

Competence-based workplace assignment using a goal programming approach

October 8, Karlsruhe

Malte L. Peters; Stephan Zelewski

{ malte.peters | stephan.zelewski }@pim.uni-essen.de

Institute of Production and Industrial
Informationmanagement

University of Duisburg-Essen, Essen

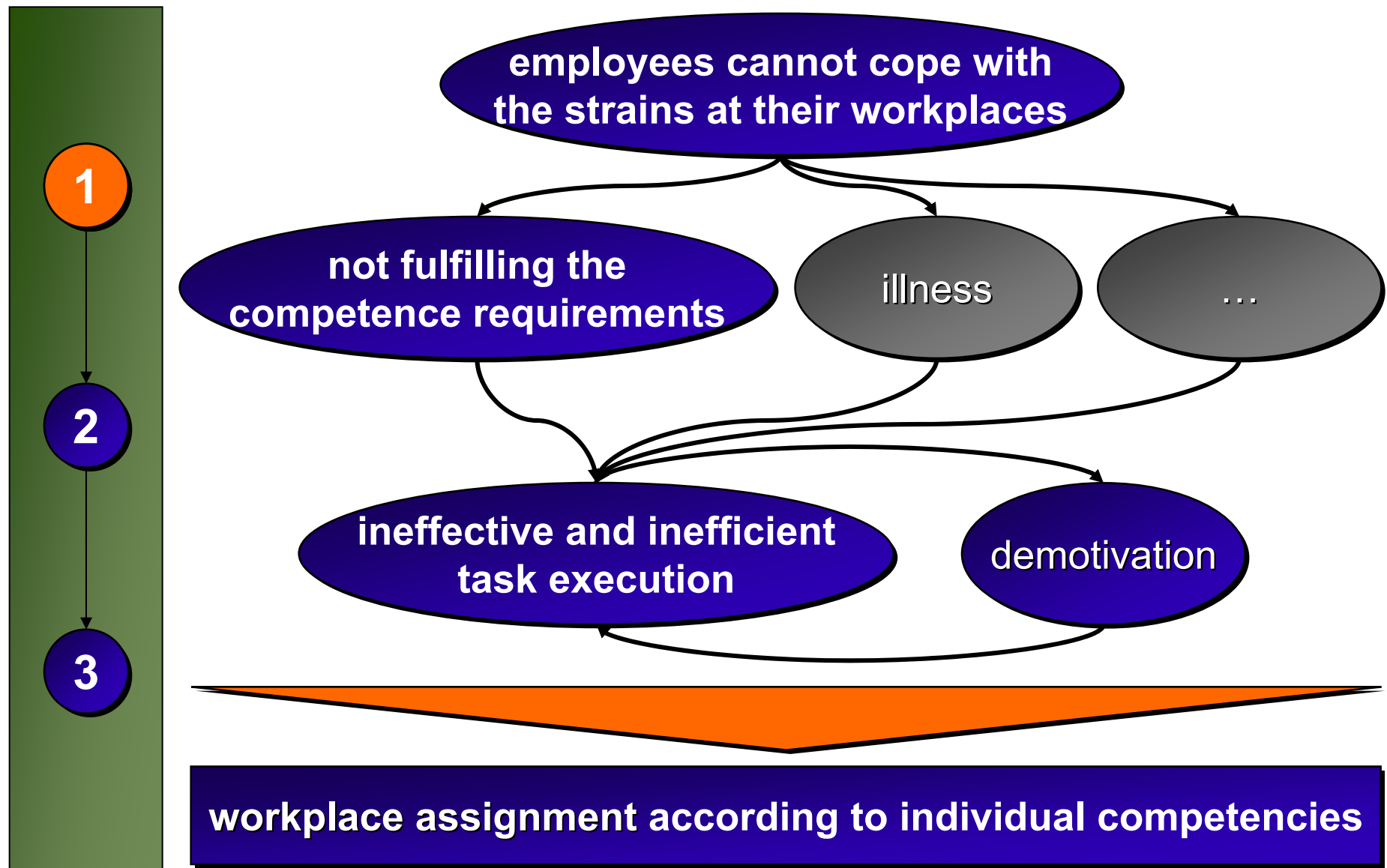
Competence-based workplace assignment

Contents



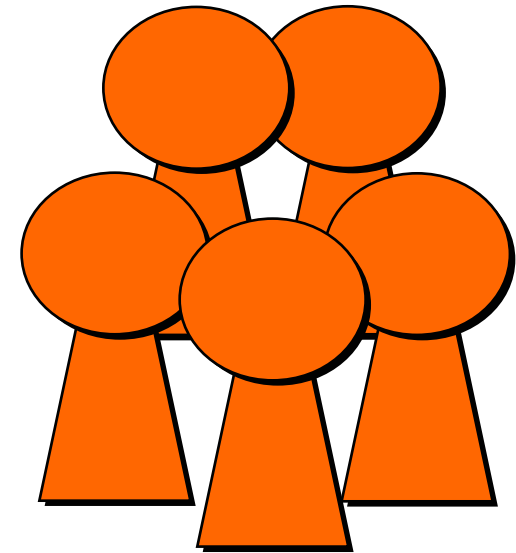
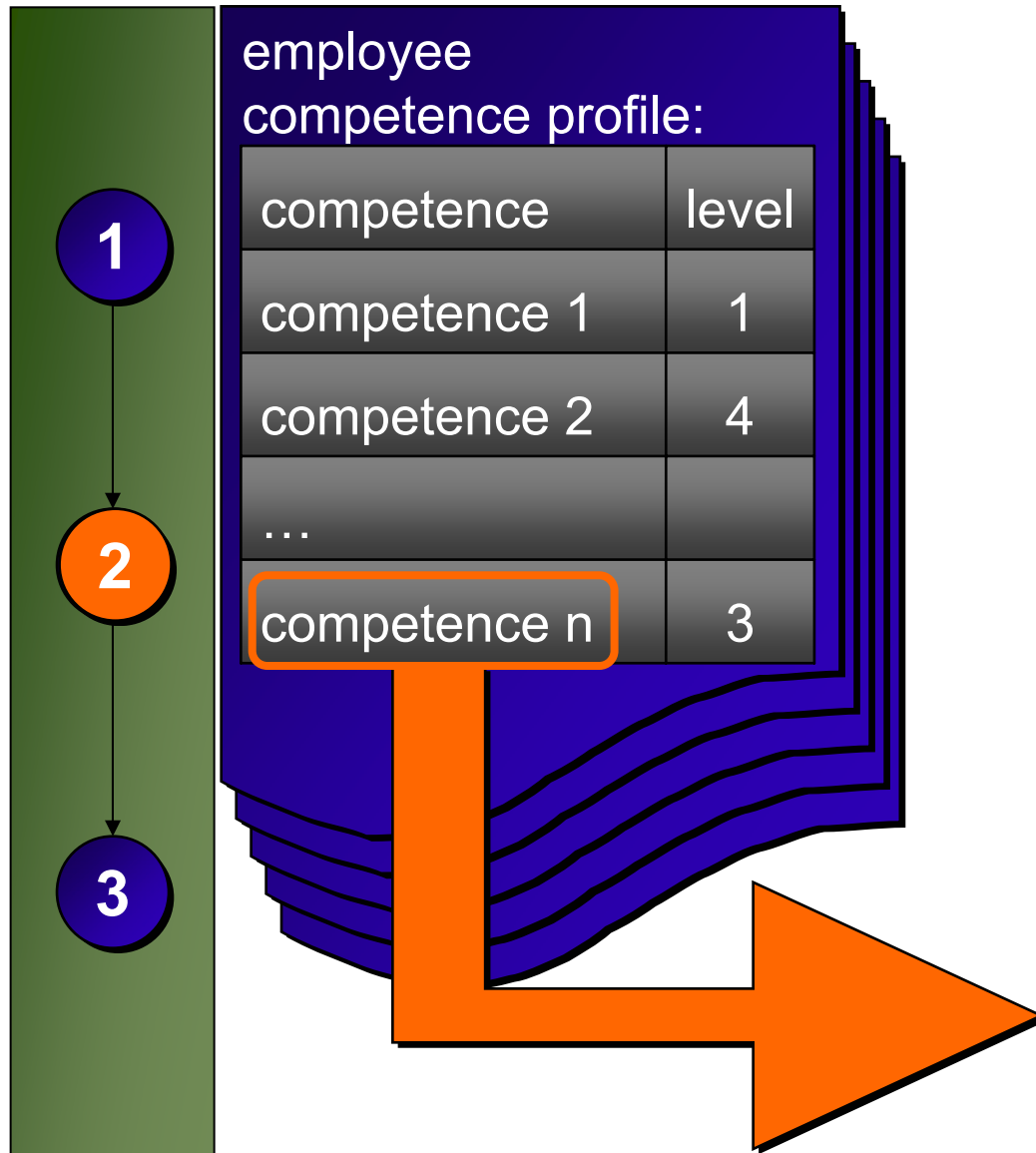
Competence-based workplace assignment

