



Digital Enterprise Research Institute www.deri.org

Business Information Systems

Unit 5

Business Processes and Software

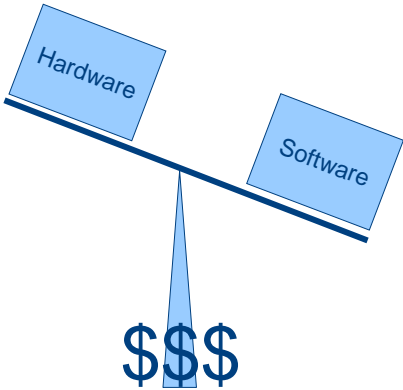
Prof. Dr. Martin Hepp

© Copyright 2005 Digital Enterprise Research Institute. The DERI Studio. All rights reserved. www.deri.at/teaching/ 1

Hardware vs. Software


Digital Enterprise Research Institute www.deri.org

- **Hardware:** The tangible components of a computer system
 - CPU, power supply, display, memory, ...
- **Software:** The intangible components of a computer system
 - Applications
 - Operating system
 - Data
 - Documentation and instructions




cf. Stair/Reynolds

© Copyright 2005 Digital Enterprise Research Institute. The DERI Studio. All rights reserved. www.deri.at/teaching/ 2




The Economics of Software Development




Digital Enterprise Research Institute www.deri.org


- High development costs, low distribution costs
- Network Externalities in the Software Market
 - Direct Network Effects
 - Indirect Network Effects



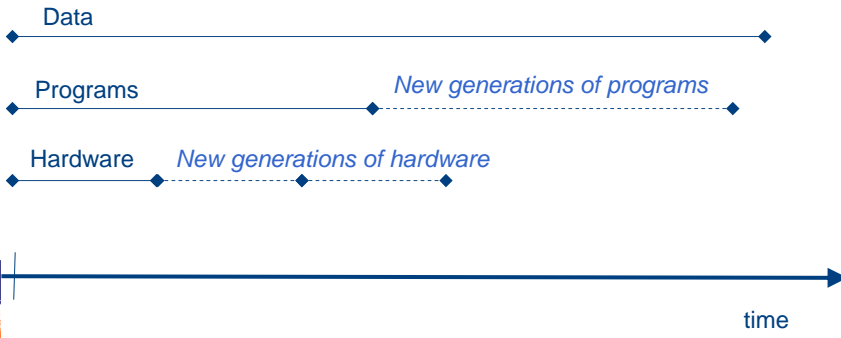
© Copyright 2005 Digital Enterprise Research Institute. The DERI Studio. All rights reserved. www.deri.at/teaching/ 3



Duration of Use: Hardware, Programs, and Data




Digital Enterprise Research Institute www.deri.org



The diagram illustrates the duration of use for three categories over time:

- Data:** Represented by a solid horizontal line with diamond endpoints, indicating the longest duration.
- Programs:** Represented by a solid horizontal line with diamond endpoints, followed by a dotted line labeled "New generations of programs", indicating a shorter duration than data.
- Hardware:** Represented by a solid horizontal line with diamond endpoints, followed by a dotted line labeled "New generations of hardware", indicating the shortest duration.

A horizontal arrow at the bottom is labeled "time".



© Copyright 2005 Digital Enterprise Research Institute. The DERI Studio. All rights reserved. www.deri.at/teaching/ 4

Economic Advantages of the Java Approach

Digital Enterprise Research Institute www.deri.org

Distribution of Translation Work:

```

graph TD
    A[Write program] --> B[Compile]
    B --> C[Bytecode]
    C -.-> D[MS Windows]
    C -.-> E[Apple Macintosh OS]
    C -.-> F[Cellphone]
    D --> G[Java Virtual Machine for Windows]
    E --> H[Java Virtual Machine for Macintosh OS]
    F --> I[Java Virtual Machine for Sony Ericsson]
    G --> J[Machine Code]
    H --> K[Machine Code]
    I --> L[Machine Code]
    J --> M[Execute]
    K --> N[Execute]
    L --> O[Execute]
    
```



© Copyright 2005 Digital Enterprise Research Institute. The DERI Studio. All rights reserved. www.deri.at/teaching/ 5

Off-the-Shelf Software

Digital Enterprise Research Institute www.deri.org

- Two approaches of developing software:
 - Custom development: Software for one particular usage
 - Common-of-the-Shelf (COTS): Software for a large number of usages
 - MS Office
 - SAP
 - Netscape


© Copyright 2005 Digital Enterprise Research Institute. The DERI Studio. All rights reserved. www.deri.at/teaching/ 6



What is **Integrated** Software?

