Modeling Knowledge Work: Case Management and Decision-aware Business Processes

Knut Hinkelmann

FHNW University of Applied Sciences and Arts Northwestern Switzerland
knut.hinkelmann@fhnw.ch
Well-known things from Switzerland
The Ultimate Swiss Armee Knife
About Me

- Head of Master of Science in Business Information Systems
- Research Associate at University of Pretoria
- Topics:
  - Enterprise Modelling
  - Business Processes and Knowledge Work
  - Alignment of Business and IT
For the latest material see:

http://knut.hinkelmann.ch/lectures/nemo2016/
Work Patterns of Knowledge Workers

Percent of the Day Spent in Different Modes

Most of a knowledge worker’s day is spent working toward an identified outcome, yet the means for achieving this cannot be predetermined.

- Purely Ad-Hoc, Never Happens the Same Way Twice: 35% (31%)
- Consistent, Defined Goals; Varying Means to Achieve: 28% (30%)
- Documented and Managed, but Not Automated: 20% (20%)
- Partially Automated, but Frequent Exceptions: 15% (17%)
- Fully Automated, Lack of Opportunity to Change: 9% (9%)

2/3 of a Knowledge Worker’s Day is Spent in Unstructured & Often Unpredictable Work Patterns

Roughly 1/3 is Structured, Predictable, Automated or Automatable

Source: 2011 - 2013 Case Management Survey
Process Logic and Business Logic

knowledge *about* processes:
- process flow
- roles
- resources

→ process logic

knowledge *in* processes:
- supports practice
- skills, experiences
- know how

→ business logic
Types of Knowledge Work

- **Integration Model**
  - Systematic, repeatable work
  - Highly reliant on formal processes, methodologies or standards
  - Dependent on tight integration across functional boundaries

- **Collaboration Model**
  - Improvisational work
  - Highly reliant on deep expertise across multiple functional
  - Dependent on fluid deployment of flexible teams

- **Transaction Model**
  - Routine work
  - Highly reliant on formal rules, procedures and training
  - Dependent on low discretion workforce or automation.

- **Expert Model**
  - Judgement-oriented work
  - Highly reliant on individual expertise and experience
  - Dependent on star performers

Process logic vs. Business logic

(Davenport 2010)
Types of Knowledge Work

- **Integration Model**
  - Systematic, repeatable work
  - Highly dependent on formal processes and methodologies
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- **Collaboration Model**
  - Improvisational work
  - Highly reliant on individual expertise
  - Dependent on flexible deployment of teams

- **Transaction Model**
  - Routine work
  - Highly dependent on rules, procedures, and processes
  - Dependent on transaction orientation

- **Expert Model**
  - Judgmental work
  - Highly dependent on individual expertise
  - Dependent on expert orientation

*(Davenport 2010)*

**Process Logic**

**Decision Table**

**Case**

**Process and Case**

**Knowledge Description**

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Prof. Dr. Knut Hinkelmann

NEMO 2016 - Modeling Knowledge Work
Model types of the Knowledge Work Designer

Process Logic

Business Process Modelling (BPMN)
Process and Case Modelling (BPCMN)
Case Management Modelling (CMMN)

Business Logic

Decision Modelling (DMN)
Document Modelling

Planning Elements
Control Elements

Organisation Modelling

degree of structure
Modeling Business Processes
## Classification of Processes

<table>
<thead>
<tr>
<th>structured process</th>
<th>case</th>
<th>ad hoc process</th>
</tr>
</thead>
<tbody>
<tr>
<td>• structured process flow</td>
<td>• process flow can partly be structured</td>
<td>• process flow cannot be structured – new tasks on the fly</td>
</tr>
<tr>
<td>• activities known in advance</td>
<td>• activities partly known in advance</td>
<td>• activities partly known in advance</td>
</tr>
<tr>
<td>• many repetitive elements</td>
<td>• some repetitive elements</td>
<td>• few repetitive elements</td>
</tr>
<tr>
<td>• no degree of freedom for people wrt process flow</td>
<td>• some degree of freedom for people wrt process flow</td>
<td>• very high degree of freedom for people wrt process flow</td>
</tr>
</tbody>
</table>