Problem identification



Competence-based workplace assignment

Employee competence profiles



A competence is defined as the ability of an employee to use his or her knowledge to achieve a predefined goal.

Competence-based workplace assignment

Employee competence profiles: SAP R/3

Person: Display Profile (01.01.1800 - 31.12.9999)

Personnel no: 10807, Name: Ellen P..., Status: Active
EE group: 1 Active employee, Personnel ar: 3400 Boston
EE subgroup: U1 Hourly rate/wage, SSN: 777-88-9999

Qualification group	Description	Proficiency
General technical knowledge	Knowledge of PC Hardware Te...	Adequate
General technical knowledge	Knowledge of PC Network Tec...	Poor
Language skills	English language skills	Mediocre
Language skills	German language skills	Native speaker
Language skills	Spanish language skills	Fluent
Legal Knowledge	International Tax Law	Very good
Legal Knowledge	Tax Law for Germany	Poor
Legal Knowledge	United Kingdom Tax Laws	Average

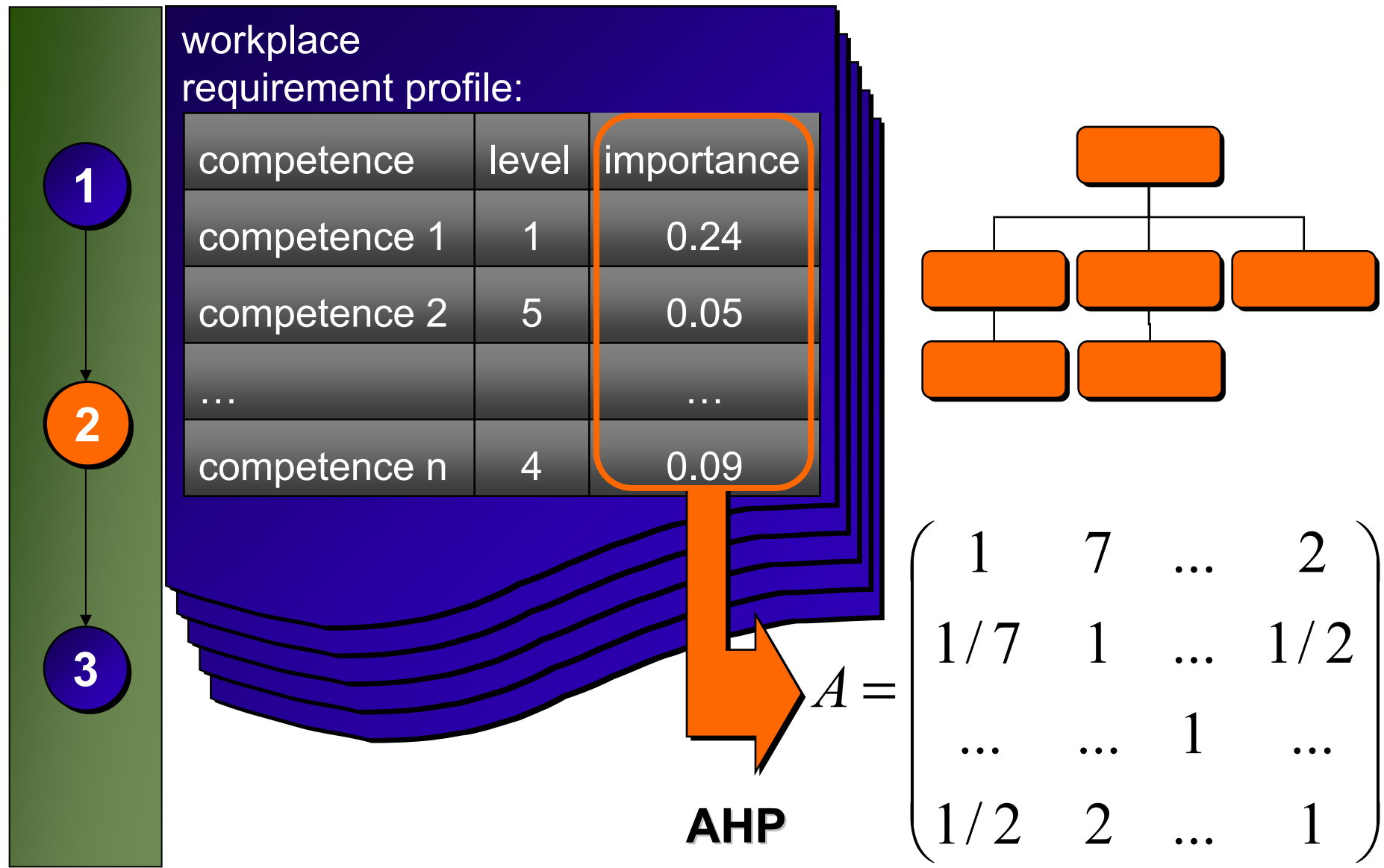
Display Qualification dialog box:

- Qualification: Default
- Proficiency: Basic knowledge (selected), Mediocre, Fluent, Native speaker
- Description of current proficiency: [Empty text area]

Screenshot: SAP R/3, Copyright SAP AG.

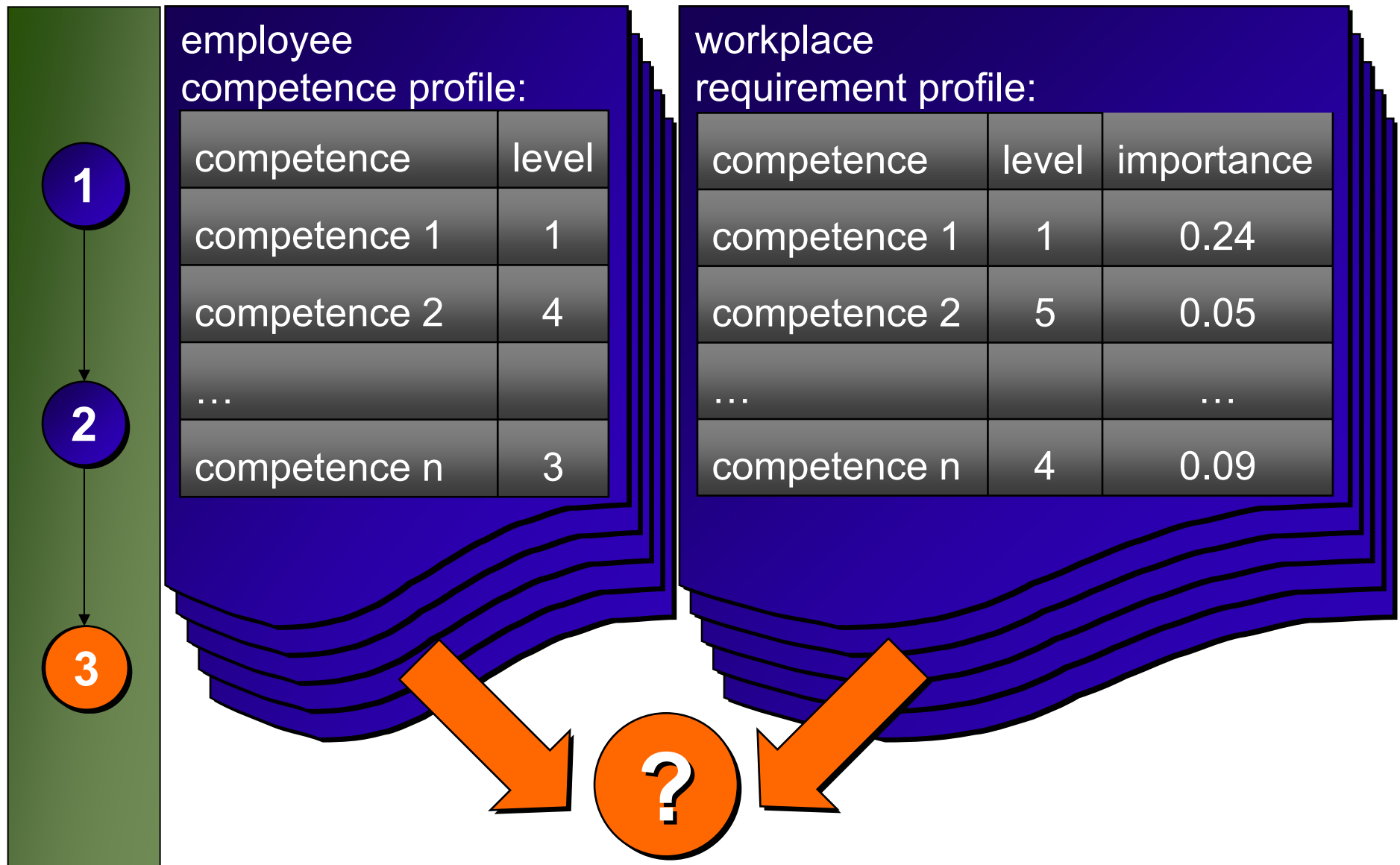
Competence-based workplace assignment

Workplace requirement profiles



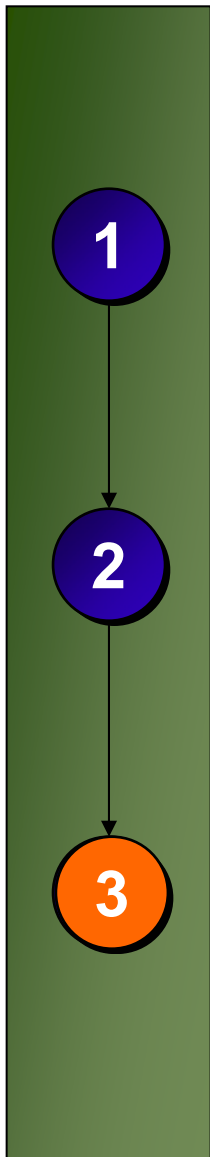
Competence-based workplace assignment

Assignment set



Competence-based workplace assignment

Formulation of the goal programming approach



I, J, N number of competencies, workplaces, employees
 d_{ij}^+, d_{ij}^- overachievement/underachievement of required competence levels for competence i at workplace j
 x_{nj} decision variables, with the following definition:
 $x_{nj} = 0$: Employee n is not assigned to workplace j
 $x_{nj} = 1$: Employee n is assigned to workplace j
 a_{in} competence level of employee n in competence i
 g_{ij} required competence level of competence i for workplace j
 w_{ij} importance of competence i to workplace j

objective function:
$$MIN \sum_{i=1}^I \sum_{j=1}^J w_{ij} * d_{ij}^-$$

subject to the constraints:

$$[1] \sum_{n=1}^N a_{in} * x_{jn} + d_{ij}^- - d_{ij}^+ = g_{ij} \quad for \quad \forall i = 1, \dots, I \quad \forall j = 1, \dots, J$$

$$[2] \sum_{n=1}^N x_{jn} = 1 \quad for \quad \forall j = 1, \dots, J$$