Digital Enterprise Research Institute www.deri.org

- **Data Integration:** "One fact at one place"
- **Functionality Integration:** one function can interact with others (copy and paste inside one program)
- **Application Integration:** Two or more software applications can interact.
- **Process Integration:** Two or more business processes are connected.

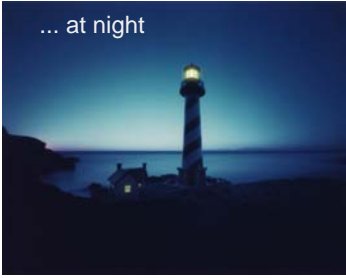


© Copyright 2005 Digital Enterprise Research Institute. The DERI Studio. All rights reserved. www.deri.at/teaching/ 7

Batch Processing


Digital Enterprise Research Institute www.deri.org



... at night

```

    graph TD
      A[Enter / Collect] --> B[Media Device  
Set of data or instructions]
      B --> C[CPU]
      C --> D[(Database)]
      C --> E[Output documents]
  
```



© Copyright 2005 Digital Enterprise Research Institute. The DERI Studio. All rights reserved. www.deri.at/teaching/ 8



What is a Business Process?



Digital Enterprise Research Institute

www.deri.org

- Any combination of activities that contribute to an individual, identifiable, desired output that adds value to the business operations.
 - Printing pay checks
 - Processing e-mail orders
 - Exchanging defective parts
 - Credit approval



© Copyright 2005 Digital Enterprise Research Institute. The DERI Studio. All rights reserved.

www.deri.at/teaching/

9



Characteristics of Business Processes



Digital Enterprise Research Institute

www.deri.org

- They have a **duration**, i.e. their execution can span a significant amount of time (not simple request-response)
- They can involve **machine and human actors**.
- They often require **data from other processes** inside the enterprise.
- They may require interaction with and contributions from the customer.



© Copyright 2005 Digital Enterprise Research Institute. The DERI Studio. All rights reserved.

www.deri.at/teaching/

10



Key Processes in a Production Firm

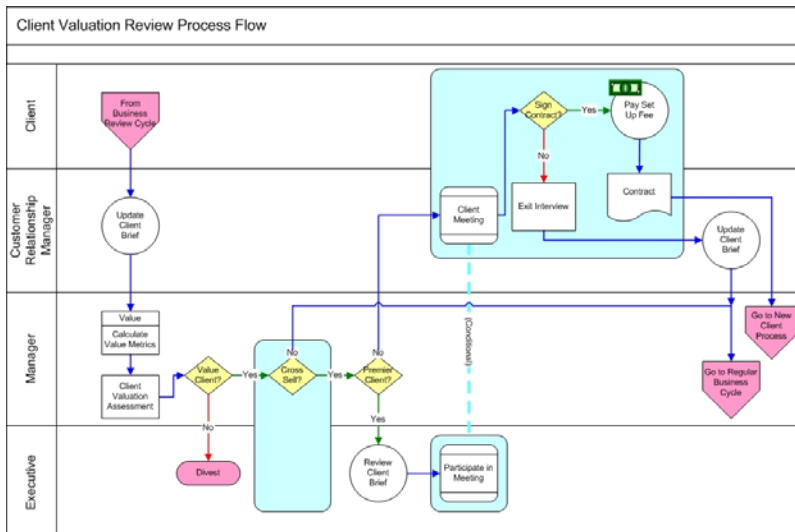


- Offer Process (customer-to-order)
- Order Process (order-to-invoice)
- Product Development (idea-to-market)
- Customer Service (failure-to-invoice)

cf. Wigand et al. (2003), p. 80



Example of a Business Process





Process Models, Process Instances, Ad-hoc Processes



Digital Enterprise Research Institute

www.deri.org

- Some processes are executed in a standardized manner, often based on a formal definition of the process. The latter is called a **Process Model**.
- Process models can be informal or formal and thus machine-readable.
 - **Informal:** McDonald's instructions for assembling a burger
 - **Formal:** UML activity diagram of a process
- An actual execution of a process is called a **Process Instance**.
- Some process instances do not follow a predefined pattern; these are called **Ad-hoc Processes**.