- can be modelled  
- cannot be modelled

partly translated from (Gadatsch 2005, S. 44)
Structure of Processes

- **Structured process**
  - Process flow can be modelled

- **Case**
  - Process flow can be modelled
  - Activities partly known in advance
  - Few repetitive elements
  - Very high degree of freedom for people wrt process flow

- **Ad hoc process**
  - Process flow cannot be structured – new tasks on the fly
  - Activities partly known in advance
  - Few repetitive elements
  - Very high degree of freedom for people wrt process flow

Partly translated from (Gadatsch 2005, S. 44)
Business Process Model and Notation BPMN

Example: Admission for Master Study at FHNW
Case Management
Case Management

Case management is the management of long-lived collaborative processes that require coordination of knowledge, content, correspondence, and resources to achieve an objective or goal. The path of execution cannot be predefined. Human judgment is required in determining how to proceed, and the state of a case can be affected by external events.

- Synonyms for Case Management are
  - Adaptive Case Management (ACM)
  - Dynamic Case Management (DCM)

(McCauley 2010)
Case Management Processes

Case management processes: common in many industry segments, where activities and documents required depend on the circumstances of each case

♦ Benefits Administration
  ● Examples: welfare assistance, student financial aid, grants programs, disability benefits

♦ Underwriting
  ● Examples: commercial lending, life and disability insurance.

♦ Dispute Resolution
  ● Example: customer demands a refund

♦ Project Management

(Silver 2011, p. 88f)
Content is Central for Case Management

- Activities create information and add it to the case.
- Ability is required to jump forward, jump backward, re-do or otherwise perform work in a sequence that cannot be determined in advance.
- The state of the Case is determined by the content within the case, not in which task the case is at any time.

Source: Nathaniel Palmer
How Case Management (bottom) Differs From Structured Workflows (top)

Rather than a path determined by a predefined workflow, the case flow evolves based on content added to the case folder

Source: Nathaniel Palmer
Case File

- The Case File is a virtual folder ultimately providing the permanent record of a case.
- The case folder provides overall coordination of the case as a whole.
- It is not possible to specify in advance all of the documents required.

Source: Nathaniel Palmer
Differences from Conventional BPM

■ Case Information Managed as Documents
  ♦ case-related information is received and managed in the form of business documents rather than structured data

■ Case Activities Added at Runtime
  ♦ Some tasks and processes may be defined in advance, but ad hoc tasks—whether selected from a pre-defined menu or defined from scratch—are a critical distinguishing element

■ Case Advancement through Events
  ♦ External events include messages whose contents are added to the case folder, Internal events include assignments and business rule to create and assign tasks.

■ Case Context through Shared Case Folder
  ♦ All case information, which is required for human judgment about advancement or resolution of the case, is typically available in the form of a shared case folder.
CMMN - Case Management Model and Notation
CMMN - Case Management Model and Notation

- OMG defined a Modeling Standard for Case Modeling
  - Case Management Model and Notation (CMMN)
- Version 1.0 is from May 2014
  - http://www.omg.org/spec/CMMN/1.0/PDF/
- Version 1.1 beta published in March 2016
  - http://www.omg.org/spec/CMMN/1.1/Beta/
- CMMN is specialized notation to model cases. It is independent from BPMN
Design Time vs Run Time = Modeling vs Planning

- A Case has two distinct phases: design-time and run-time
  - **Design-time: Business analysts** define
    - Tasks of pre-defined segments
    - “discretionary” Tasks that are additionally available to the Case worker
  - **Run-time: Case workers** execute the plan
    - performing Tasks based on control flow criteria,
    - adding discretionary Tasks if needed.

