Better Training for Safer Food
Initiative

Helmut Hartmann

BTSF

Better Training for Safer Food is an initiative of the European Commission aimed at organising an EU training strategy in the areas of food law, feed law, animal health and animal welfare rules, as well as plant health rules.

2nd Quarter 2017

Food safety

European Commission

Information systems - Practical implementation of specific functionalities

Session 4.4

Systematic development & testing

Traceability functionality

Risk analysis

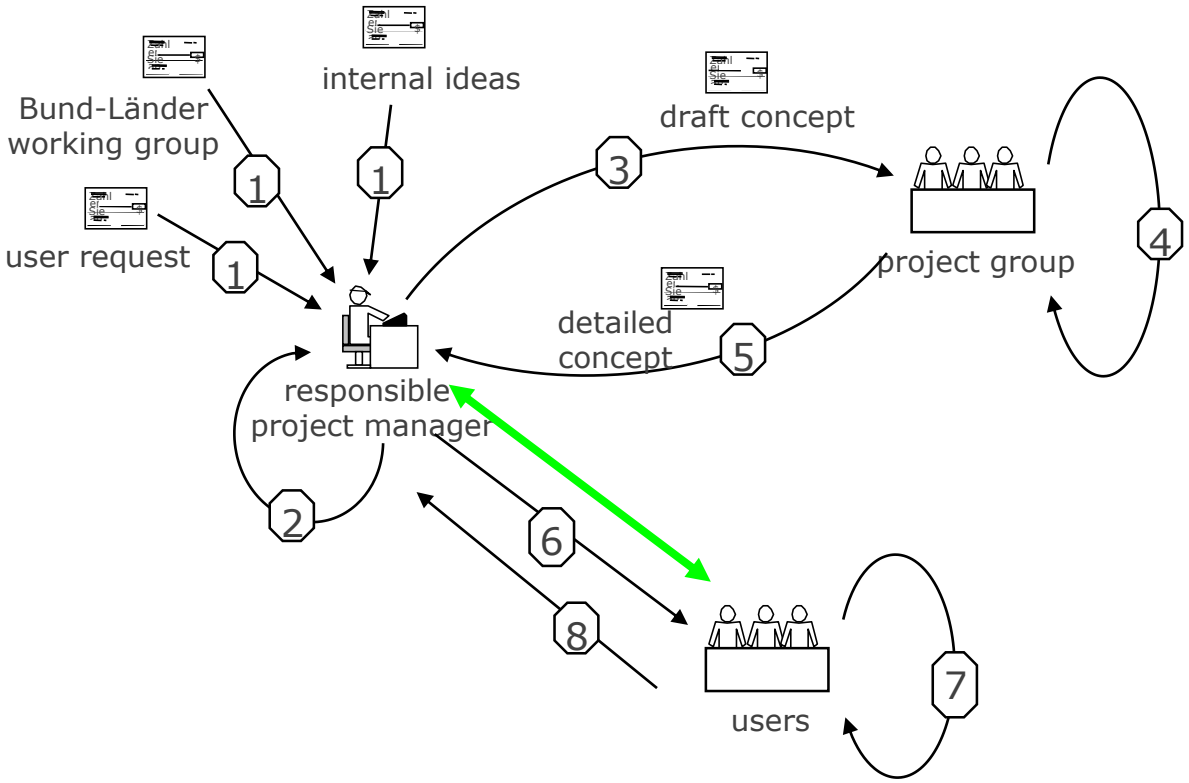
On-spot control and cross-compliance based on the working concept of the German animal identification, registration and traceability system (HIT)

Q&A Session

Food safety

Systematic development & testing – part 1

Interaction of stakeholders during development process



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Systematic development & testing – part 2

- Systematic testing of every aspect of the business logic
  - own test framework as HITP-client to communicate with appl. server
  - design test scenarios with data and interaction workflow for every user case
  - define expectations and proof assertions
  - some 10.000 test cases

