Applied Business Informatics 2/
Applied Information Systems 2: Business Process Modeling
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Objectives

Students should
1. be aware of critical aspects with regards to the performance of business processes
2. have basic knowledge about business process modeling
3. be able to use ARIS method to model business processes
4. be able to perform a business modeling project
Content

Part 1:
• Requirements analysis (DATA-ID-method)
• Process modeling
  – modeling the current state of a process (ARIS)
  – analysing it by means of various operating figures
  – modelling the target process
• Process organisation
• Tools for process modeling: Visio, ARIS Express

Part 2:
• Realisation of a process modeling project

Teaching and learning method / assessment

Teaching and learning method:
• Presentations by course instructor
• Practical exercises during the course and at home
• Realisation of a process modeling project

Exam and evaluation:
• Home exercises (approximately 5 home exercises)
• Written exam
• Project report and project presentation

Final assessment:
  – grade of the project report and presentation
  – plus/minus one grade on the basis of the exam
  – plus/minus one grade on the basis of the participation in the course and home exercises
Recommended Reading

- Seidlmeier Heinrich: Prozessmodellierung mit ARIS. 2. Aufl., Vieweg, 2006 (only in German)

COLLECTION OF REQUIREMENTS / PRESENT STATUS

DATA-ID-Method:

1. Identification of concerned organisational units
2. Identification of affected tasks and the organisational units which are concerned with them
3. Identification of staff members which are to be interviewed
4. Collection of requirements with regards to
   - objectives
   - activities/functions
   - data
   - events
   in so-called „Requirement Collection Forms“
Collection of requirements / present status

5. Filtering/Condensing of „Requirement Collection Forms“
6. Generation of three specific forms (on the basis of the filtered requirement collection form):
   - 1. Data Forms: characterised by words like „is“, „has“, „consists of“, „concerns“, ...
   - 2. Operation Forms: characterised by activity words/verbs like „make“, „execute“, ...
   - 3. Event Forms: characterised by words like „if“, „in the case

7. Filtering/condensing the data, operation and event forms

Example: see Excel-file.

BUSINESS PROCESS MODELING

Several process modeling approaches / information architecture approaches have been suggested.

Examples:

- ARIS („Architecture of Integrated Information Systems“) (Scheer)
- Holistic Information System Architecture Model (Modell der ganzheitlichen Informationssystem-Architektur (ISA) (Krcmar)
- Information Engineering (James Martin)
- Kölner Integration Model (KIM) (Grochla)
- CIM-OSA-Architecture
- IFIP WG 8.1-Architecture
- AD/CYCLE (IBM)
ISA Model by Krcmar

Essentially, an information systems architecture consists of

- data architecture
- application/function architecture
- communication architecture

It forms a buffer between

- business strategy and
- process architecture (operational structuring) and organisation structure on the one hand AND
- technological infrastructure on the other hand

Architecture of Integrated Information Systems (ARIS)

3 (4) different „views“:

- Data view
- Functional view
- Organizational view
- Control view (process view)
Architecture of Integrated Information Systems (ARIS)

3 description levels:
- Conceptual level (semantic models): closely connected to real-world problems
- Data processing concept
- Implementation

ARIS house
ARIS house: conceptual model

ARIS: data view

ARIS uses the Entity-Relationship-Model (ERM) to represent the data view.

Components of ERM (and their illustration in the original ERM):

- Entity (object type): rectangle
- Relationship (establish a relation between two or more entities): rhombus
- Attribute (describe entities and relationships in more detail): oval
  - attribute (describes properties of a data object)
  - primary key (unique identifier for an object or a relation): underlined attributes
- Cardinality (number of interconnections between two (or more) objects
ARIS: data view

ERM – example:

aggregation state: solid, liquid, gaseous
unit: kilo, liter, cubic meter

ARIS: data view

Components of ERM (and their illustration in the original ERM):
• Cardinality (number of interconnections between two (or more) objects:
  – 1:1: 1 object of the first object type is connected with (0 or) 1 object of the second object type; 1 object of the second object type is connected with (zero or) 1 object of the first object type
  – 1:N: 1 object of the first object type is connected with (0,) 1, 2, … N objects of the second object type; 1 object of the second object type is connected with (0 or) 1 object of the first object type
  – M:N: 1 object of the first object type is connected with (0,) 1, 2, … N objects of the second object type; 1 object of the second object type is connected with (0,) 1, 2 … M objects of the first object type
ARIS: data view