<table>
<thead>
<tr>
<th>Design-time phase</th>
<th>Run-time phase</th>
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<tbody>
<tr>
<td><strong>Modeling</strong></td>
<td><strong>Plan</strong></td>
</tr>
<tr>
<td><img src="A,B" alt="Plan Items" /></td>
<td><img src="C,D" alt="A,B" /></td>
</tr>
<tr>
<td><img src="C,D" alt="Discretionary Items" /></td>
<td><img src="C,D" alt="This is the plan to be executed" /></td>
</tr>
</tbody>
</table>

(CMMN 1.0, p. 5f)
Characteristics of Case Management Modeling

- No model of sequence flow
  - Execution of a task depends on events and conditions
    - Sentries

- Planning at run-time
  - Humans can decide about execution of tasks
    - Discretionary tasks
    - Planning table
CMMN Case Plan Modelling in the Knowledge Work Designer

case plan model

control elements:
determine task execution

planning elements
support human planner
Case Plan Models

- There are four types of Plan Items:
  - Tasks / Discretionary Tasks
  - Plan Fragments / Stages
  - Event Listeners
  - Milestones

- There is one connector

- There are two types of "control flow" elements:
  - Sentries
  - Planning Tables

(CMMN 1.0, p. 17)
Discretionary Tasks

Discretionary Tasks are available to the Case worker, to be applied to his/her discretion

It is up to the Case worker

- whether he/she want to execute a discretionary task
- when to execute a discretionary task
- how often he/she wants to execute a discretionary task

A discretionary Task is depicted with dashed lines

(CMMN 1.0, p48f)
Example:
Check Eligibility of MSc Candidates
Process: Check Eligibility of MSc Candidates

- A new application triggers the process.
- First: Study assistant confirms that the application has arrived.
- The study assistant determines whether the bachelor degree is ok. The study assistant may check the transcript of record if he/she is unsure.
- It is also checked whether the university is accredited. If the university is unknown to the study assistant can look in the Anabin database or enic-naric.net or ask public authorities.
- It is checked whether the average grade is at least “good”.
- The average grade is calculated, if it is not mentioned.
- The study assistant has to register the student.
- The study assistant can discuss with the dean at any time.
- The dean decides, whether the candidate is eligible.
- Candidates are informed by the study assistant.
What is the basis process?

- Which tasks are executed in every case?
- Which tasks are executed only for specific cases?
Exercise: Check Eligibility of MSc Candidates

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Basic Process in CMMN

- Application arrived
- Check Eligibility
- Confirm application
- Check if grade is at least good
- Calculate average grade
- Check bachelor degree
- Register candidate
- Check accreditation of university
- Decide eligibility
- Inform candidate
Which tasks depend on the experience, preference or judgment of the worker?

♦ These are the discretionary tasks
Exercise: Check Eligibility of MSc Candidates

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Process as CMMN Model
Details about CMMN Elements
Tasks

- Three types of tasks
  - **Human Task** - a Task that is performed by a Case worker, they can be
    - Blocking: Task is waiting until the work associated with the Task is completed
    - Non-Blocking: the Task is not waiting for the work to complete and completes immediately, upon instantiation.
  - **Process Task** - can be used in the Case to call a Business Process
  - **Case Tasks** - can be used to call another Case

(CMMN 1.0, 48ff)
Discretionary Tasks

- Discretionary Tasks are available to the Case worker, to be applied to his/her discretion.
- A discretionary Task is depicted by a rectangle shape with dashed lines and rounded corners.
- Any task type can be discretionary.

(CMMN 1.0, p48f)
Sentry

- Sentries define the criteria according to which the Plan Items are enabled (or entered) and terminated (or exited).
- A Sentry is a combination of an event and/or a condition.
  - On-Part specifies the event that serves as trigger.
  - If-Part specifies a condition that evaluates over the Case File.
    
    on <event>
    if <condition>

- Both On-Part and If-Part are optional.
- An Sentry and the task correspond to an ECA (Event-Condition-Action) rule.

(CMMN 1.0, p. 23f)
Events

CMMN distinguishes three kinds of events:

■ Anything that can happen to information in the CaseFile
  ♦ a case file time created, deleted, modified, ….

■ Anything that can happen to Tasks, Stages and Milestones.
  ♦ as tasks is started, cancelled, finished, …

■ Event Listeners to model events that do not happen to plan items.
  ♦ Event Listeners are specialized to
    ♦ Timer Event Listener
    ♦ User Event Listener

(CMMN 1.0, p. 18f, 52f)
Milestones

- A Milestone is a Plan Item Definition that represents an achievable target, defined to enable evaluation of progress of the Case.