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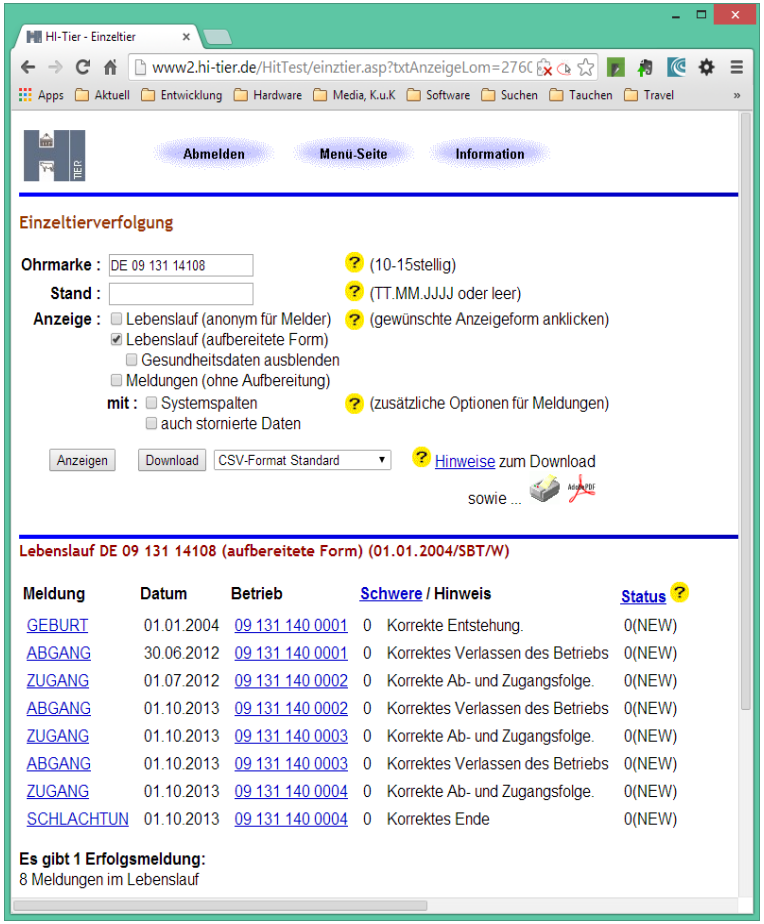
Online-Demonstration

Live-Cycle of an animal

based on the working concept of the German animal identification, registration and traceability system (HIT)

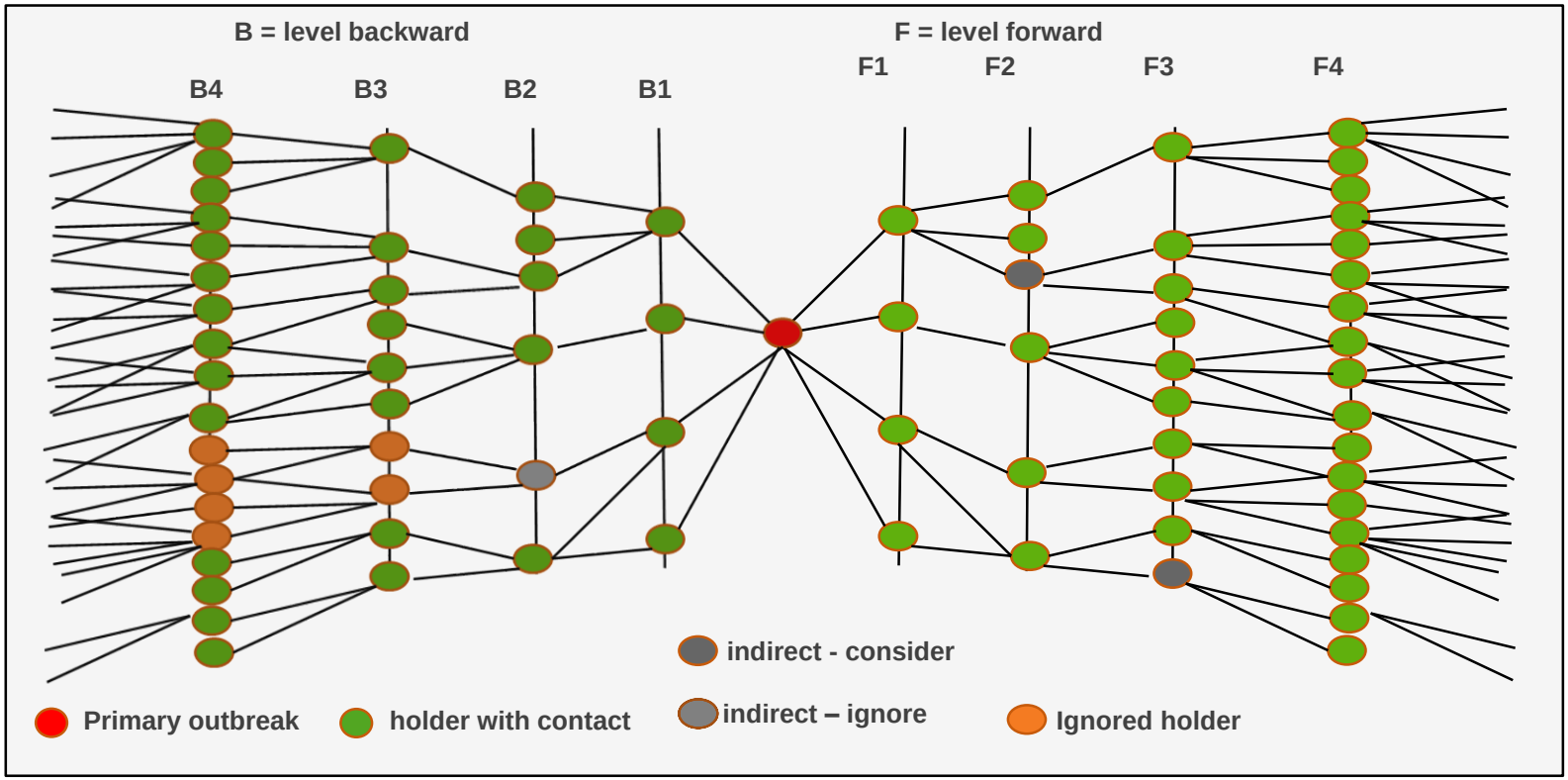
Traceability – part 1: at the small scale

