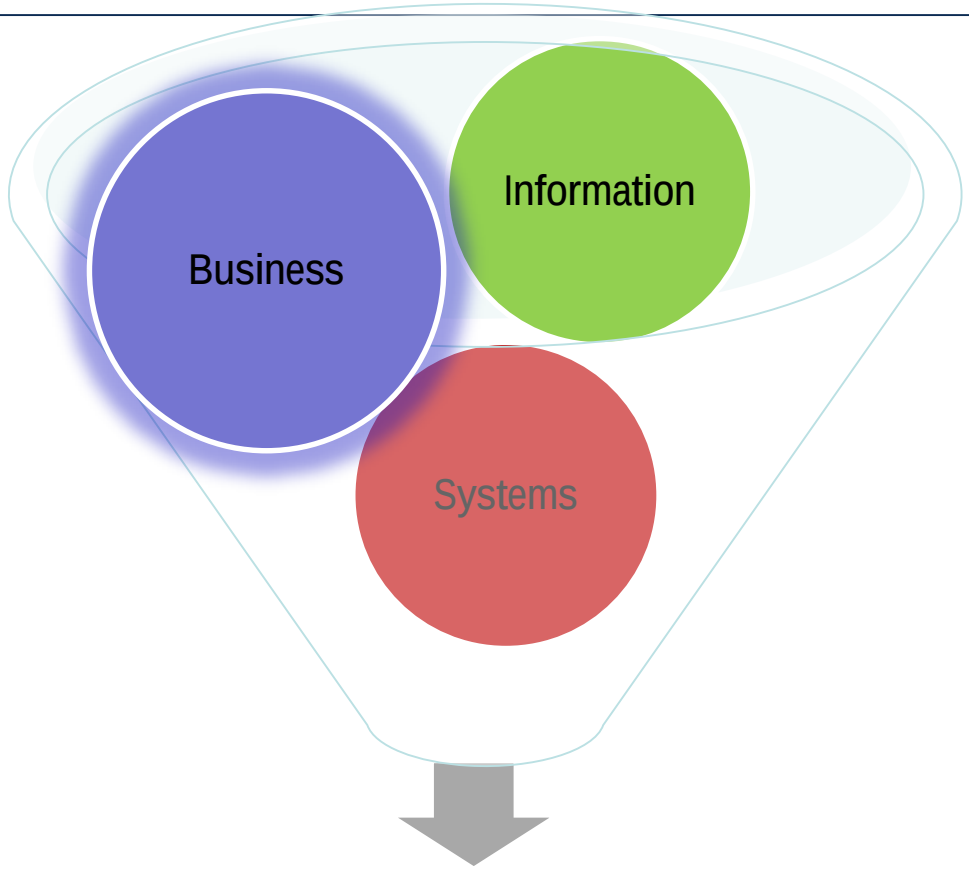
source: Maier 2009

Development of IT from the Perspective of Data



source: Maier 2007, 38

Basic Structure



Business Information Systems

Definition Business

- sector of society: the economy
- institutional / legal: a firm, company, enterprise
- functional, process-oriented: lists of related activities to produce goods/services for customers
- informational: information represents activities in businesses; drives businesses
- management: run businesses

Management

- management comprises analysis, decision, evaluation and control (Ansoff 1966)
- classic management model consists of planning – organizing – leading – controlling (Pearlson 2001, 8 after Stoner 1982)
- management can be defined as processing of information and its use for goal-oriented control of people and processes (Wild 1971)
- the essence of management is the creation, adaption, and coping with change (Leontiades 1982)

- functional
  - people function: servicing, integration, fostering personnel, work place design,
  - professional function: realization of company goals
- institutional
  - all persons who permanently perform management tasks, e.g., board of directors, executive board, supervisors, managers, executives

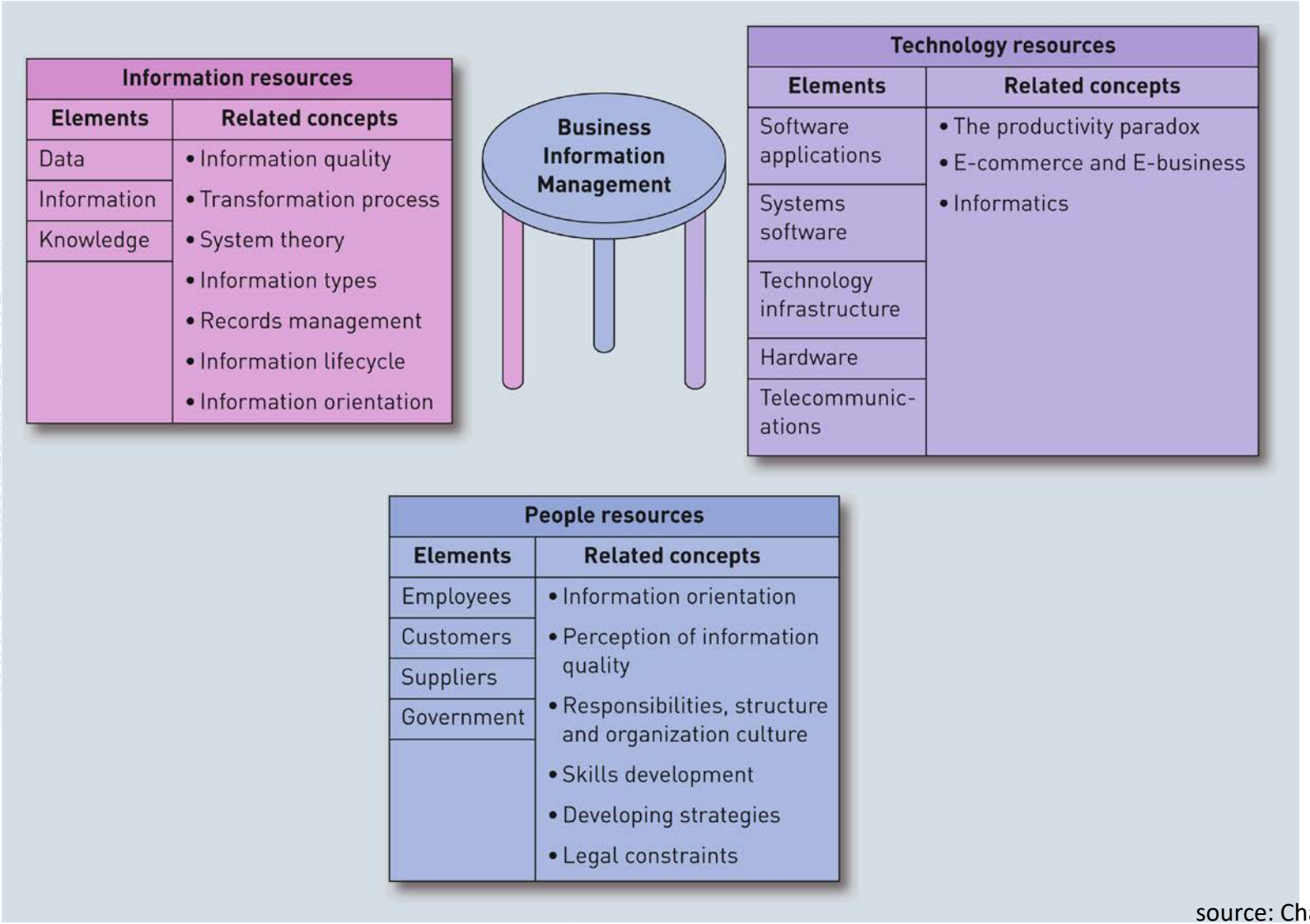
after: Krcmar 2005, 23f

Classic Management Model

Classic Management Model	
planning	Managers think through their goals and actions in advance. Their actions are usually based on some method, plan, or logic, rather than a hunch or gut feeling.
organizing	Managers coordinate the human and material resources of the organization. The effectiveness of an organization depends on its ability to direct its resources to attain its goals.
leading	Managers direct and influence subordinates, getting others to perform essential tasks. By establishing the proper atmosphere, they help their subordinates do their best.
controlling	Managers attempt to assure that the organi-zation is moving toward its goal. If part of their organization is on the wrong track, managers try to find out why and set things right.