- Completion of set of tasks or the availability of key deliverables (information in the CaseFile) typically lead to achieving a Milestone.

- A Milestone may have zero or more entry criteria, which define, when a milestone is reached.

(CMMN 1.0, p. 21, 52)
Connectors

- Connectors can be used to visualize dependencies between Plan Items, in particular
  - The dependency of the On-Part of a Sentry
  - between a Human Task and Discretionary Items

(CMMN 1.0, p. 53ff)
Connector Usage: Control Flow

- Connectors that represent Sentry On-Parts can be used to visualize dependencies between Plan Items.
- The following pictures illustrates situations where Task C can be activated only
  1. if Task A is complete
  2. if Task A and Task B are complete
  3. if Task A or Task B are complete

(CMMN 1.0, p. 54)
Plan Fragments and Stages

- A Plan Fragment is a container of Plan Items and the Sentries.
- Stages are Plan Fragments that can be tracked.
- Stages maybe considered “episodes” of a Case.
- A Stage has a marker in the form of a “+” or "-" sign to designate expanded or collapsed stages.

Collapsed stage with two entry and one exit criterion

Expanded versions of the Stage with one sub Stage and three Tasks (CMMN 1.0, p. 46f)
Planning at Run Time: Applicability Rules

- PlanningTables can be assigned to a Stage or a HumanTask.
- Case workers are said to “plan” (at run-time), when they select Discretionary Tasks.
- A Planning Table can have applicability rules for Discretionary Tasks.
- Applicability Rules are used to specify, whether a Discretionary Task is “applicable” (“eligible”, “available”) for planning, based on conditions that are evaluated over information in the Case File.
- At run-time only Discretionary Items, for which the ApplicabilityRule evaluates to “true”, must be shown to the Case Worker.

(CMMN 1.0, p. 29, 56)
Planning Table and Applicability Rules

Relation of Planning Table, Discretionary Item and Applicability Rules in the Knowledge Model Designer
BPMN and CMMN
CMMN for Subprocesses in BPMN
Comparing Elements of BPMN and CMMN

<table>
<thead>
<tr>
<th></th>
<th>BPMN</th>
<th>CMMN</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tasks</strong></td>
<td>Tasks</td>
<td>Tasks</td>
</tr>
<tr>
<td><strong>Process hierarchy</strong></td>
<td>Subprocesses, Call Activities</td>
<td>Process Tasks, Case Tasks</td>
</tr>
<tr>
<td><strong>Events</strong></td>
<td>Events: start – intermediate – end</td>
<td>Event Listeners, implicit Events, Milestones</td>
</tr>
<tr>
<td></td>
<td>catching – throwing</td>
<td></td>
</tr>
<tr>
<td><strong>Control Flow</strong></td>
<td>Gateways/Events</td>
<td>Sentries</td>
</tr>
<tr>
<td></td>
<td>Sequence Flow</td>
<td>Sentry with empty condition</td>
</tr>
<tr>
<td><strong>Planning</strong></td>
<td>--</td>
<td>Discretionary Tasks</td>
</tr>
<tr>
<td><strong>Responsibilities</strong></td>
<td>Lanes</td>
<td>Role attribute</td>
</tr>
<tr>
<td><strong>Process Container</strong></td>
<td>Pool</td>
<td>Folder</td>
</tr>
</tbody>
</table>

Diagram:
- BPMN: Sequence Flow with Task 1 and Task 2.
- CMMN: Sentry with empty condition between Task 1 and Task 2.

Diagram Image:
- BPMN: Sequence Flow with Task 1 and Task 2.
- CMMN: Sentry with empty condition between Task 1 and Task 2.
# Rules in BPMN and CMMN

<table>
<thead>
<tr>
<th>BPMN</th>
<th>CMMN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business rules (tasks)</td>
<td>---</td>
</tr>
<tr>
<td>Events/gateways</td>
<td>Sentries</td>
</tr>
<tr>
<td>---</td>
<td>Applicability rules (planning tables)</td>
</tr>
</tbody>
</table>
Implicit Control Flow in CMMN

What does it mean?