- Animal live cycle



Traceability – part 2: at the large scale

- Epidemiologic research: trace back / trace forward



Traceability – part 3: technical historiography

- Implicit technical historiography
  - Timestamp of storage – "valid from" (SYS_VON)
  - Timestamp of revocation – "valid until" (SYS_BIS)
  - No physical DELETE – only STORNO (like in book-keeping)
  - No physical UPDATE – only STORNO + INSERT
  - Responsible user for storage or revocation (MELD_BNR/MBN)
- Example: Sequence to correct business begin (DTYP_VON)

BNR15	TYP_BETR	DTYP_VON	DTYP_BIS	SYS_VON	SYS_BIS	MELD_BNR	MELD_MBN
276091330100001	1	01.01.2000/00.00.00.0	31.12.2100/00.00.00.0	01.01.2004/13.00.22.666571	11.05.2012/09.50.11.694936	276090000000013	0
276091330100001	1	01.01.2001/00.00.00.0	31.12.2100/00.00.00.0	11.05.2012/09.50.11.715342	-- open --	276090000000013	0

Traceability – part 4: Using technical history

- Delta transfer
  - Possible to retrieve only new or modified data, e.g. for replication
  - Store query and execution timestamp for each user
- Point in time retrieval
  - Generate reports at specific "knowledge time" (e.g. grass-land & diary cow premium)
  - Time reproducibility of data queries (reports & statistics)
- Example: retrieve data as it looked like on 1. Jan. 2010 12:00h

BNR15	TYP_BETR	DTYP_VON	DTYP_BIS	SYS_VON	SYS_BIS	MELD_BNR	MELD_MBN
276091330100001	1	01.01.2000/00.00.00.0	31.12.2100/00.00.00.0	01.01.2004/13.00.22.666571	11.05.2012/09.50.11.694936	276090000000013	0
276091330100001	1	01.01.2001/00.00.00.0	31.12.2100/00.00.00.0	11.05.2012/09.50.11.715342	-- current --	276090000000013	0

```
*6:RS/Z01.01.2012/12.00:BTR_T/*:BNR15;=;276091330100001
```

BNR15	TYP_BETR	DTYP_VON	DTYP_BIS	SYS_VON	SYS_BIS	MELD_BNR	MELD_MBN
276091330100001	1	01.01.2000/00.00.00.0	31.12.2100/00.00.00.0	01.01.2004/13.00.22.666571	11.05.2012/09.50.11.694936	276090000000013	0

Traceability – part 5: business history

- Logical business historiography
  - Timestamp begin of effect – "effective since"
  - Timestamp end of effect – "effective until"
  - Distinguish between
    - Correction of information – it was stored but wrong
    - Change of information – it was correct in a certain period
- Example: cattle holder (Type: 1) switched to pig production (Type: 31)