ARIS: organisational structure view

- Functions/activities will be performed in organisational units (departments)
- Illustration as ovals
ARIS: organisational view

Further modelling elements:
- department
- role / position („Stelle“): persons can be assigned to a role but also directly to a department
- staff member / holder of a position

ARIS: functional view

Activities (functions):
- Indicate an action/operation, for example: „compile/generate an invoice“
- Usually they need, change or produce data (objects) during their execution
- They are performed by organizational units.
- Distinction among complex functions, sub-functions, and elementary functions
- Elementary functions are activities where it does not make sense to further decompose them.
- Activities can be described by attributes:
  - Quantities: e.g., number of inquiries per day
  - Time specifications:
    - Adjustment period
    - Actual processing time
    - Wait/lay time
    - ...
  - ...

Diagram:
- Product div. 2
- Preparatory work
- Production scheduling
- Work preparer: Ms. Meier
- Head of prod. scheduling: Mr. Tatscher
- Work scheduler: Mr. Höller, Mr. Müller, Mr. Meister
ARIS: functional view

Notations for modelling activities (diagrams):
- Function trees
- Structograms
- Flow charts
**ARIS: structogram**

**Structogram** = for presenting algorithms graphically

**Control structures:**

- **pass or operation**
- **sequence:** series of operations, which are performed one after the other (consecutively)
- **selection:** as result of a condition a corresponding sequence (of operations) will be performed
  
  
  \[
  \text{IF } \text{condition} \text{ THEN sequence1 } \text{ ELSE sequence2 }
  \]

- **Loop** (iteration): DO WHILE condition (is TRUE):
  
  perform sequence of operations

---

**ARIS: structogram**

**Operation und sequence:**

<table>
<thead>
<tr>
<th></th>
<th>Operation 1</th>
<th>Operation 2</th>
<th>Operation 3</th>
</tr>
</thead>
</table>

**Selection / IF … THEN … ELSE:**

<table>
<thead>
<tr>
<th>TRUE</th>
<th>Condition?</th>
<th>FALSE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sequence 1 | Sequence 2
ARIS: structogram

Iteration/loop:

```
DO WHILE condition
    Sequence
```
Sequence can be performed 0-times, 1-times, and n-times (as long as „condition“ = TRUE)
In principle also an infinite loop is possible!!!

(Abstract) Example:

Name_der_Function:

<table>
<thead>
<tr>
<th>Sequence 1</th>
<th>TRUE</th>
<th>Condition 1?</th>
<th>FALSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>DO WHILE condition 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sequence 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sequence 4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Order execution:

```
Read data of a customer order
DO WHILE there are ordered articles available
    Article stock >= Ordered quantity?
        TRUE
        Article stock > 0?
            TRUE
            Article stock := 0
            Partial delivery allowed?
                TRUE
                Outstanding delivery quantity := ordered quantity – article stock
                Article stock := 0
            FALSE
        FALSE
```

ARIS: process overview

**Process landscapes:**
- Used to give an overview and to structure the process portfolio of an organization
- Can be used to describe a value chain

**Process types:**
- Core processes (i.e. value-adding processes)
- Management processes (e.g. strategy development)
- Support processes (e.g. marketing).

• Also possible to model a process hierarchy (e.g. top-process → sub-process → sub-sub-process)
• Also possible to assign organizational units and data objects to processes
ARIS: Control view (process view)

- The control view merges the 3 other views (data, functions, organization)
- Notation (modeling language) used: Event-driven Process Chains (EPC)
- Each process is initiated by an event, each process leads to a certain result (event); this is the same for activities
- Level of detailedness:
  - Events and activities/functions
  - Events and activities/functions and data
  - Events and activities/functions, data, organization units
  - Events and activities/functions, data, organization units, and various additional information (e.g. kind of processing type (batch or interactive, access authorization, …)

ARIS: control view

Event-driven Process Chain (EPC) - icons:

- Event:
  - ... 1) initiates an activity, 2) is result of an activity
  - refers to a point in time (is punctual)

- Activity (Operation):