Visible conditions are better for understanding
Explicit Control Flow in BPMN

What does it mean?

Task 1
- Task 2.1
- Task 2.2
- Task 2.3

Task 1
- Task 2.1 (condition 1)
- Task 2.2 (condition 2)
- Task 2.3 (condition 3)

Task 1
- Task 2.1
- Task 2.2
- Task 2.3

Which condition?

condition 1
condition 2
condition 3
Basic Process in CMMN

Check Eligibility

- Application arrived
- Confirm application
  - Check bachelor degree
  - Calculate average grade
  - Check if grade is at least good
- Register candidate
- Check accreditation of university
- Decide eligibility
- Inform candidate
Basic Process in BPMN
Process as BPMN including Discretionary Items

Problem: Main elements cannot be distinguished from discretionary parts.

Criteria for execution of discretionary only depend on human judgment or preference.

→ gateways not adequate
Discretionary Tasks in CMMN Model

Application arrived → Confirm application → Check eligibility:
- Discuss bachelor degree with dean
- Register candidate
- Check accreditation of university

- Check Transcript of Record
- Look in Anabin
- Look in enic-naric.com
- Ask public authority

- Calculate average grade
- Check if grade is at least good

- Decide eligibility
- Inform candidate
BPCMN: A combined Process and Case Modeling Language

A combination of control flow elements of BPMN and discretionary tasks and planning elements of CMMN

a suitable language to deal with any kind of process.
BPCMN – Combining BPMN and CMMN
Decision-aware Business Processes
Decision Tasks in Business Processes

- **A decision task** is a task in which some decision is made.
- The business logic that is used for decision making is called *decision logic*.
- Two kinds of decision tasks:
  - Decision tasks deriving values for data
  - Decision tasks providing data for gateways
    - At the gateway only the result of the decision should be tested (for the selection of the path) not the criteria for the decision.

![Diagram]

**Decision: Is the applicant eligible?**

**Decision: What is the amount of the insurance premium in this case?**
Decision-Aware Process Models: Managing Process Logic and Decision Logic Separately

- The process model contains the process logic → procedural
- Decision logic is externalized from decision tasks and represented in a different kind of model → declarative
- Separating business decisions from business process tasks:
  - simplifies the business process model
  - allows to manage business logic in a declarative form
Example: Declarative vs. Procedural Solutions

**Option 1**

Start → Person Employment History → Good → Person Debt → Low → Set Person Credit Rating to A → End

Start → Person Employment History → Bad → Person Debt → High → Set Person Credit Rating to A → End

**Option 2**

Start → Person Debt → Low → Person Employment History → Good → Set Person Credit Rating to A → End

Start → Person Debt → High → Person Employment History → Bad → Set Person Credit Rating to A → End

**Option 3**

Start → Determine Person Credit Rating → End

**Process Model**

(von Halle & Goldberg 2010, p. 69)

**Decision Table**

<table>
<thead>
<tr>
<th>Rule Pattern</th>
<th>Person Debt</th>
<th>Person Employment History</th>
<th>Person Credit Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Low</td>
<td>Good</td>
<td>A</td>
</tr>
<tr>
<td>1</td>
<td>Low</td>
<td>Bad</td>
<td>?</td>
</tr>
<tr>
<td>1</td>
<td>High</td>
<td>Good</td>
<td>?</td>
</tr>
<tr>
<td>1</td>
<td>High</td>
<td>Bad</td>
<td>?</td>
</tr>
</tbody>
</table>
Collapsing Gateways into a Decision Task
Example:
Decision-aware Process
Exercise: Decisions in Processes (1)
Process Logic vs Business Logic

■ How many decisions are made in this process?
■ Which business logic can you identify?
■ What would you improve?
Exercise: Decisions in Processes (2)
Process Logic vs Business Logic

- This process only contains one decision:
  - Accept or reject application

- The decision is distributed over three activities which are executed sequentially:
  - The order of the checks, however, is not compulsory. There is an unnecessary sequentialisation.