BNR15	TYP_BETR	DTYP_VON	DTYP_BIS	SYS_VON	SYS_BIS	MELD_BNR	MELD_MBN
276091330100002	1	01.01.2000/00.00.00.0	31.12.2100/00.00.00.0	11.05.2012/10.54.39.729518	11.05.2012/10.54.39.865052	276090000000013	0
276091330100002	1	01.01.2000/00.00.00.0	01.01.2009/00.00.00.0	11.05.2012/10.54.39.891998	-- open --	276090000000013	0
276091330100002	31	01.01.2009/00.00.00.0	31.12.2100/00.00.00.0	11.05.2012/10.54.39.921050	-- open --	276090000000013	0

Risk analysis – part 1 legal basis

- Integrated risk analysis and common on spot control regime
  - veterinary and IACS / CC,
    according to regulation (EC) 2630/97, regulation (EC) 2419/2001
  - common data basis, risk parameters und calculation model
  - consistent documentation through identical control reports
- Guidelines and provisions for parameter selection
  - see article 2 paragraph 4 regulation (EC) 1082/2003
  - explicitly mentioned
    - amount of live stock, changes in stock compared to previous year
    - aspects of public health
    - aspects of animal health, protection and welfare
    - control results and findings from previous years

Risk analysis – part 2 legal basis

- Amount of entities to control on spot
  - according to vet. requirements: formerly 5% now 3% of animal holders
  - according to IACS: 1% of subsidy applicants
  - in case of a certain percentage of irregularity, percentage has to be increased
- Requirement to draw comparison group by random selection
  - according to IACS: 20% - 25% within total amount
  - according to vet. resort under discussion
    - formerly we used 20%
    - according to DG AGRI one should use 0% (no random) for bovine and carpine

Risk analysis – former, classical approach

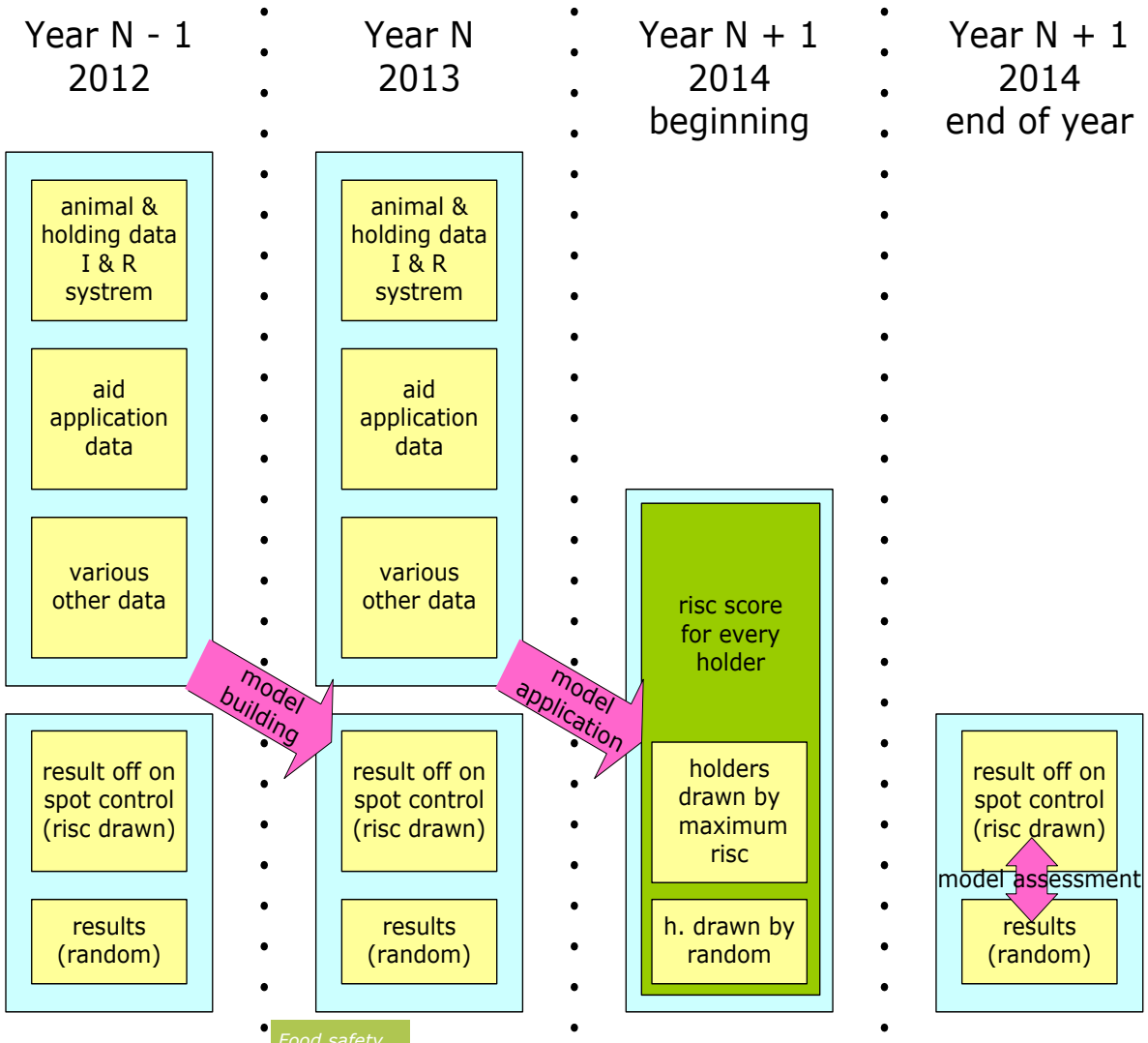
- Calculation of individual risk for holding via weight or point system
  - within different criteria a calculation formula or grouping scheme is established to assign a certain amount of "risk points" to each holding
  - points for different criteria weighted and combined as "score value"
- Drawing the required amount of holdings for on spot control
  - "risk proportional" – by random, probability derived from score
  - "worst first" – take holdings in descending succeeding order
- Improve and adjust by retrospection of the control results
- Main disadvantages
  - depends highly on expert appreciation
  - difficult to improve systematically