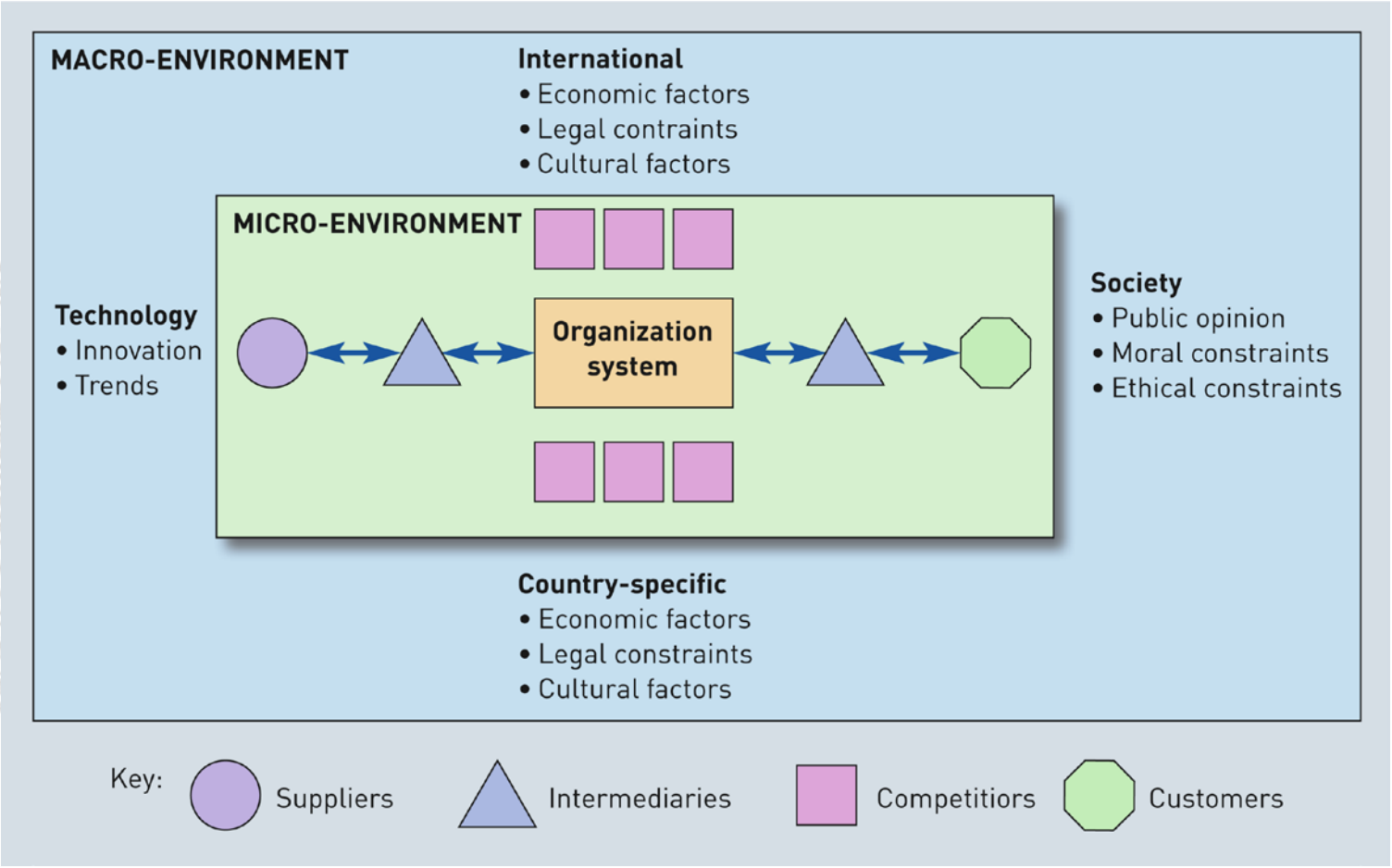
source: Pearlson 2001, 8 after Stoner 1982

Integration: People, Information, Technology



source: Chaffey 2005

Micro and Macro Environment



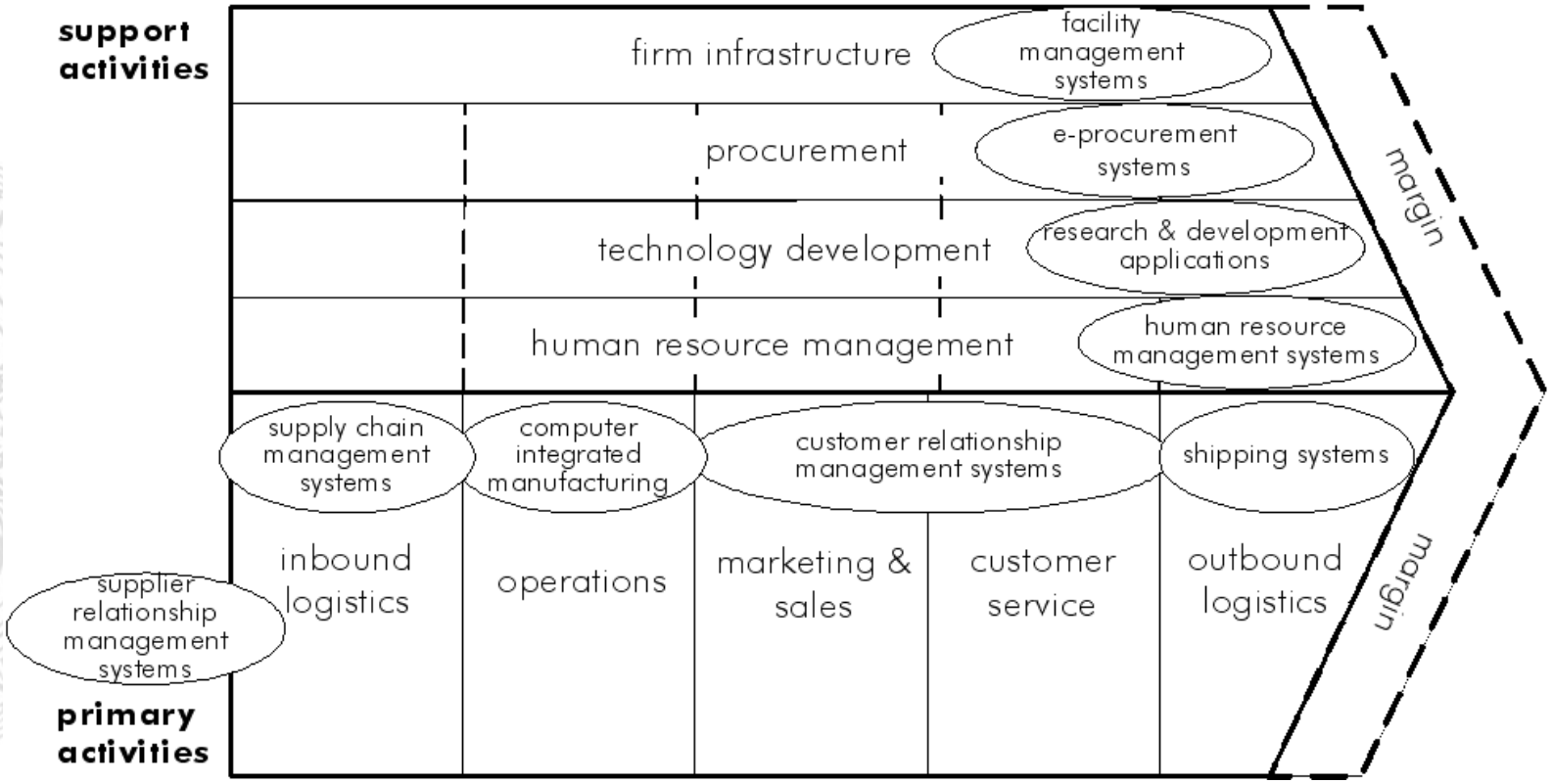
source: Chaffey 2005

Information Characteristics by Management Level

	Information					
Management level	**Time period**	**Frequency**	**Source**	**Certainty**	**Scope**	**Detail**
Strategic	Wide	Infrequent	External	Less certain	Wide	Summarised
Tactical	↔	↔	↔	↔	↔	↔
Operational	Narrow	Frequent	Internal	More certain	Narrow	Detailed

source: Bocij et al. 2015, p. 20 f.