- The criteria for the decision are written on the gateways. This is business logic and not process logic. It should be hidden:
  - Change in the criteria should not affect the process model.
Exercise: Decisions in Processes (3)
Process Logic vs Business Logic

Process logic:

- This model is more appropriate
  - Process is simplified
  - Decision logic is modeled separately
  - Change of business (decision) logic does not affect process model
Advantages of separating Business Logic from Business Process Model

- Allows a much simpler business process model
  - If a business process is too complicated, a reason might be that business rules are embedded in the flow

- Makes changes to business process and business logic easier
  - Permits changes in the Decision Model without changing the business process model and vice versa

- Makes governance of business processes and business logic easier to manage

- Decision Model can be reused in several processes
  - the whole decision model
  - individual decision tables and rules
Modelling Decision Logic
Decision Model and Notation

Decision Requirements Diagram

Decision Tables

<table>
<thead>
<tr>
<th>Candidate Eligible</th>
<th>Bachelor Degree</th>
<th>University accredited</th>
<th>eligible</th>
</tr>
</thead>
<tbody>
<tr>
<td>FC</td>
<td>yes/no</td>
<td>yes, no, unclear</td>
<td>yes, no</td>
</tr>
<tr>
<td>1</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>2</td>
<td>no</td>
<td>no</td>
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<tr>
<td>3</td>
<td></td>
<td>no</td>
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</tr>
<tr>
<td>4</td>
<td>yes</td>
<td>unclear</td>
<td>yes</td>
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<table>
<thead>
<tr>
<th>Bachelor Degree</th>
<th>Bachelor Degree in</th>
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</thead>
<tbody>
<tr>
<td>FC</td>
<td>Information Systems, Business Administration, Information Technology, other, none</td>
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<tr>
<td>1</td>
<td>Information Systems</td>
</tr>
<tr>
<td>2</td>
<td>Business Administration</td>
</tr>
<tr>
<td>3</td>
<td>Information Technology</td>
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<td>4</td>
<td>other</td>
</tr>
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<td>5</td>
<td>none</td>
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<table>
<thead>
<tr>
<th>Bachelor Degree</th>
<th>eligible</th>
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<tbody>
<tr>
<td>yes</td>
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<tr>
<td>yes</td>
<td>yes</td>
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<td>yes</td>
<td>yes</td>
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<tr>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>no</td>
<td>no</td>
</tr>
</tbody>
</table>

Study Regulation

Data Form

Eligibility Rules

Bachelor Degree

Candidate Eligible

Decision Tables
Decision Model and Notation

Decision Requirements Diagram

Decision Tables

Documents in Case File
References to Decision Models

- Decision models can be referenced from
  - Process models
  - Case plan models
  - BPCMN models
Decisions requiring Human Judgment

- Some decisions require human judgment
  - Example: Communication and analytical skills
- Can be supported by …
  - Checklists
  - Best practices
  - Lessons learned
- Modelled as documents
Decisions requiring Human Judgment

<table>
<thead>
<tr>
<th>Bachelor Degree</th>
<th>Bachelor Degree in</th>
<th>Bachelor Degree</th>
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<tbody>
<tr>
<td>1</td>
<td>Information Systems, Business Administration, Information Technology, other, none</td>
<td>yes, no</td>
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<tr>
<td>2</td>
<td>Information Systems</td>
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<tr>
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</tr>
<tr>
<td>6</td>
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<td>no</td>
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</tbody>
</table>

Candidate Eligible

<table>
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Study Regulation

Candidate Profile

Acceptance of candidate

Acceptance rules

Bachelor Degree

Communication and Analytical Skills

Professional experience

Check list Communication Skills

FAQ

NEMO 2016 - Modeling Knowledge Work
Conclusion

- Modeling of Knowledge Work includes:
  - process logic and business Logic
  - on different degrees of structure
- in an integrated environment

The modeling language was developed in adoxx.org
University of Applied Sciences and Arts Northwestern Switzerland

School of Business
MSc in Business Information Systems

Prof. Dr. Knut Hinkelmann
Dean
Postal address: Riggenbachstrasse 16, CH-4600 Olten
Office: Von Roll-Strasse 10, CH-4600 Olten
T +41 62 957 23 01  M +41 78 896 84 24
knut.hinkelmann@fhnw.ch  www.fhnw.ch/business