RISK ANALYSIS METHODS IN PROCESSING INDUSTRY

A SWISS - GERMAN SURVEY

Dr.-Ing. Ralf Mock
Chair of Safety Technology
Swiss Federal Institute of Technology Zurich
Switzerland

Dr.-Ing. Jens van Mahnen
Bergische Universität-Gesamthochschule Wuppertal
Fachbereich Sicherheitstechnik
Germany

RISK ANALYSIS METHODS IN PROCESSING INDUSTRY

Project Goals

- Overview on the disposition of RA-methods
  in the chemical processing industry
  of Switzerland and Germany

- Optimisation of future research projects
- Keeping courses up to date

Procedure
Questionnaire:

- Mailed to 1612 companies (976 CH; 636 D)
- Response from 237 companies (174 CH, 63 D)

RISK ANALYSIS METHODS IN PROCESSING INDUSTRY

A SWISS - GERMAN SURVEY

Content

- Project Goals and Procedure
- Questionnaire: Basic Data
- Cluster Analysis
- Disposition of Risk Analysis Methods
- Judgement of Methods
- Conclusions

Questionnaire: Basic Data

Companies According to
Country and Number of Employees

Participation

- 179 companies (129 CH; 50 D)
  - CH: mostly small companies
  - D: mostly medium sized companies

Questionnaire: Basic Data

Companies Applying Risk Analysis
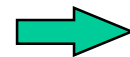**According to Country and Number of Employees**
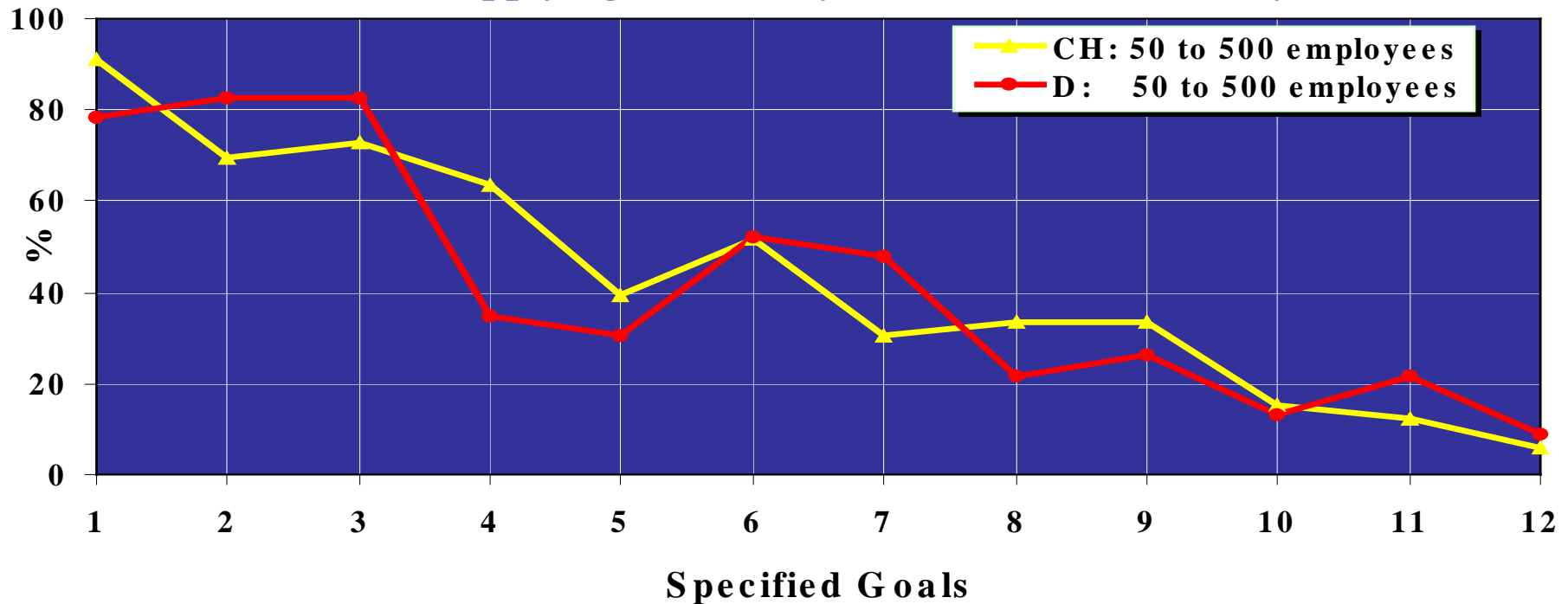

Risk Analysis

112 companies (74 CH; 38 D)