Value Chain



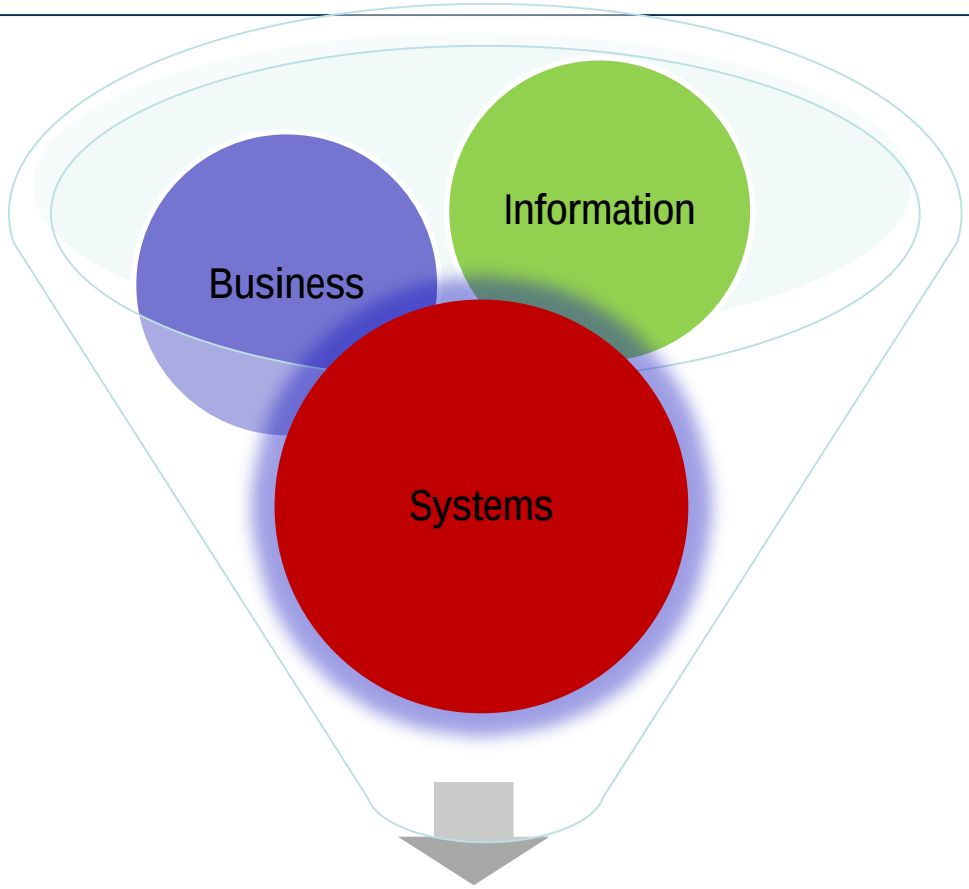
source: Porter 1985

New Economics of Information

- Information can impact the value chain in three ways:
  - **Reach**: A business can share information with more stakeholders or gain a larger audience at relatively low cost.
  - **Customization**: Information can be more readily tailored for sharing with a large number of partners.
    Dell's Premier Pages Extranet enables them to provide customized sales and order histories for large accounts.
  - **Interactivity**: Interaction between the parties is two-way rather than the traditional push of information.
    For example, it is possible for a supplier to anticipate a retailer's product requirements from examining their inventory forecast rather than awaiting a faxed order.

Evans and Wurster (1997)

Basic Structure



Business Information Systems

Systems Theory

- Systems theory provides a powerful means for analyzing and improving business processes. It can be applied to a wide variety of different areas and is fundamental to gaining a good understanding of the managerial application of BIS.

- A system can be defined as a collection of interrelated components that work together towards a collective goal. The function of a system is to receive inputs and transform these into outputs.

source: Bocij et al. 2015, p. 36

System Characteristics 1

- *The components of a system work towards a collective goal*. This is known as the system's objective. The objective of a system is normally very specific and can often be expressed in a single sentence. As an example, the objective of a car might be expressed simply as: to transport people and goods to a specified location.

  - **System objective**: All components of a system should be related to one another by a common objective.

source: Bocij et al. 2015, p. 37

System Characteristics 2

- *Systems do not operate in complete isolation*. They are contained within an environment that contains other systems and external agencies. The scope of a system is defined by its boundary. Everything outside of the boundary is part of the system's environment, everything within the boundary forms part of the system itself. The boundary also marks the interface between a system and its environment. The interface describes exchanges between a system and the environment or other systems.
  - **Environment**: surroundings of a system, beyond its boundary.
  - **Boundary**: interface between a system and its environment.
  - **Interface**: defines exchanges between a system and its environment, or other systems.

source: Bocij et al. 2015, p. 38

System Characteristics 3.1

- *Systems can be complex and can be made up of other, smaller systems,* known as subsystems. Systems composed of one or more subsystems are sometimes referred to as suprasystems.

- The objective of a subsystem is to support the larger objective of the suprasystem. For an organization, the subsystems such as marketing and finance would lie within the system's boundary, while the following elements would lie outside as part of the business environment:
  - customers, sales channel/distributors, suppliers, competitors, partners, government and legislation, the economy.

source: Bocij et al. 2015, p. 38

System Characteristics 3.2

- An organization will interact with all these elements that are beyond the system boundary in the environment. We refer to this as an open system. Most information systems will fall into this category since they will accept input and will react to it. Totally closed systems which do not interact with their environment are unusual.
  - **Subsystem**: Large systems can be composed of one or more smaller systems known as subsystems.
  - **Suprasystem**: A larger system made up of one or more smaller systems (subsystems).
  - **Open system**: Interaction occurs with elements beyond the system boundary.
  - **Closed system**: No or limited interaction with environment.

source: Bocij et al. 2015, p. 38

System Characteristics 4

- *Subsystems in an information system interact by exchanging information*. This is known as the interface between systems. For information systems and business systems, having clearly defined interfaces is important to an efficient organization.

- For example, sales orders must be passed from the sales subsystem to the finance subsystem and the distribution subsystem in a clear, repeatable way. If this does not happen, orders may be lost or delayed and customer service will affected.

source: Bocij et al. 2015, p. 38

System Characteristics 5

- *The linkage or coupling between subsystems varies*. The degree of coupling defines how closely linked different subsystems are. Loose coupling means that the modules pass only the minimum of information between them and do not share data and program code. Close-coupled systems are highly dependent on each other. It is a fundamental principle of systems theory and BIS design that subsystems should be loosely coupled.

- In **close-coupled systems**, outputs of one system are direct inputs of another system.

- **Decoupled systems** (or subsystems) are less dependent on one another than coupled systems and so are more able to deal with unexpected situations or events. They tend to have higher levels of autonomy, being allowed more freedom to plan and control their activities. Although decoupled systems are more flexible and adaptive than close-coupled systems, this flexibility increases chances of inefficiencies.