© Copyright 2005 Digital Enterprise Research Institute. The DERI Studio. All rights reserved.

www.deri.at/teaching/

13

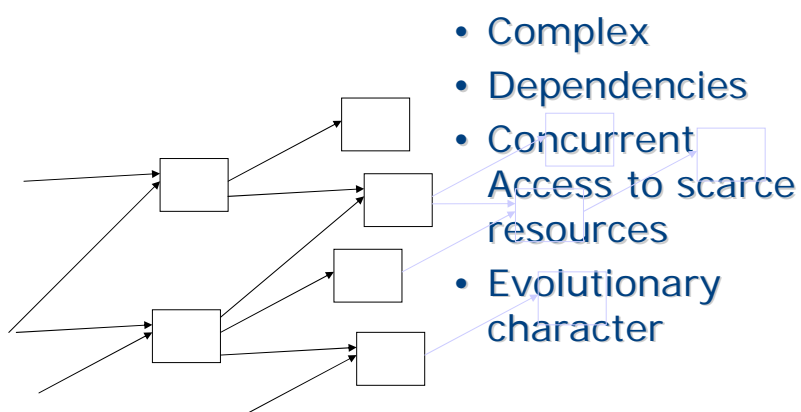


The Process Space of an Enterprise



Digital Enterprise Research Institute

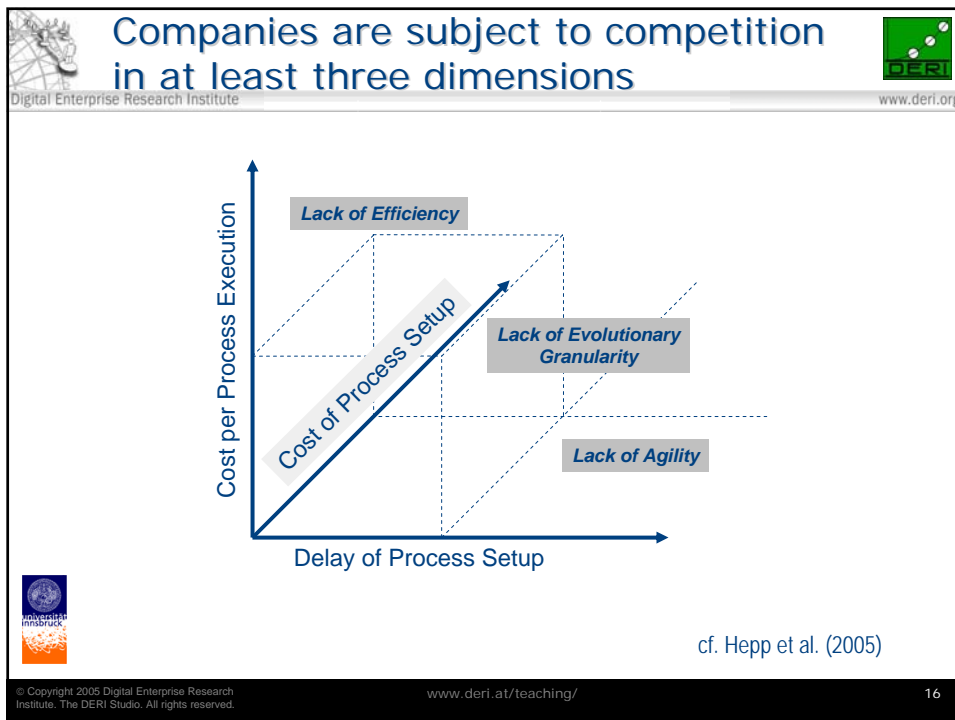
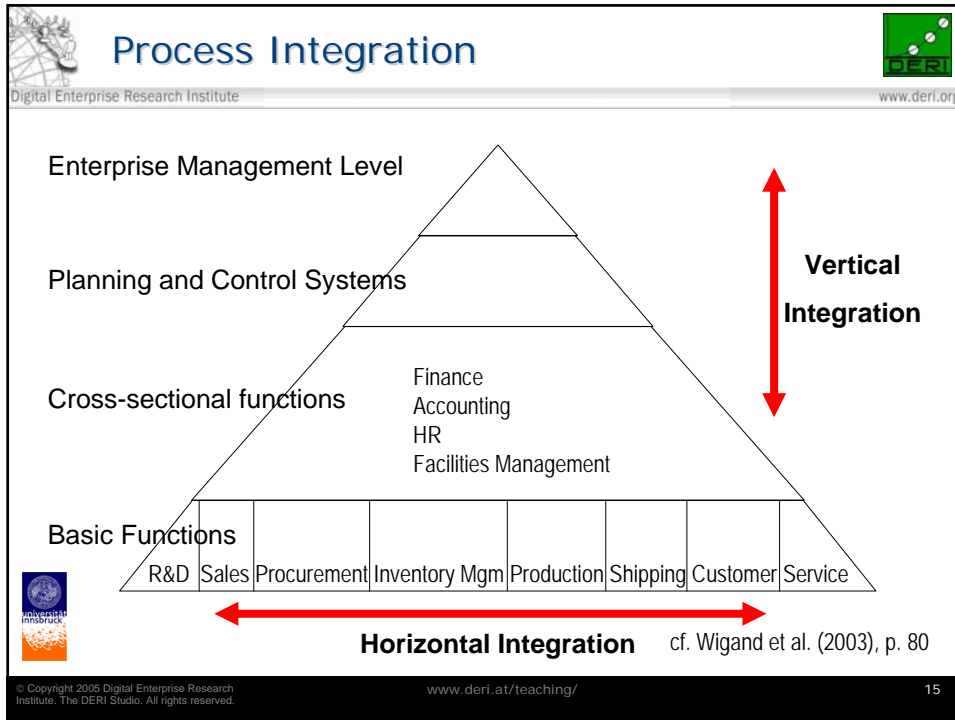
www.deri.org



© Copyright 2005 Digital Enterprise Research Institute. The DERI Studio. All rights reserved.

www.deri.at/teaching/

14



The Critical IT / Process Divide

Digital Enterprise Research Institute www.deri.org

Business Experts' Perspective: Processes

Querying the Process Space

Process Implementation

IT Implementation Perspective

© Copyright 2005 Digital Enterprise Research Institute. The DERI Studio. All rights reserved. www.deri.at/teaching/ 17