$$[3] \sum_{j=1}^J x_{jn} = 1 \quad for \quad \forall n = 1, \dots, N$$

$$[4] x_{jn} = \{0; 1\} \quad for \quad \forall j = 1, \dots, J \quad \forall n = 1, \dots, N$$

$$[5] d_{ij}^+, d_{ij}^- \geq 0 \quad for \quad \forall i = 1, \dots, I \quad \forall j = 1, \dots, J$$

Competence-based workplace assignment

Lingo 8.0: Data

The screenshot displays the LINGO 8.0 interface with the following data sections:

```

endsets
data:
weight=
.09 .08 .02
.13 .11 .30
.02 .03 .31
.03 .19 .16
.13 .14 .09
.12 .14 .05
.33 .20 .05
.15 .11 .02;

Goal=
4 4 3
4 3 5
1 2 5
3 5 4
4 5 2
5 4 2
5 4 2
4 3 1;

Profile=
4 3 2
5 2 4
4 4 5
3 2 3
3 2 3
2 4 1
3 5 4
1 3 4;
enddata

!Objective function;
min=
@sum(comp_work(i,j): (Dminus(i,j)*Weight(i,j))
);

!Constraints;
[w1_c1] Goal(1,1) = @sum(Employees(n): Profile(1,n) * Assignment(1,n) + Dminus(1,1) - Dplus(1,1));
[w1_c2] Goal(2,1) = @sum(Employees(n): Profile(2,n) * Assignment(1,n) + Dminus(2,1) - Dplus(2,1));

```

Annotations on the right side of the screenshot:

- importance of competencies to workplaces**: Points to the `weight=` data table.
- required competence levels**: Points to the `Goal=` data table.
- competence levels of employees**: Points to the `Profile=` data table.
- workplace requirement profiles**: A bracket grouping the `weight=` and `Goal=` tables.
- employee competence profiles**: A bracket grouping the `Profile=` table.