  The traditional method of production where material is held 'in-hand' as inventory is decoupled. In this arrangement, it is not necessary for production to match sales so closely, but this results in higher costs of holding inventory.

source: Bocij et al. 2015, p. 38

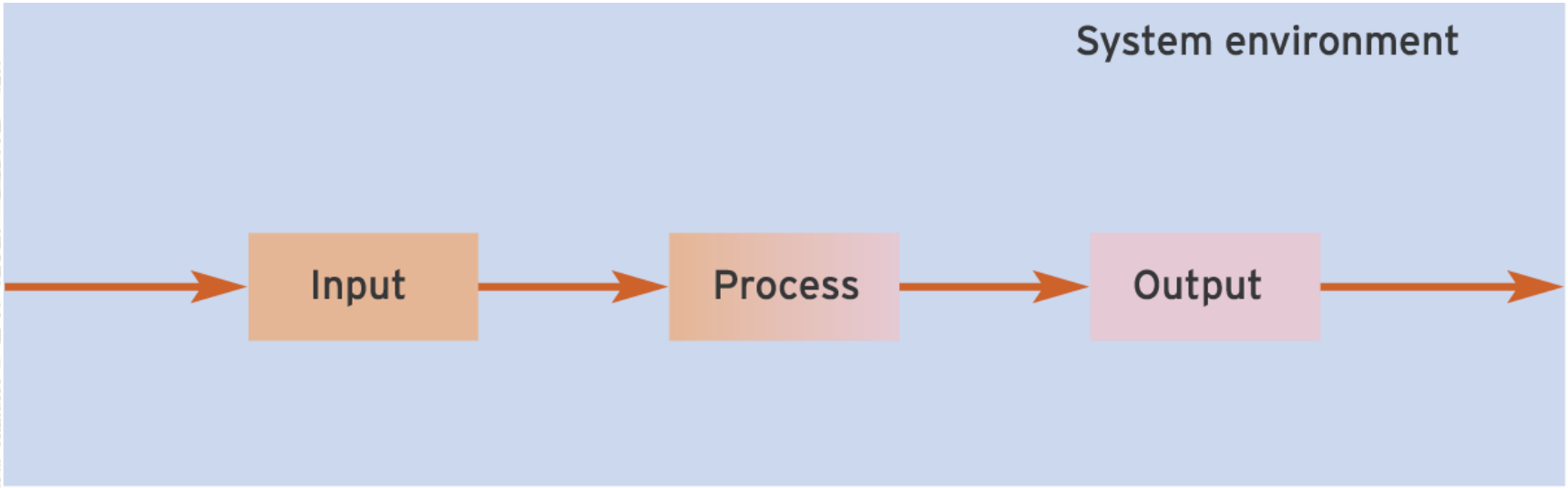
System Characteristics 6

- *Systems are hierarchical*. Systems are made up of subsystems that may themselves be made up of other subsystems. From this, one should realize that the parts of a system are dependent on one another in some way. This interdependence means that a change to one part of a system leads to or results from changes to one or more other parts.

Interdependence: means that a change to one part of a system leads to or results from changes to one or more other parts.