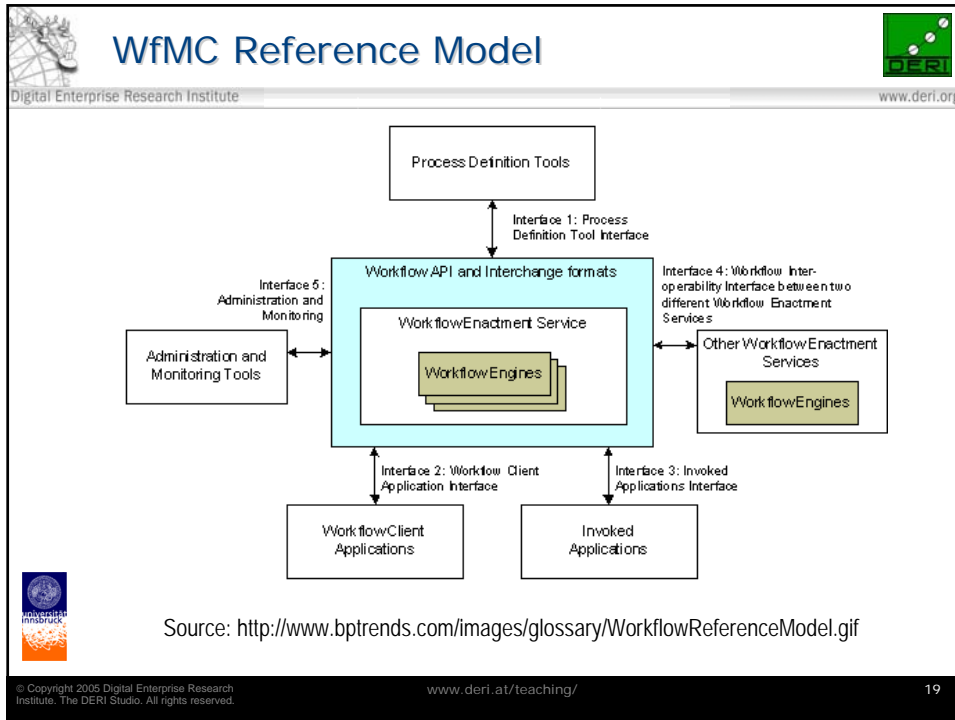
P2A: Workflow Management Systems

Digital Enterprise Research Institute www.deri.org


- First era of process automation
- WfMS – a system that „supports a specific set of business processes through the execution of a **process specification**“
- Perspectives:
 - Resources and Resource Management
 - Organizational Units
 - Tasks and Task Management
 - Data and Data Flow
 - Temporal Aspects (e.g. deadlines and durations)
 - Applications
 - Business Rules
 - Exception Handling

cf. A. Oberweis: Person-to-Application Processes: Workflow Management,
in Dumas/van der Aalst/ ter Hofstede: Process-Aware Information Systems


© Copyright 2005 Digital Enterprise Research Institute. The DERI Studio. All rights reserved. www.deri.at/teaching/ 18



- ## Challenges of Workflow Mgm Systems
- Lag in modeling or modifying workflow types (= models)
 - Alternative approach: Workflow Mining
 - Multiple workflow definition languages
- © Copyright 2005 Digital Enterprise Research Institute. The DERI Studio. All rights reserved. www.deri.at/teaching/ 20




P2P: Computer-Supported Collaborative Work




Digital Enterprise Research Institute www.deri.org

- Focus: Collaboration between human actors
- Difference to WfMS: P2P instead of P2A
 - interaction instead of sequential contributions
- Core challenges: Complexity of social interaction
 - supporting without restricting
 - e.g. voting mechanisms
- A form of a CSCW: Wiki infrastructure




cf. Ellis/Barthelmeß/Chen/Wainer: Person-to-Person Processes: Computer-supported Collaborative Work, in Dumas/van der Aalst/ ter Hofstede: Process-Aware Information Systems

© Copyright 2005 Digital Enterprise Research Institute. The DERI Studio. All rights reserved. www.deri.at/teaching/ 21




M2M: Enterprise Application Integration and Supply-Chain Integration



Digital Enterprise Research Institute www.deri.org

- **EAI**: Integrating processes, data flows, and systems inside an enterprise
- Business environments are usually heterogenous, autonomous, and distributed („HAD“).
- Reasons: Historically grown systems landscape, decentralized decision making
- Lack of a „Chief Integration Officer“
- Due to inherent change, systems evolve in an uncoordinated manner
 - non-synchronized software updates / release changes
 - modifications in data representation and services choreographies
- Web services (SOAP-based) offer at least a technological base for exposing legacy functionality



cf. C. Bussler: Enterprise Application Integration and Business-to-Business Integration Processes, in Dumas/van der Aalst/ ter Hofstede: Process-Aware Information Systems

© Copyright 2005 Digital Enterprise Research Institute. The DERI Studio. All rights reserved. www.deri.at/teaching/ 22



M2M: Supply-Chain Integration



Digital Enterprise Research Institute

www.deri.org

SCOR is Based on Five Distinct Management Processes



Source: <http://www.supply-chain.org>

Integration of processes that have independent paths of evolution!