On the left side, a vertical green bar contains three numbered circles (1, 2, 3) with arrows pointing downwards, indicating the flow of data from the first to the third section.

Screenshot: Lingo 8.0, Copyright Lindo Systems Inc.

Competence-based workplace assignment

Lingo 8.0: Model

1

2

3

```

endsets
data:
Weight=
.09 .08 .02
.13 .11 .30
.02 .03 .31
.03 .19 .16
.13 .14 .09
.12 .14 .05
.33 .20 .05
.15 .11 .02;

Goal=
4 4 3
4 3 5
1 2 5
3 5 4
4 5 2
5 4 2
5 4 2
4 3 1;

Profile=
4 3 2
5 2 4
4 4 5
3 2 3
3 2 3
2 4 1
3 5 4
1 3 4;
enddata

!Objective function;
min=
  @sum(comp_work(i,j): (Dminus(i,j)*Weight(i,j)))
  );

!Constraints;
[w1_c1] Goal(1,1) = @sum(Employees(n): Profile(1,n) * Assignment(1,n) + Dminus(1,1) - Dplus(1,1));
[w1_c2] Goal(2,1) = @sum(Employees(n): Profile(2,n) * Assignment(1,n) + Dminus(1,1) - Dplus(2,1));

```

Screenshot: Lingo 8.0, Copyright Lingo Systems Inc.

Competence-based workplace assignment

Lingo 8.0: Solution Report

1

2

3

LINGO - [Solution Report - final0106]

File Edit LINGO Window Help

WEIGHT(4, 1)	0.3000000E-01	0.000000
WEIGHT(4, 2)	0.1900000	0.000000
WEIGHT(4, 3)	0.1600000	0.000000
WEIGHT(5, 1)	0.1300000	0.000000
WEIGHT(5, 2)	0.1400000	0.000000
WEIGHT(5, 3)	0.9000000E-01	0.000000
WEIGHT(6, 1)	0.1200000	0.000000
WEIGHT(6, 2)	0.1400000	0.000000
WEIGHT(6, 3)	0.5000000E-01	0.000000
WEIGHT(7, 1)	0.3300000	0.000000
WEIGHT(7, 2)	0.2000000	0.000000
WEIGHT(7, 3)	0.5000000E-01	0.000000
WEIGHT(8, 1)	0.1500000	0.000000
WEIGHT(8, 2)	0.1100000	0.000000
WEIGHT(8, 3)	0.2000000E-01	0.000000
ASSIGNMENT(1, 1)	0.000000	-0.000000
ASSIGNMENT(1, 2)	1.000000	-0.000000
ASSIGNMENT(1, 3)	0.000000	-0.000000
ASSIGNMENT(2, 1)	0.000000	-0.000000
ASSIGNMENT(2, 2)	0.000000	-0.000000
ASSIGNMENT(2, 3)	1.000000	-0.000000
ASSIGNMENT(3, 1)	1.000000	-0.000000
ASSIGNMENT(3, 2)	0.000000	-0.000000
ASSIGNMENT(3, 3)	0.000000	-0.000000