- Connector:
  - ... describes how (AND, OR, XOR) two or more events/activities are connected with each other

- Control flow:
  - ... describes the logical sequence of activities and events

- Information (data) object:
  - ... illustration of real-world objects

- Materials object or other resource object:

- Information object (e.g. entity or relation of an ERM):

- Information object (document – in print):

- Information or materials flow:
  - ... Indicate if an activity requires information (input), produces information (output) or updates information (both)

- Organization unit (department):

- Assignment of resources or organizational units to activities
ARIS: control view

EPC for tender preparation (level of detail: events and activities)

Tabular illustration:

<table>
<thead>
<tr>
<th>Event</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer wants to get an offer</td>
<td>Collecting of calculation data</td>
</tr>
<tr>
<td>Calculation data are complete</td>
<td>Performing of calculation</td>
</tr>
<tr>
<td>Offer is finished</td>
<td>XOR</td>
</tr>
<tr>
<td>Submission of an offer is refused</td>
<td>XOR</td>
</tr>
<tr>
<td>Result is not satisfactory</td>
<td>XOR</td>
</tr>
</tbody>
</table>

Graphic illustration:

- Customer wants to get an offer
- Collecting of calculation data
- Calculation data are complete
- Performing of calculation
- Offer is finished
- Submission of an offer is refused
- Result is not satisfactory

ARIS: control view

EPC for tender (offer) preparation (level of detail: events, activities and data objects)

- Customer wants to get an offer
- Parts list
- Art# Quantity, raw material costs, machine costs, machine_op_time
- Work schedule
- Machine# Machine
- Calculation (data)
- Art# Quantity, raw material costs, machine costs, machine_op_time, price
- Performing of calculation
- Offer/ Offer refusal
- Art# quantity, raw material, machine costs, machine_op_time, price
- Offer is finished
- Submission of an offer is refused
- Result is not satisfactory
ARIS: control view

Connectors:

✓ Use:
  • If one event is followed by at least two activities
  • If one activity is followed by at least two events
  ➔ if one event/activity is followed by one activity/event, a connector is not necessary

✓ Connector types:
  ∧ ... Boolean AND: z. B. both (all) activities must be performed, both (all) events must occur
  ⊕, XOR... Exclusive OR: either the one or the other activity (but NOT both) must be performed, ...
  ∨ ... Boolean OR: either the one or the other activity or BOTH must be performed, ...

ARIS: control view

Connectors:

To distinguish if a branch splits or merges, there is a distinction between Input and output connectors:
  • output connector (lower half of a circle): one input, several outputs
  • input connector (upper half): several inputs, one output

Output connectors (if a branch splits):

1 event initiates two activities:  The completion of an activity is followed by two events:

After occurrence of event E, the activities A1 and A2 must be performed.  The completion of activity A results in the two events E1 and E2.
ARIS: control view

Connectors:

Input (and output) connectors:

The occurrence of both event $E_1$ and $E_2$ initiates activity $A$

\[ E_1 \quad \cap \quad E_2 \quad \rightarrow \quad A \]

The occurrence of either event $E_1$ or $E_2$ or both, initiates both activity $A_1$ and $A_2$

\[ E_1 \quad \lor \quad E_2 \quad \rightarrow \quad A_1 \quad \lor \quad A_2 \]

ARIS: control view

EPC for stock receipt (incl. organizational view):

Articles have arrived

Inspecting of articles

Goods receiving point

Articles are approved

Articles are locked

Articles are refused

ORDER

QUALITY INSPECTION

PRODUCTION
ARIS: control view

EPC for production:

Basic rules when drawing an EPC:
1. Each process must be initiated by at least one event (e.g., "customer wants an offer").
2. The completion of a process must also result in an event (e.g., offer is finished).
3. The above two points are also relevant for each activity. Basis structure of an EPC: Event → Activity → Event → … → Event.
4. Verbs should be used to name activities (e.g., collecting of calculation data).
5. Each object in an EPC must be connected (with another one by means of a line/edge).
6. A line/edge must connect (only) two (different) objects.
7. If a control flow which was split due to a certain output connector (e.g., XOR) merges again, one must use the same input connector (XOR) as for the output connector.
8. It is also possible to connect two connectors with a line/edge.
ARIS: control view

Be careful: With regard to (only!) **naming**, there is often only a minor difference among event, activity and information object.