The same process can be part of multiple supply chains!



cf. C. Bussler: Enterprise Application Integration and Business-to-Business Integration Processes, in Dumas/van der Aalst/ ter Hofstede: Process-Aware Information Systems

© Copyright 2005 Digital Enterprise Research Institute. The DERI Studio. All rights reserved.

www.deri.at/teaching/

23



The Sense and Nonsense of Business Process Modeling and Business Process Reengineering



Digital Enterprise Research Institute

www.deri.org

- Modeling existing processes is costly and takes time
- Many processes are „home-grown“ and do not follow best practices.
- As a consequence, modeling existing, sub-optimal processes for later implementation can be nonsense, because
 - the process itself could be improved
 - the process might change in the meantime
- Trend: Comprehensive packages of business software as libraries of best practices
 - also simplifies supply chain integration, reporting, ...



cf. R. Thome, A. Hufgard.: Continuous System Engineering., Würzburg 1996.

© Copyright 2005 Digital Enterprise Research Institute. The DERI Studio. All rights reserved.

www.deri.at/teaching/

24



Process Modeling



Digital Enterprise Research Institute

www.deri.org

- **UML**
 - General idea of UML: common framework for software engineering notations that cover varying aspects
 - General challenge of UML: Ground all models in a common formal semantics
 - Most important model for Process Modeling: **Activity Diagrams**
 - Also: Class Diagrams for organizational structure etc.
- **Event-Driven Process Chains (EPCs)**
 - key component of SAP ERP software for business engineering
- **Petri Nets**
 - Models of distributed and concurrent discrete dynamic systems with a focus on local consequences of operations
 - Various subtypes of Petri Nets
 - strong formal grounding

[1] Engels/Förster/Heckel/Thöne: Process Modeling Using UML

[2] Scheer/Thomas/AdamA. Oberweis: Process Modeling Using Event-Driven Process Chains,

[3] J. Desel: Process Modeling Using Petri Nets

All in: Dumas/van der Aalst/ ter Hofstede: Process-Aware Information Systems



© Copyright 2005 Digital Enterprise Research Institute. The DERI Studio. All rights reserved.

www.deri.at/teaching/

25



Process Mining



Digital Enterprise Research Institute

www.deri.org

- Idea: WfMS and other Information Systems leave a lot of data about how processes are actually executed and how systems are used
 - Log files
 - execution times
 - Menu paths followed
 - etc.
- This can be used to
 - identify mismatches between software usage and predefined processes
 - identify the need for new processes

cf. van der Aalst/Weijters: Process Mining,
in Dumas/van der Aalst/ ter Hofstede: Process-Aware Information Systems



© Copyright 2005 Digital Enterprise Research Institute. The DERI Studio. All rights reserved.

www.deri.at/teaching/

26

Business Process Monitoring: Technical Perspective

Digital Enterprise Research Institute www.deri.org

MIFOGHT BUSINESS APPLICATION SYSTEM EVENTS REPORTS

Weblogic Java Petstore JOY Applications

Locations

- Pleasanton

Web Server

CPU Mem Disk

Application Server

CPU Mem Disk

Database Server

CPU Mem Disk

a-PetStore - DogCatalog - Pleasanton

Current 11.611 s
High 16.111 s
Low 6.283 s
Avg 10.186 s

■ Normal ■ Exceeded 200 s ■ Timeout

a-PetStore - BirdCatalog - Pleasanton

Current 11.126 s
High 16.173 s
Low 4.579 s
Avg 9.134 s

■ Normal ■ Exceeded 200 s ■ Timeout

a-PetStore - FishCatalog - Pleasanton

Current 12.829 s
High 16.453 s
Low 4.626 s
Avg 9.396 s

■ Normal ■ Exceeded 200 s ■ Timeout

Weblogic Java Petstore Availability

Hourly	100.000 %
Daily	98.738 %
Weekly	96.685 %
Monthly	96.471 %

© Copyright 2005 Digital Enterprise Research Institute. The DERI Studio. All rights reserved.
www.deri.at/teaching/
27

Business Process Monitoring: Business Perspective

Digital Enterprise Research Institute www.deri.org

Corporate Performance Cockpit

Process cycle time 2nd quarter

Process cycle time across customers and regions

Process Mining: 8-11th levels in processes

Tendency of process cycle time

Top/Top Analyse over customers

© Copyright 2005 Digital Enterprise Research Institute. The DERI Studio. All rights reserved.
www.deri.at/teaching/
28