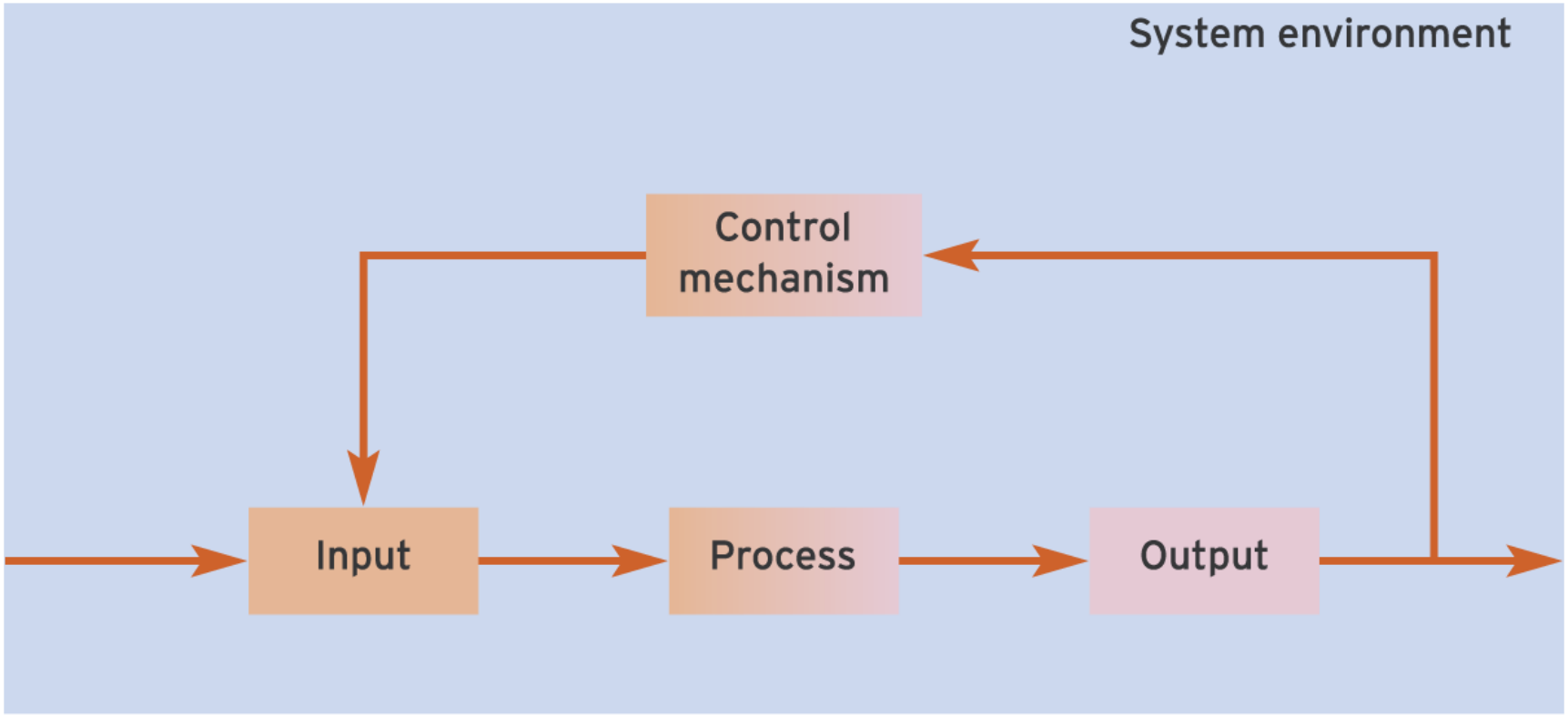
source: Bocij et al. 2015, p. 39

Generic Open-Loop System



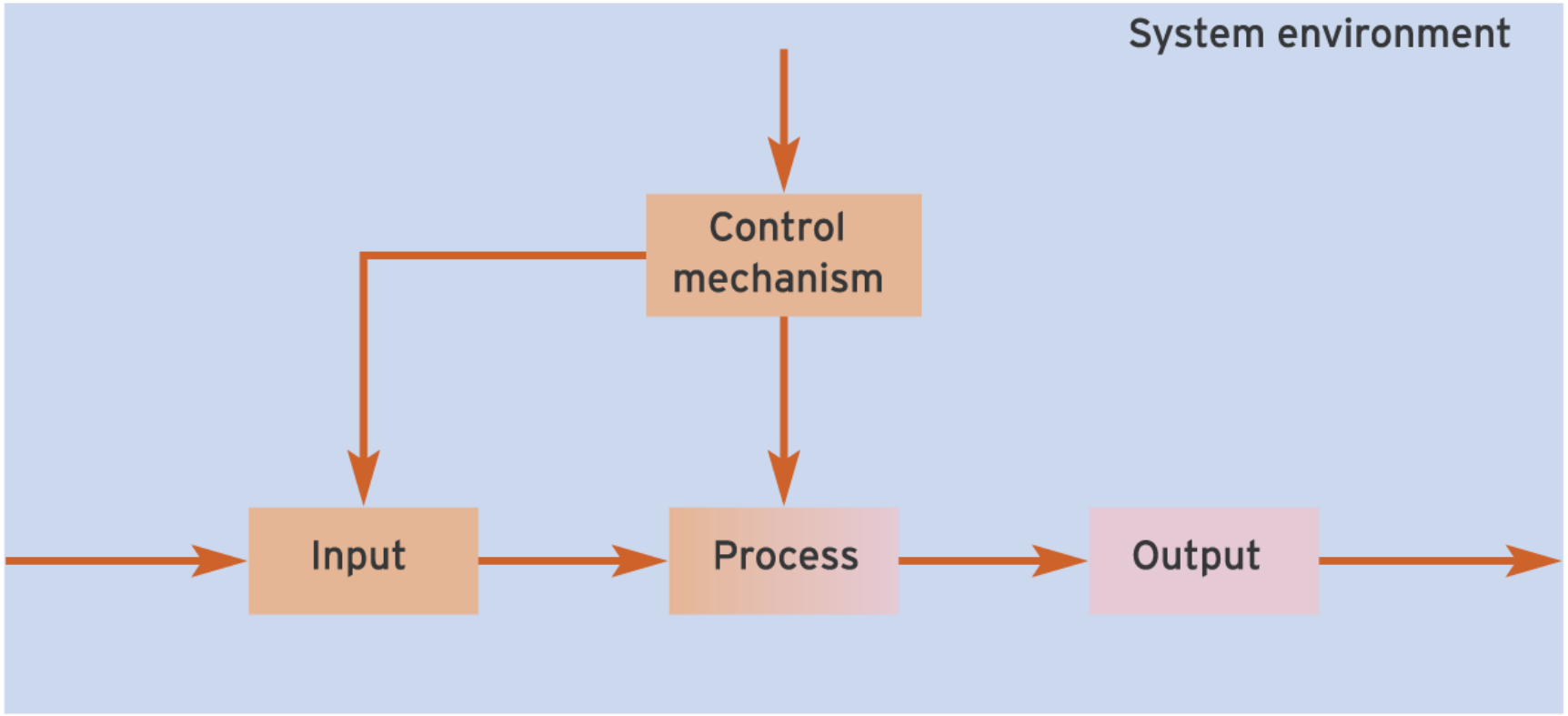
source: Bocij et al. 2015, p. 40

Generic Closed-Loop Feedback Control System



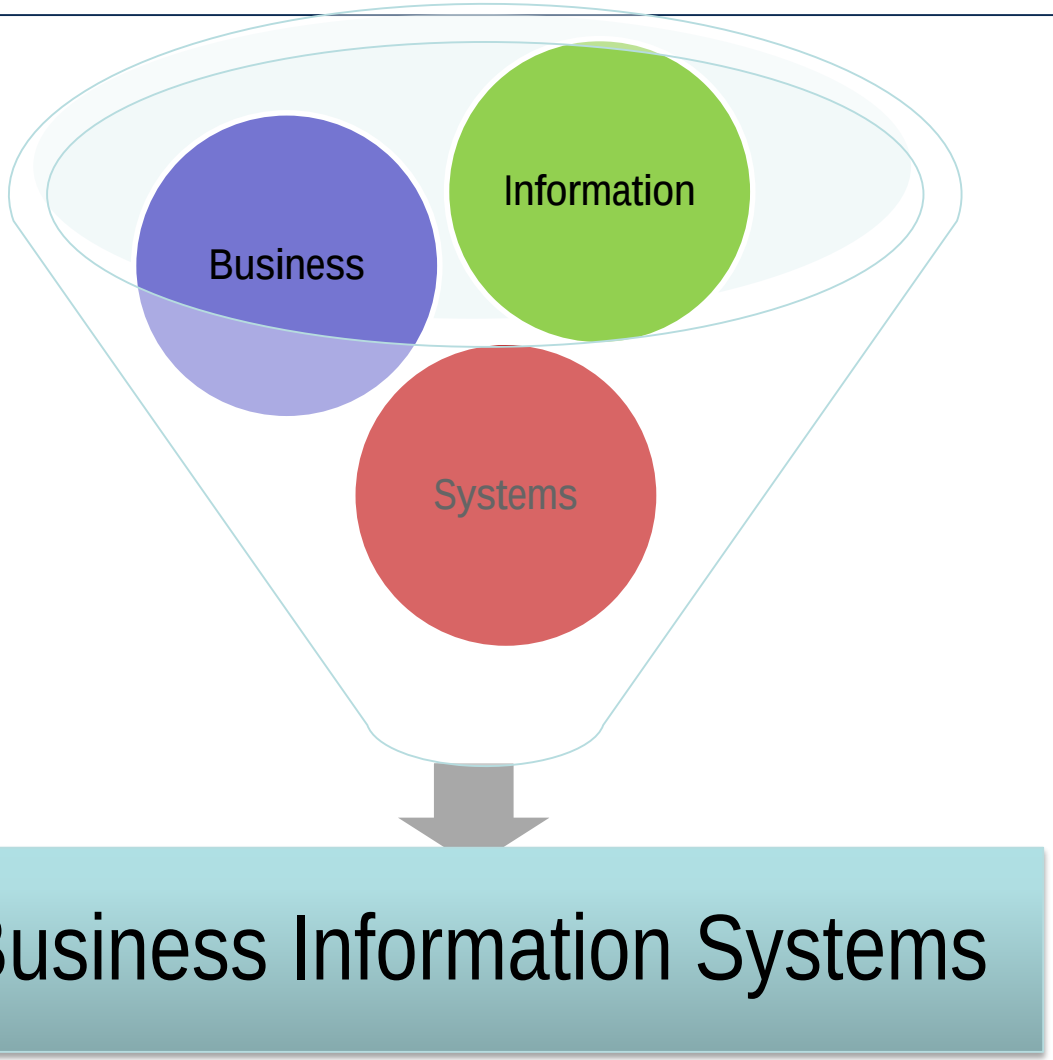
source: Bocij et al. 2015, p. 40

Generic Closed-loop Feedforward Control System



source: Bocij et al. 2015, p. 41

Basic Structure

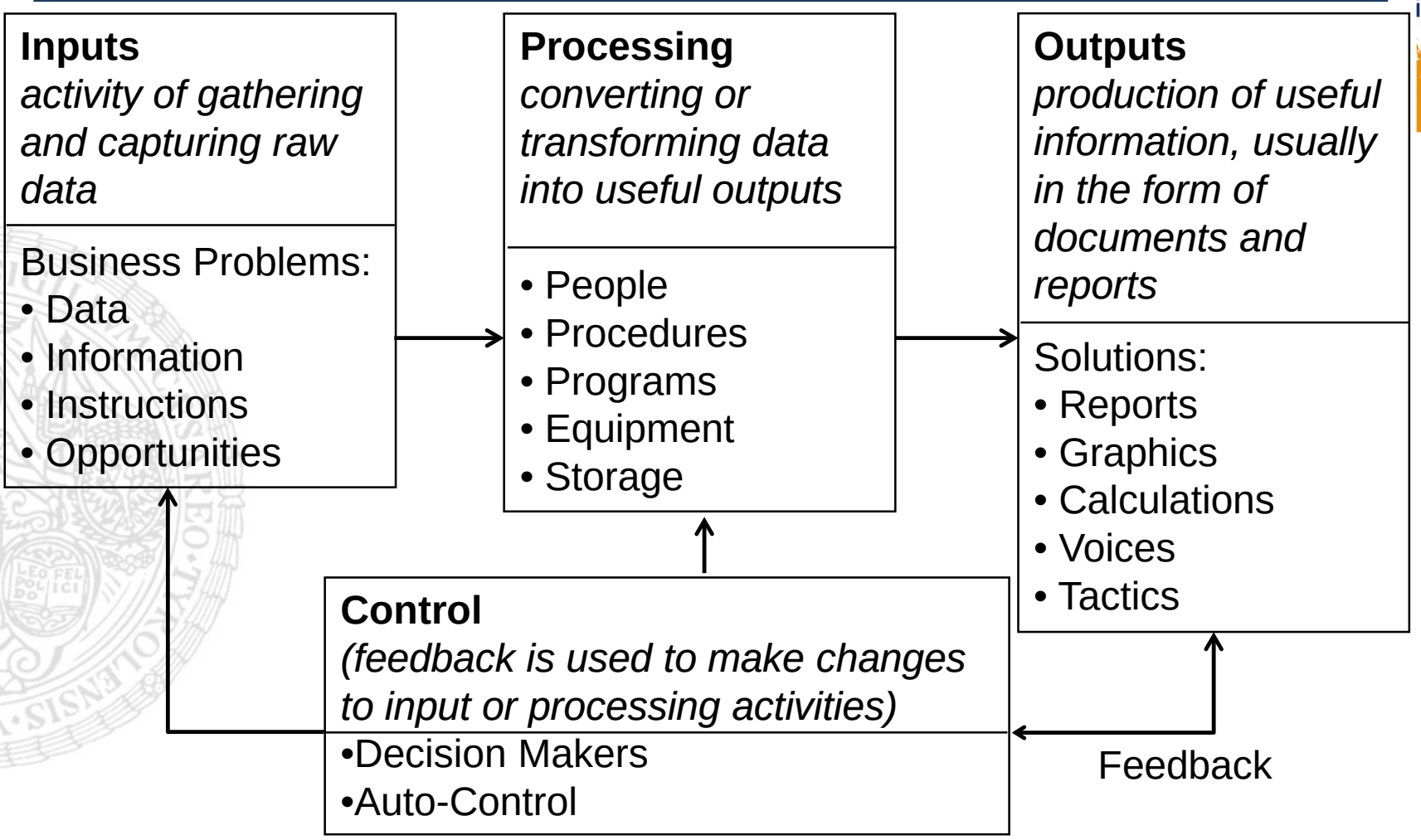


Facets of a Definition of (Business) Information System

- An information system (IS) collects, processes, stores, analyzes, and disseminates information for a specific purpose.
- An IS includes
  - inputs (data, instructions) and
  - outputs (reports, calculations).
- It processes the inputs and produces outputs that are sent to the user or to other systems.
- A feedback mechanism that controls the operation may also be included.
- An IS operates within an environment.
- An IS is not necessarily computerized, although most of them are.
- Basic components of computer-based IS:
  - people,
  - procedures (organization),
  - hardware, software, data base, network (technology).
- An IS that is used to support activities in business organisations is called business information system.

after: Turban et al. 2002, 20f

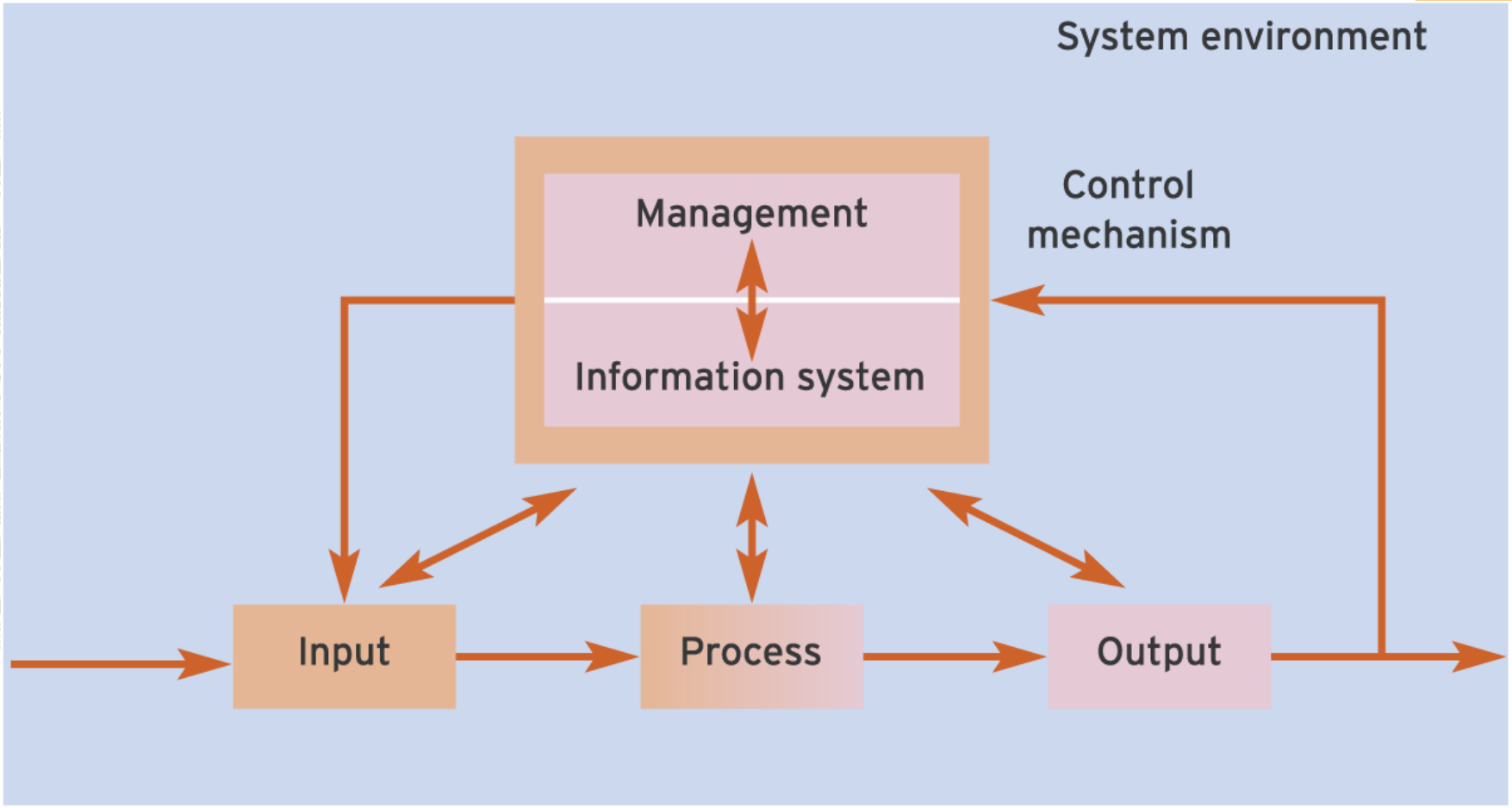
Schematic View of an Information System



Organizational environment: e.g., customers, suppliers, competitors, government

source: after Turban et al. 2002, S. 21

Business Information Systems as Control Mechanisms



source: Bocij et al. 2015, p. 39

Definition of Business Information System

- *'A business information system is*

  a group of interrelated components

  that work collectively to carry out

  input, processing, output, storage and control actions

  in order to convert data into information products

  that can be used to support

  forecasting, planning, control, coordination, decision making and operational activities

  in an organization.'

source: Bocij et al. 2015, p. 42

Resources that Support BIS

1. **People resources**: include the users of an information system and those who develop, maintain and operate the system.

2. **Hardware resources**: refers to all types of machines, not just computer hardware.

3. **Software resources**: in the same way, does not only refer to computer programs and the media on which they are stored. The term can also be used to describe the procedures used by people.

4. **Communications resources**: are also required to enable different systems to transfer data.

5. **Data resources**: describe all of the data that an organization has access to, regardless of its form.

source: Bocij et al. 2015, p. 43

Advantages of Computer Processing

- **Speed**: Computers can process millions of instructions each second, allowing them to complete a given task in a very short time.

- **Accuracy**: The result of a calculation carried out by a computer is likely to be completely accurate. In addition, errors that a human might make, such as a typing error, can be reduced or eliminated entirely.

- **Reliability**: In many organizations, computer-based information systems operate for twenty-four hours a day and are only ever halted for repairs or routine maintenance.

- **Programmability**: Although most computer-based information systems are created to fulfill a particular function, the ability to modify the software that controls them provides a high degree of flexibility.