![Diagram](image)

Besides events, activities, information objects and organizational units, the following **additional objects** can be considered in an EPC:

- **data carrier** of information objects
- **application system** used by an activity
- **kind of processing** of an activity: batch/interactive, hand operated
- **access authorization**: read only, insert, update, delete
ARIS: control view

Icons for data carriers:
- document
- card index
- file
- ring binder
- fax
- diskette

Icons for application systems:
- [SAP R/3] specific application system
- [Text proc.] type of application system

ARIS: goal chart

- modelling of the goal system of an organization
- Goal chart:
  - Hierarchic illustration of the goals of an enterprise and/or a project
  - goal hierarchy: top/superior goals → intermediary goals → sub-goals
  - Goals can be quantify by assigning of success factors (e.g. performance figures)
  - Goals will be reached by means of functions (function view)
  - which makes it possible to connect the goal system with the other views (models)
ARIS: goal chart

Goal chart with functions and success factors

- higher profitability
- decreasing costs
- increasing sales
- increasing market share
- performing sales campaigns
- performing sales promotions
- Sales
- Market share

PROCESS MODELLING: general aspects

General procedure model:

- Project preparation
  - project selection and definition
  - defining project goals and project organization
  - defining tasks and schedule for project
- Collecting of actual process state
  - data collection (organisational structure, functions, data, processes)
  - process modelling
  - verification
  - calculation of performance figures (times, costs, ...)
- Process analysis
  - realization of weak points
  - analysis of performance figures
  - discussion/revision
  - suggestions for improvement
- To-be conception
  - modelling of one or more target processes
  - assessment of target processes
  - necessary actions
  - investments / expenditures
  - time for implementation
- Presentation of results
  - consequences for structural organisation
  - ...
PROCESS MODELLING: general aspects

Interview guide for collecting the actual process state (1)

Aim: Collection of the actual state of process …

Triggers + Events
- Which event starts the process?
- How or by whom you are informed that you have to spring into action in the process?
- How many times is the process initiated?
- What is the result of the process?

Input
- Which documents must be available in which quality?
- Which data (records) must be provided by the application system?

Process structure
- Please describe the various operations/functions. Which operations must be performed in which sequence?
- Which are the preceding operations and which the subsequent activities?

Staff involved in the process
- Which staff members are involved in the process? (Who collaborates with whom?)
- Which departments/organizational units are involved?

PROCESS MODELLING: general aspects

Interview guide for collecting the actual process state (2)

Process output
- Which documents are produced? Which documents are relevant?
- How long does it take to produce a document?

Process interfaces
- Is it necessary to communicate with other departments in order to perform the operation? If yes, how does this communication process take place?

Necessary resources
- Which resources (e.g. technical equipment) do you need?
- Which data are required by which application system when, where and in which form for which function/operation? How are the data processed for the relevant function/operation?

Possible improvements
- Where occur often problems/difficulties in the process? How often do they occur? How severe are they?
- When arise waiting and idle times?
- Which operations are not properly supported by application systems?
- Do you have any other ideas how to improve the process?
- Is there a course of action in case of critical incidents? Are the necessary responsibilities determined?
PROCESS MODELLING: general aspects

Process analysis – performance figures (1):

• **Lead time/throughput time:**
  - processing time + time for information/data transfer + waiting time + idle time (=Liegezeit)
  - Usually processing time is only a small fraction of lead time!!!
  - Notation: mean value or median, in addition minimum and maximum values (ev. distribution function)

• **Process costs:**
  - All labour costs, material costs and other costs which can be directly attributed to a process
  - Much more transparent and precise picture of the actual cost situation (unlike overhead/indirect costs which are more or less randomly assigned to a cost unit)

• **Alternation between departments/roles (%)**:
  - number of alternations between different organisational units/roles divided by the total number of possible alternations (= total number of functions – 1)
  - (usually a high percentage leads to a high lead time (in particular waiting and idle times))

• **Degree of automatization (%)**:
  - number of functions which are computer-supported (fully automated) divided by total number of functions

• **Alternation between application systems (%)**:
  - number of alternations between different application systems divided by the total number of possible alternations (= total number of functions – 1)
  - (usually a high percentage leads to a high lead time (in particular information/data transfer time))