Conclusion

- Both histograms show expected subdivisions

➡ **The data base is representative.**

Goals of Applying Risk Analysis in Chemical Industry

Legend of specified goals
1. Hazard identification
2. Fulfilment of legal demands
3. Optimisation of safety and protection installations
4. Fulfilment of "Ordinance for the Protection Against Major Accidents"
5. Product safety
6. Certifications according to ISO 9001 or 14001
7. Communication with authorities
8. Quantitative risk assessment
9. Optimisation of systems-/products
10. Optimisation of maintenance
11. Reliability analysis

Results
1. Swiss and German companies of same size are similar in their goal ratings
2. Swiss companies concentrate on "1. Hazard identification"
3. Swiss companies name more often "4. Ordinance .." than German companies
4. For medium Swiss companies "5. Product safety" is more important

sra.ppt/R. Mock/07.10.98

Cluster Analysis

(Multivariate Statistics)

The Cluster Analysis is a tool to identify patterns (cluster) in a set of objects
• Objects within the same cluster should be as similar as possible
• Objects within different classes should differ as much as possible

Cluster Analysis

The goals of risk analyses can be grouped.

CH

Cluster 1: "Handling with Hazards"

- Hazard identification
- Fulfilment of "Ordinance for the Protection ..."
- Optimisation of safety/protection installations
- Fulfilment of legal demands

Cluster 2: "Engineering"

- Optimisation of system-/products
- Quantitative risk assessment
- Reliability analysis
- Optimisation of maintenance
- Fulfilment of insurance demands
- Certifications according to ISO 9001/14001
- Communication with authorities

Cluster 3: "others"

- Product safety

D

Cluster 1: "Handling with Hazards"

- Hazard identification
- Optimisation of safety/protection installations
- Fulfilment of legal demands
- Communication with authorities
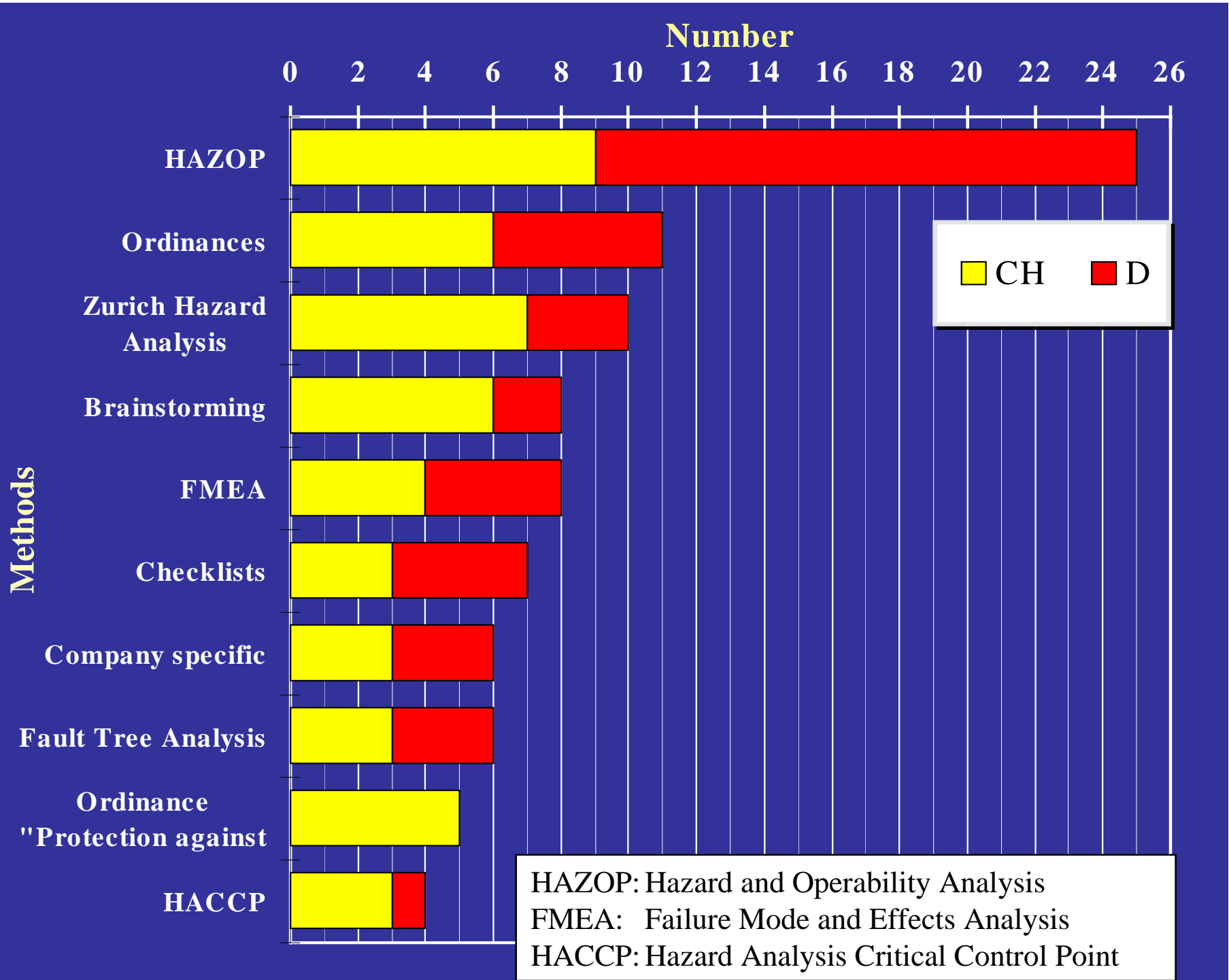
Cluster 2: "Engineering"