Risk analysis with statistical methodology

paradigm shift towards mathematical and statistical methods

- According to EU bodies in announcements and control visits
  - it‘s secondary which parameter you use
  - of primary importance is to use effective parameters
  - you have to monitor and adjust your parameter selection
  - the covered risk must be significantly higher in the risk drawn control population compared to the randomly drawn comparison group
- Best practice is to use statistical methodology

Risk analysis statistical approach



Risk analysis – details, step by step

- The following slides show the process of the model building and model application very detailed - step by step

Risk analysis – step 1: data preparation

- Data basis for risk analysis
  - extract data from AIT system
  - receive data from paying agencies and vet. admin off all states
- Plausibility check for potential parameters
  - descriptive statistic (sample next slide) for overview and check
  - disqualification of parameters
    - insufficient amount of observations
    - unusable – to little variation, date values
- Decisions to be taken
  - which scope? (bovine, carpine, first pillar aid …)
  - do we need combination/integration of different scopes?
  - what is the prediction objective?
    (breach yes/no, sanction height – absolute or relative …)

Risk analysis – step 1: preparation, descriptive statistic

	A	B	E	F	G	H	I	J	K	L	M
1	_name_	nummer	CA01_FLAE	CA02_FL_X	CA03_FL_A	CA04_FL_G	CA05_FL_FH	CA06_FL_VO	CA07_FLWSG	CA08_FL_NA	CA100_BTKA
2	N	1	119980	119980	119980	119980	119980	119980	119980	119980	119980
3	PCT_POP	2	1	1	1	1	1	1	1	1	1
4	NMISS	3	0	0	0	0	0	0	0	0	0
5	MIN	4	0	-9999	0	0	0	0	0	0	0
6	MEAN	5	26.85	0.93	17.27	10.53	0.86	0.86	1.1	1.3	0.46
7	MAX	6	2837.6	100	1743.95	1227.65	647.34	642.38	272.47	647.46	1
8	P1	7	0.38	-37	0	0	0	0	0	0	0
9	P5	8	1.2	-9	0	0	0	0	0	0	0
10	P10	9	2.58	-2	0	0	0	0	0	0	0
11	P25	10	6.25	0	0.48	1.2	0	0	0	0	0
12	P50	11	16.78	0	7.63	5.1	0	0	0	0	0
13	P75	12	35.26	0	21.27	14.52	0	0	0	0.07	1
14	P90	13	61.98	3	45.89	27.14	1.49	0.38	2.19	2.47	1
15	P95	14	84.89	14	67.01	37.15	3.69	3.3	5.86	5.9	1
16	P99	15	151.75	100	129.25	63.05	13.53	19.35	21.32	23.04	1