The Six Sigma Principle of Process Quality



Digital Enterprise Research Institute

www.deri.org

- **Idea:** Make defective parts or insufficient service delivery an extremely unlikely event.
- **Background:** The more complex business interactions are, the more costly is the occurrence of any component failure
- **Example:**
 - one defective seat prevents the completion of a whole car and can interrupt the overall production run
 - a defective power supply or CD-ROM in a cell phone package can lead to extremely costly product exchange and service operations
- **Definition:** Less than 3.4 parts per million parts (or service transactions) are allowed to exceed the lower or upper limit of product specification.



© Copyright 2005 Digital Enterprise Research Institute. The DERI Studio. All rights reserved.

www.deri.at/teaching/

29



The Six Sigma Principle of Process Quality (2)



Digital Enterprise Research Institute

www.deri.org

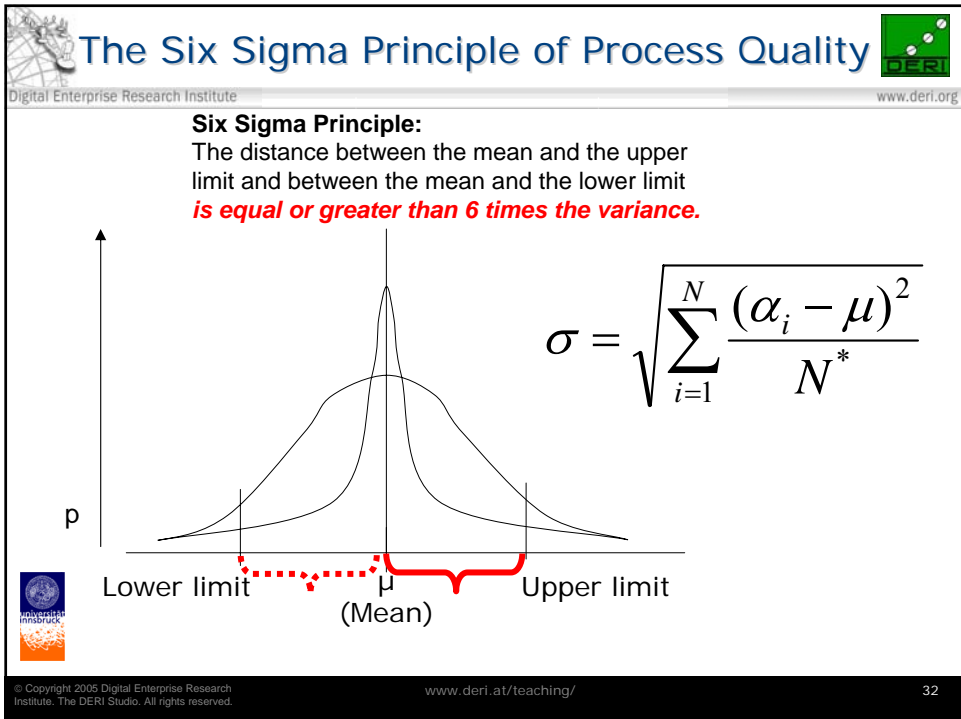
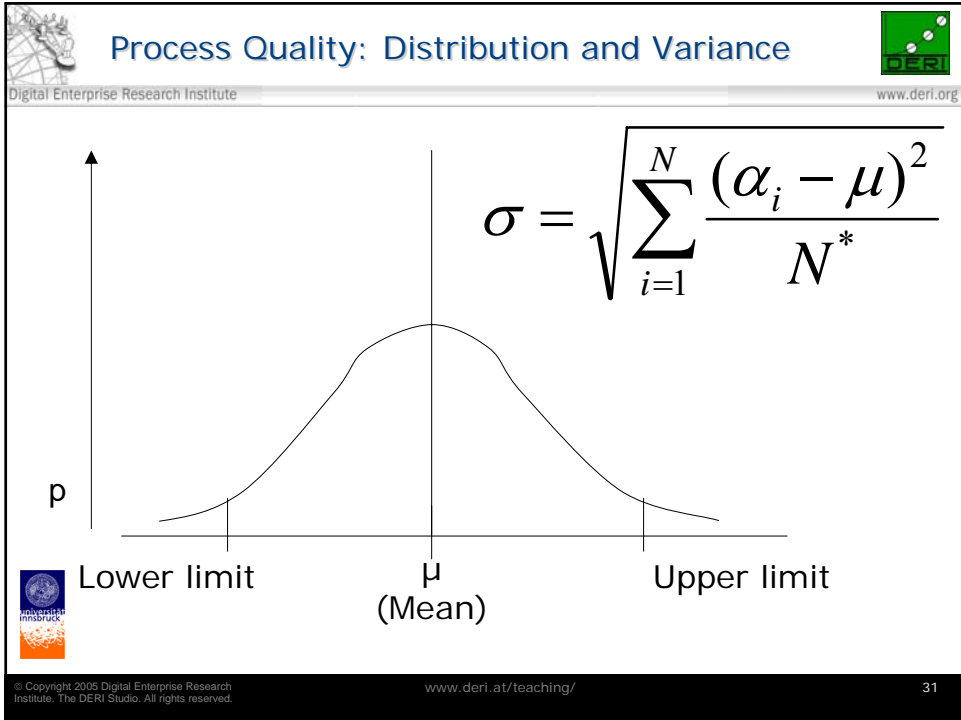
- It is **impossible** to produce
 - sausages that weigh **exactly** 100 grams,
 - foils that are **exactly** 100 mm wide,
 - corn flakes packages that contain **exactly** 250 grams,
 - match boxes that **always** contain 100 matches.
- The likelihood for a continuous variable in a stochastic process to have exactly a discrete value is zero. **Only intervals** for values **may have a non-zero likelihood**.
- **There is always variance**, due to
 - human error,
 - limitations of measuring,
 - unavoidable tolerances in machines and operations.