- **Repetitive tasks**: Computer-based information systems are suited to highly repetitive tasks that might result in boredom or fatigue in people. The use of technology can help reduce errors and free employees to carry out other tasks.

source: Bocij et al. 2015, p. 44

Limitations of Computer-Based Processing

- **Judgment/experience**: Despite advances in artificial intelligence techniques, computer-based IS are considered incapable of solving problems using their own judgment/experience.
- **Improvisation/flexibility**: In general, IS are unable to react to unexpected situations and events. Since most systems are created to fulfill a particular function, it can be difficult to modify them to meet new or changed requirements.
- **Innovation**: Computers lack the creativity of a human being. They are unable to think in the abstract and are therefore restricted in their ability to discover new ways of improving processes or solving problems.
- **Intuition**: Human intuition can play an important part in all kinds of social situations. For example, one might use intuition to gauge the emotional state of a person before deciding whether or not to give them bad news. BIS cannot use intuition in this way and are therefore unsuitable for certain kinds of situations.
- **Qualitative information**: Managers often take unstructured decisions based on others' recommendations. Their confidence in the person they are dealing with often has a major influence on the decision itself. Once again, BIS cannot act upon qualitative information of this kind.

source: Bocij et al. 2015, p. 44

Usage and Applications

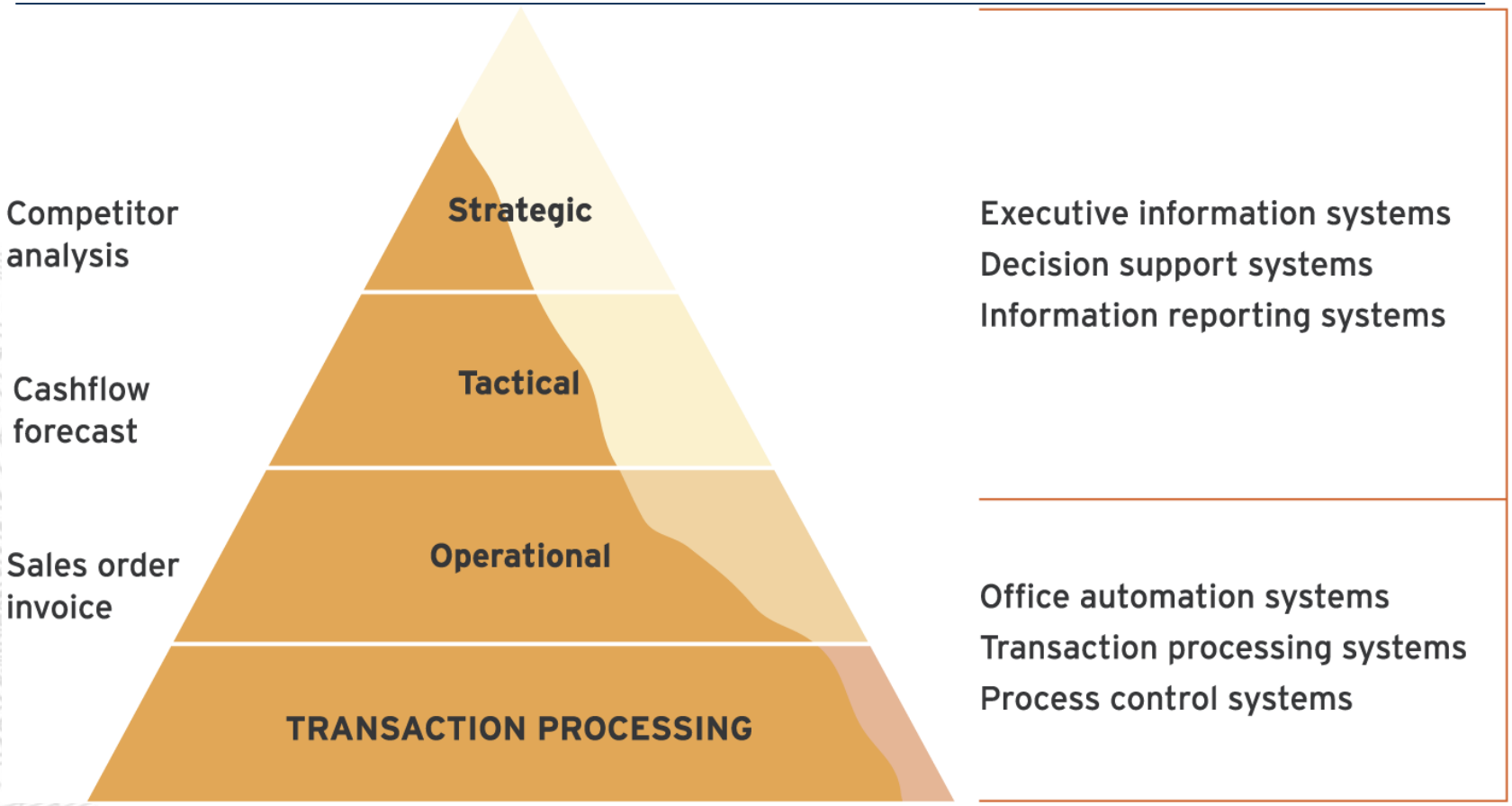


Figure: Usage and applications of computer-based information systems by organizational level (shading denotes usage of BIS)

source: Bocij et al. 2015, p. 45

IT & Competitive Advantages

Figure: Applying computer-based information systems for competitive advantage

source: Bocij et al. 2015, p. 55

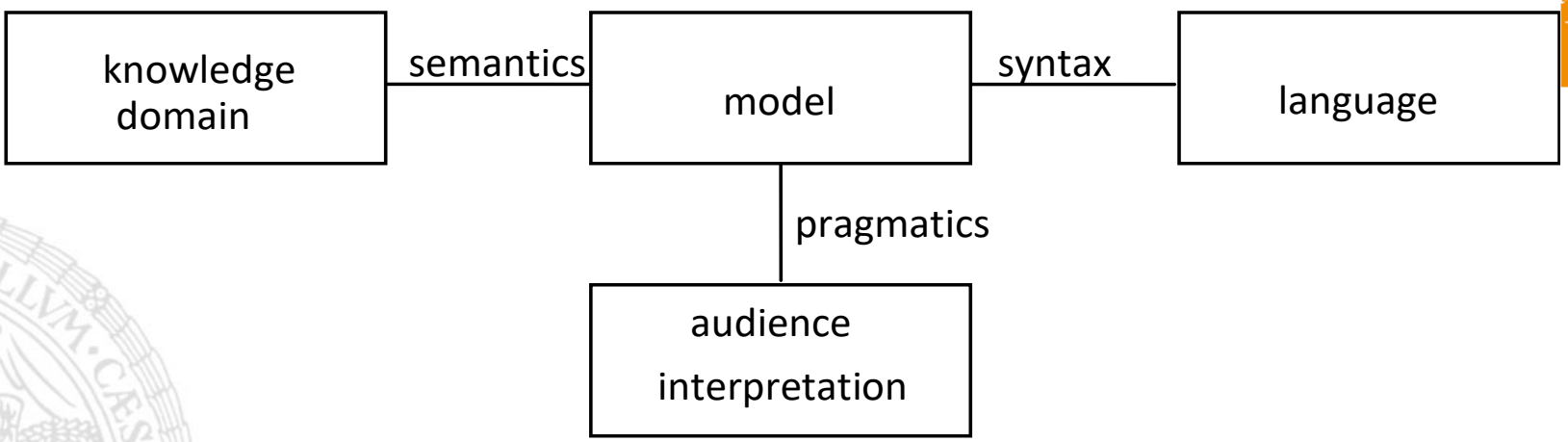
Agenda

- Information Systems
- Business Information Systems
- **Modeling**

Definition of Model

- A model represents reality or a portion of reality.
- Thus, model building is a representation process and a construction process using language as the medium.
- Models are used for description, explanation, prescription
- central quality: similarity between models and reality
  - structural similarity
  - functional similarity
  - behavioral similarity
- goal: mastering of complexity

Elements of a Framework for Modeling



- syntactic correctness
- semantic correctness
  - (feasible) validity
  - (feasible) completeness
- pragmatic correctness
  - (feasible) understanding

source: Lindland et al. 1994

Modeling Language

- model is a linguistic construction, model building needs a modelling language
- modeling language comprises
  - set of symbols,
  - syntax, which describes their valid arrangement,
  - semantics.
- abstract and concrete syntax
  - abstract syntax is limited to describing the concepts / meaning of the set of symbols and the rules for their arrangement,
  - concrete syntax (notation) determines what the symbols look like.
- A modelling language has one abstract syntax, but can have multiple notations.

source: Frank, van Laak 2003, S. 20

Definition of (Organizational) Process

- A process transforms input into output, often requiring multiple steps.
- Depending on the application area, transformation, input and output mean different things.
- A process in Management Science or an organizational process represents the organization of value creation with the aim to create output goods and services using production factors as input.