Generated via "Better Means"-Macro
by Myra A. Oltsik and Peter Crawford (Paper 059-31 / SUGI 31)

Risk analysis – step 2: choosing parameter candidates

- Prerequisites and primary selection
  - more than 230 candidates, some 100,000 observations
  - stepwise „forward-selection“ combined with „backward-elimination“
  - inclusion or exclusion by experts decision possible
- Analysis of interdependences (correlation analysis)
  - two different statistical methods (see sample)
    - simple cross correlation matrix
    - variance inflation factor – a measure for multiple inter correlation
  - often highly correlated parameters, one of group selected by expert
  - advantage of reduction
    - avoiding model bias
    - easier to handle

Risk analysis – step 2: choosing …, correlation analysis

variance inflation
- exclude > 10

	A	B
1	variable	varianceinflation
2	Intercept	0
3	CA101_BTSW	22.77560176
4	CA24_PSMLA	1.490983619
5	CA50_WKVOR	1.513543636
6	CA88_BUFF	1.333717423
7	CA93_BVSW	23.36592572
8	CA95_BVPS	1.264493495
9	R03_RE_FRM	1.857946444
10	R109_ZAD	1.297173404
11	R110_EL_AS	1.087124119
12	R112_DSB_S	1.609305179
13	R20_ANZP_A	4.387699877

cross correlation matrix
- attention if corr.value > 0.4 and < -0.4

	A	B	C	D	E	F	G	H	I	J
1	Variable	CA101_BTSW	CA24_PSMLA	CA50_WKVOR	CA88_BUFF	CA93_BVSW	CA95_BVPS	R03_RE_FRM	R109_ZAD	R110_EL_AS
2	CA101_BTSW	1	0.176867847	0.446917186	0.080902397	0.976268268	0.031737237	0.099230709	-0.134859848	0.010394164
3	CA24_PSMLA	0.176867847	1	0.068524721	0.031004369	0.150548185	0.226222363	0.16526452	0.131711456	0.039634387
4	CA50_WKVOR	0.446917186	0.068524721	1	0.154522483	0.473248405	-0.081064855	0.011501697	-0.048306481	-0.013858151
5	CA88_BUFF	0.080902397	0.031004369	0.154522483	1	0.084801271	0.099451453	0.033720109	0.086019597	0.119181382
6	CA93_BVSW	0.976268268	0.150548185	0.473248405	0.084801271	1	0.039623843	0.097269888	-0.144795132	0.016024332
7	CA95_BVPS	0.031737237	0.226222363	-0.081064855	0.099451453	0.039623843	1	-0.001617914	0.017355917	0.017255369
8	R03_RE_FRM	0.099230709	0.16526452	0.011501697	0.033720109	0.097269888	-0.001617914	1	0.221858766	0.157379326
9	R109_ZAD	-0.134859848	0.131711456	-0.048306481	0.086019597	-0.144795132	0.017355917	0.221858766	1	-0.087465779
10	R110_EL_AS	0.010394164	0.039634387	-0.013858151	0.119181382	0.016024332	0.017255369	0.157379326	-0.087465779	1
11	R112_DSB_S	0.947711047	0.18352776	0.44929115	0.090771815	0.964346593	0.027368822	0.159427554	-0.128396948	0.039407763

Risk analysis – step 3: model building

- Iterative model generation
  - build model from pre selected parameter candidates
  - calculate model quality measures and prediction certainty
  - exclude parameters with weak or uncertain influence
  - iterate to improve
- Model assessment by means of quality measures
  - Akaikes information criteria (AIC)
  - p-values for model and parameters
  - convergence
- Used statistical techniques
  - logistic regression for binary forecast objects
  - linear or regression for continual forecast objects