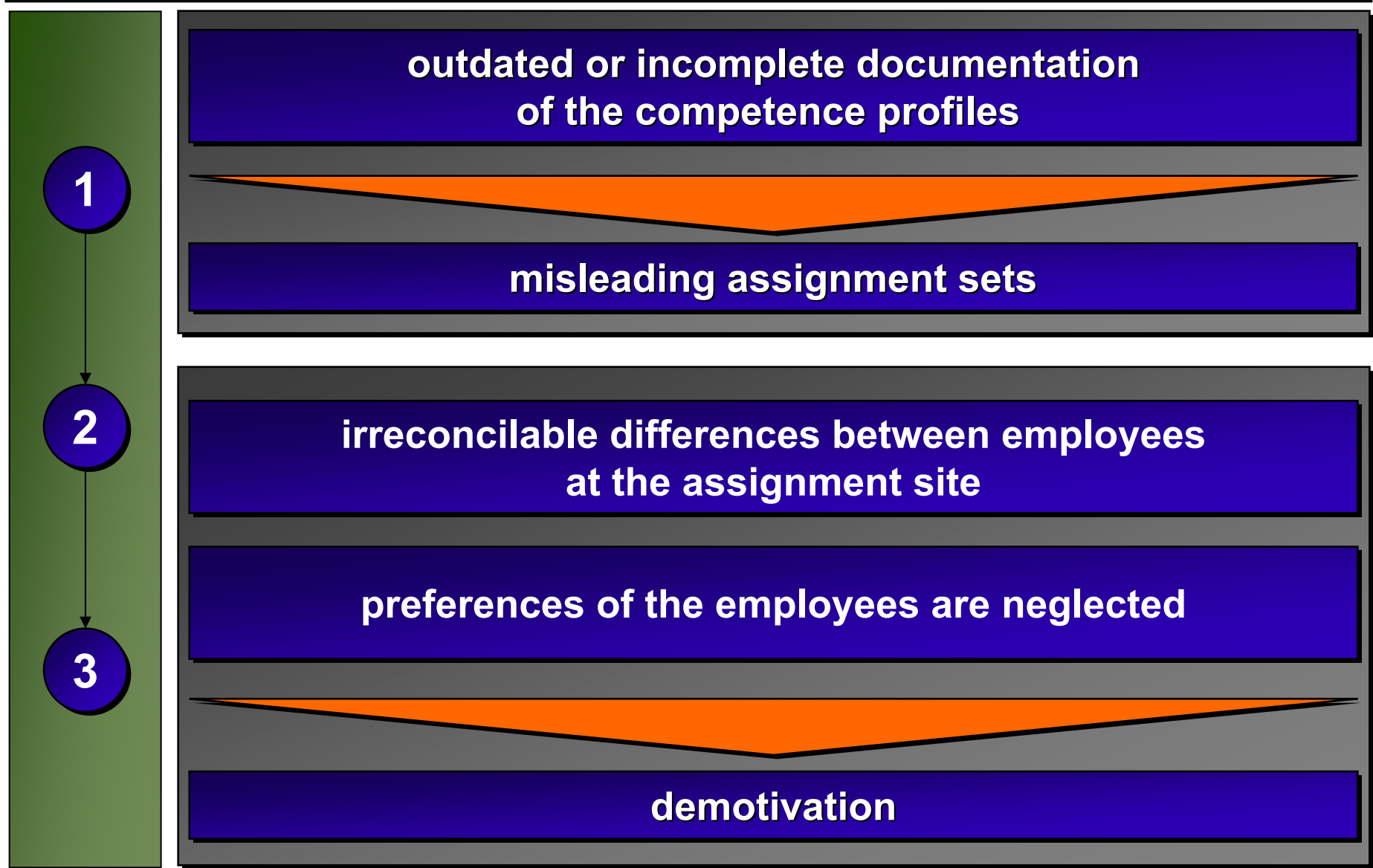
Row	Slack or Surplus	Du
1	0.8733333	-
W1_C1	0.000000	0.1000000E-01
W1_C2	0.000000	0.4333333E-01
W1_C3	0.000000	0.000000
W1_C4	0.000000	0.1000000E-01
W1_C5	0.000000	0.4333333E-01
W1_C6	0.000000	0.4000000E-01
W1_C7	0.000000	0.1100000
W1_C8	0.000000	0.5000000E-01
W2_C1	0.000000	0.2666667E-01
W2_C2	0.000000	0.000000
W2_C3	0.000000	0.000000
W2_C4	0.000000	0.6333333E-01
W2_C5	0.000000	0.4666667E-01

For Help, press F1

Screenshot: Lingo 8.0, Copyright Lindo Systems Inc.

Competence-based workplace assignment

Difficulties



Competence-based workplace assignment

1

2

3

Thank you for your time and attention!

This work was funded by the Federal Ministry of Education and Research (BMBF) and coordinated by the German Aerospace Center (DLR) within the project "MOTIWIDI".