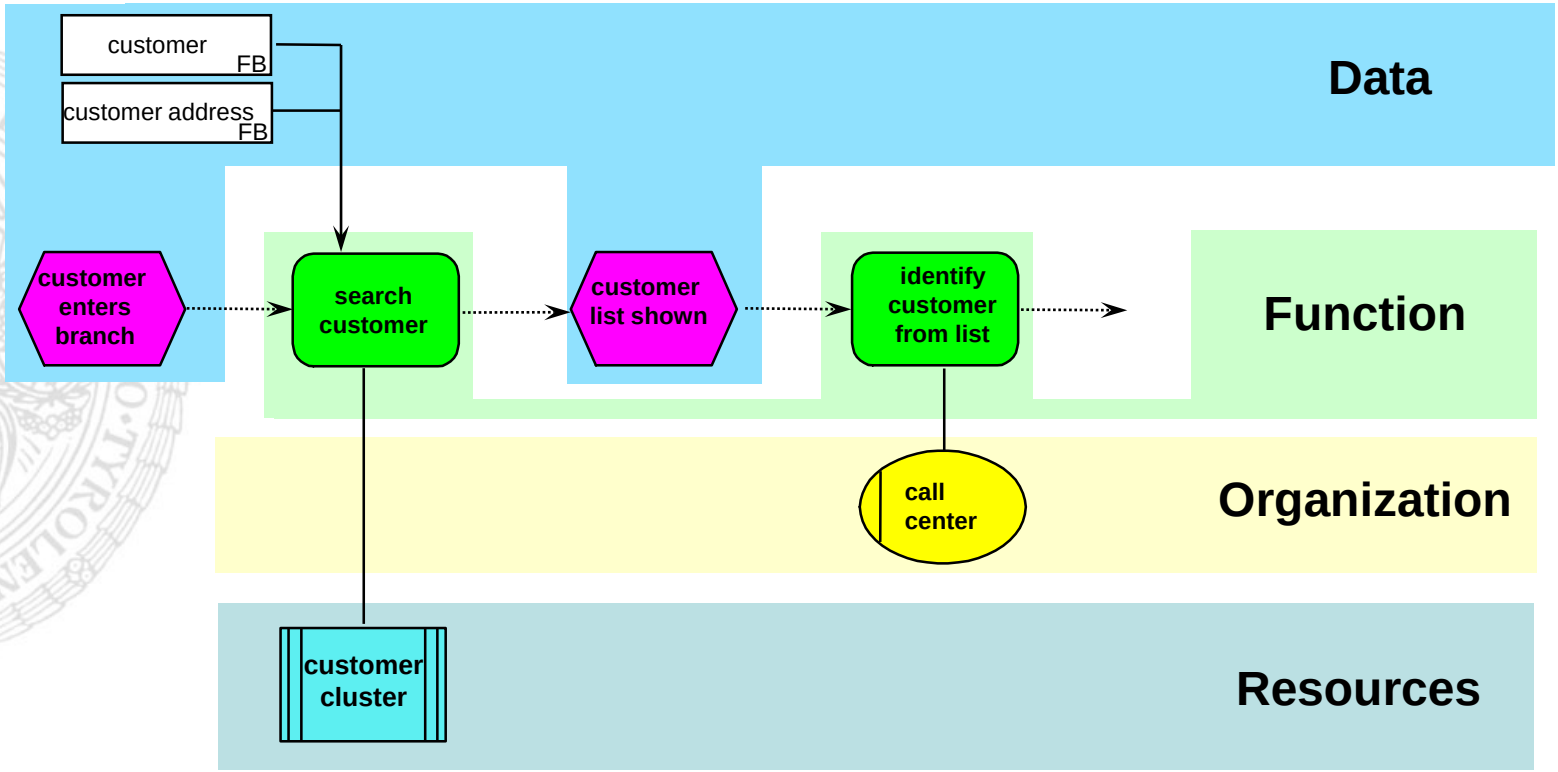
source: Schmidt 2002

Definition of Business Process

- A business process is a sequence of interconnected tasks or activities which are required to fulfill an organizational function. The tasks are performed by agents (human or computer) in organizational units which use organizational resources (after Staud 2001).
- Business processes consist of an inter-connected sequence of tasks the aim of which is the creation of value (after Scheer 1998).
- A business process can be decomposed into a number of (sub-) processes which are performed in a temporal or causal order (after Frank, van Laak 2003)

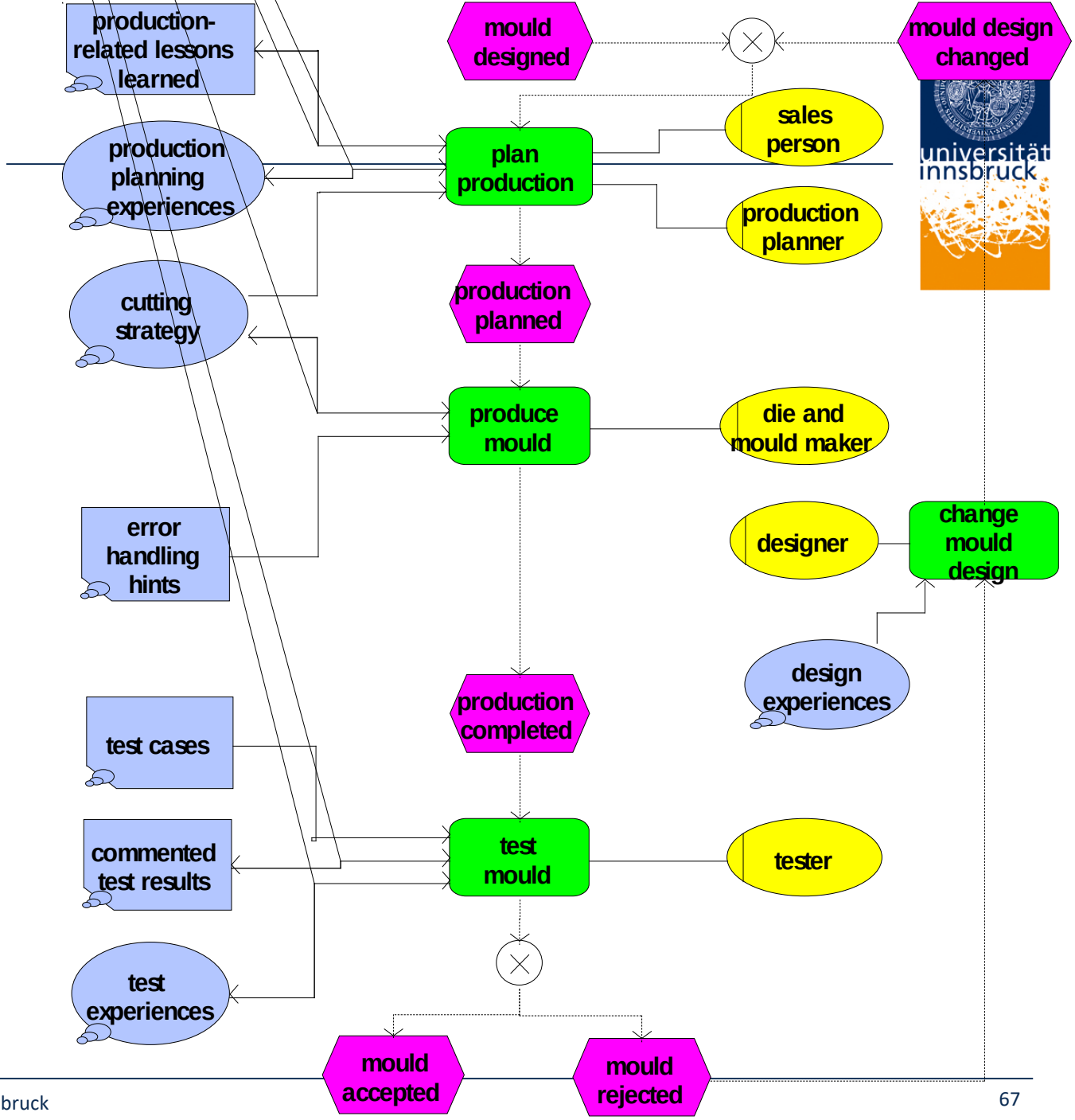
Process Modeling with ARIS

Reduction of complexity by using multiple perspectives



after: ARIS course documents of University of Münster

Example extended Event-Driven Process Chain (eEPK / eEPC)



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