Risk analysis – step 3: model building / example

model example :

$$
\begin{aligned}
Risk = \quad & (-1.9176 + \\
& (0.8709 \quad * CA95\_BVPS) + \\
& (-0.00004 * R11\_HB\_ST1) + \\
& (0.0252 \quad * R120\_FWA2) + \\
& (-0.00074 * R24\_BF\_FFN) + \\
& (0.00544 \quad * R27\_FL\_EI) + \\
& (0.0180 \quad * R33\_FL\_NAL) + \\
& (0.0141 \quad * R40\_FL\_AFS) + \\
& (-1.5001 \quad * R43\_FL\_SFA) + \\
& (0.0547 \quad * R46\_FL\_DK) + \\
& (-0.00123 * R54\_DSB\_R) + \\
& (-0.0316 \quad * R59\_DSB\_PF) + \\
& (0.8572 \quad * R73\_AB\_EGF) + \\
& (-0.8200 \quad * R77\_S\_ELE1) + \\
& (1.2814 \quad * R78\_S\_ELE2))
\end{aligned}
$$

transformation:

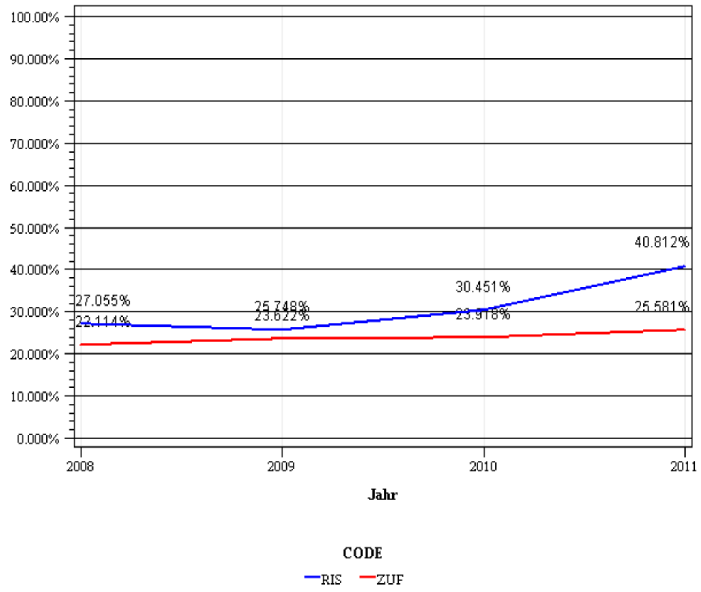
$$Scoring = \frac{e^{Risk}}{1 + e^{Risk}}$$

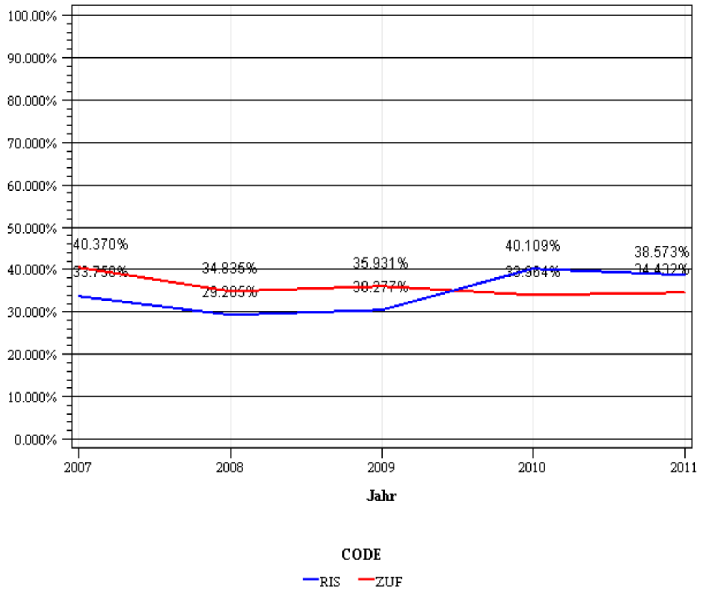
Risk analysis – step 4: forecast, scoring, drawing

- Apply model to data of current year to forecast
  - calculate formula for parameter values of each holder
  - no interpretation possible for resulting objective value at this stage
- Transformation according to used statistical techniques
  - for binary models: probability or breach / irregularity
  - for continuous models: estimated height of sanction
- Drawing of holders for on spot control
  - different percentage according to regulation requirements
  - complex additional logic if integration of different scopes

Risk analysis – step 5: assessment of effectiveness

- All control report results are completely entered into CDB
- Effectiveness calculated by comparing risk drawn to random
  - assessment in regard to different objectives
  - statement whether better or not AND whether discrepancy is significant





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Thank you for your attention!

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IMPLEMENTED BY

IN SUBCONTRACT WITH

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