© Copyright 2005 Digital Enterprise Research Institute. The DERI Studio. All rights reserved.

www.deri.at/teaching/

30





Example: SLA for a Call Center Process



Digital Enterprise Research Institute

www.deri.org

- Service Level Agreement
 - every call should be answered in less than 20 seconds
- Log file
- **Is this a Six Sigma Process?**

Incoming	Answered	Delay
11:03:50	11:03:51	00:00:01
11:03:52	11:03:59	00:00:07
11:03:57	11:04:30	00:00:33
11:04:13	11:04:15	00:00:02
11:03:50	11:03:59	00:00:09
11:03:52	11:04:30	00:00:38
11:03:57	11:03:59	00:00:02
11:04:13	11:04:15	00:00:02
11:03:50	11:04:30	00:00:40
11:03:52	11:03:59	00:00:07



© Copyright 2005 Digital Enterprise Research Institute. The DERI Studio. All rights reserved.

www.deri.at/teaching/

33



Example: SLA for a Call Center Process



Digital Enterprise Research Institute

www.deri.org

Incoming	Answered	Delay
11:03:50	11:03:51	00:00:01
11:03:52	11:03:59	00:00:07
11:03:57	11:04:30	00:00:33
11:04:13	11:04:15	00:00:02
11:03:50	11:03:59	00:00:09
11:03:52	11:04:30	00:00:38
11:03:57	11:03:59	00:00:02
11:04:13	11:04:15	00:00:02
11:03:50	11:04:30	00:00:40
11:03:52	11:03:59	00:00:07

Mean:

$$\mu = (1+7+33+2+9+38+2+2+40+7)/10$$

$$= 14.1$$

$$\sigma^2 = \sum_{i=1}^N \frac{(\alpha_i - \mu)^2}{N^*}$$

$$\sigma^2 = 233.69$$

$$\sigma = 15.29$$

Upper limit: 20 secs

Upper limit – mean: 5.9

$$6 * \sigma = 91.72$$



© Copyright 2005 Digital Enterprise Research Institute. The DERI Studio. All rights reserved.

www.deri.at/teaching/

34



Thank you!

The slides will be available on the internet at
<http://www.heppnetz.de/teaching/bis/>