- Optimisation of system-/products
- Quantitative risk assessment
- Reliability analysis
- Optimisation of maintenance
- Product safety
- Fulfilment of insurance demands
- Certifications according to ISO 9001/14001

Cluster 3: "others"

- Fulfilment of "Ordinance for the protection ..."

sra.ppt/R. M....

Judgement of Methods

Legend: **"Method is ..."**

HBAR: easy (difficult) manageable
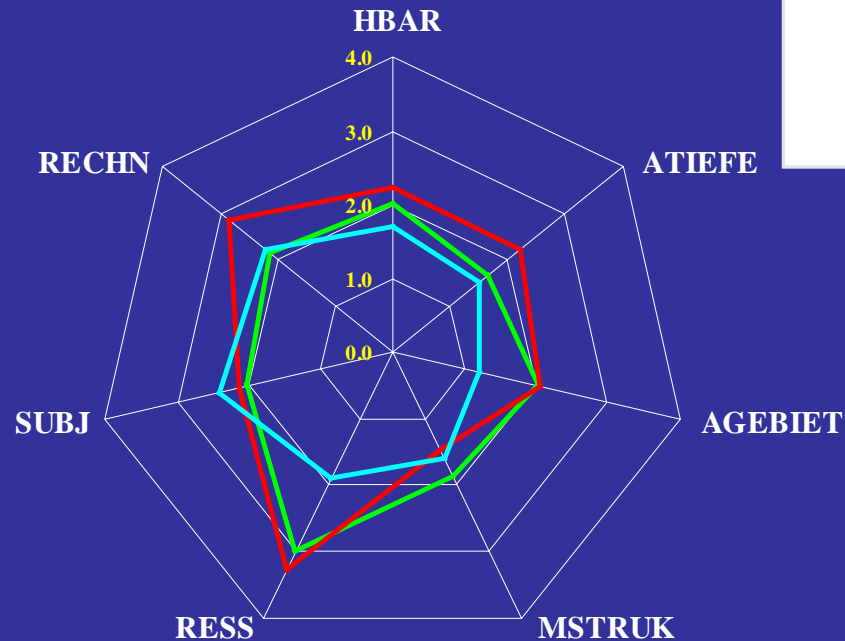
ATIEFE: (not)flexible in respect of analysis depth/scope

AGEBIET: (not)flexible in respect of areas of application

MSTRUK: methodically (un)structured

RESS: (not) sparing resources

SUBJ: (not) depending on experts subjectivity

RECHN: well (badly) practicable by computers

Selected Results

Manageability (HBAR)

•HAZOP: more difficult than FMEA

Analysis depth and scope (ATIEFE)

•Good rating for ZHA

Area of Application (AGEBIET)

•ZHA: good appraisal

Resources (RESS)

HAZOP, FMEA need many resources

Methodical structure (MSTRUK)

ZHA: good rating

Conclusion

The propertis of "Method is ..." of ZHA fit well to requirements in chemical industry.

Conclusions

In General

• Insight in current approaches and problems of RA-methods

• A wide variety of methods is used

• Most methods used are methodically simple

Major Goals of RA-Methods

• Hazard identification

• Fulfilment of legal requirements

• Optimisation of safety and protection installations

• Fulfilment of "Ordinance for Protection ..."

Cluster Analysis

• CH: Combined area of "hazard identification" and "Ordinance for Protection..."

• D: The application of this ordinance is a working area of its own

Partners in Risk Analysis

• CH: Engineering companies

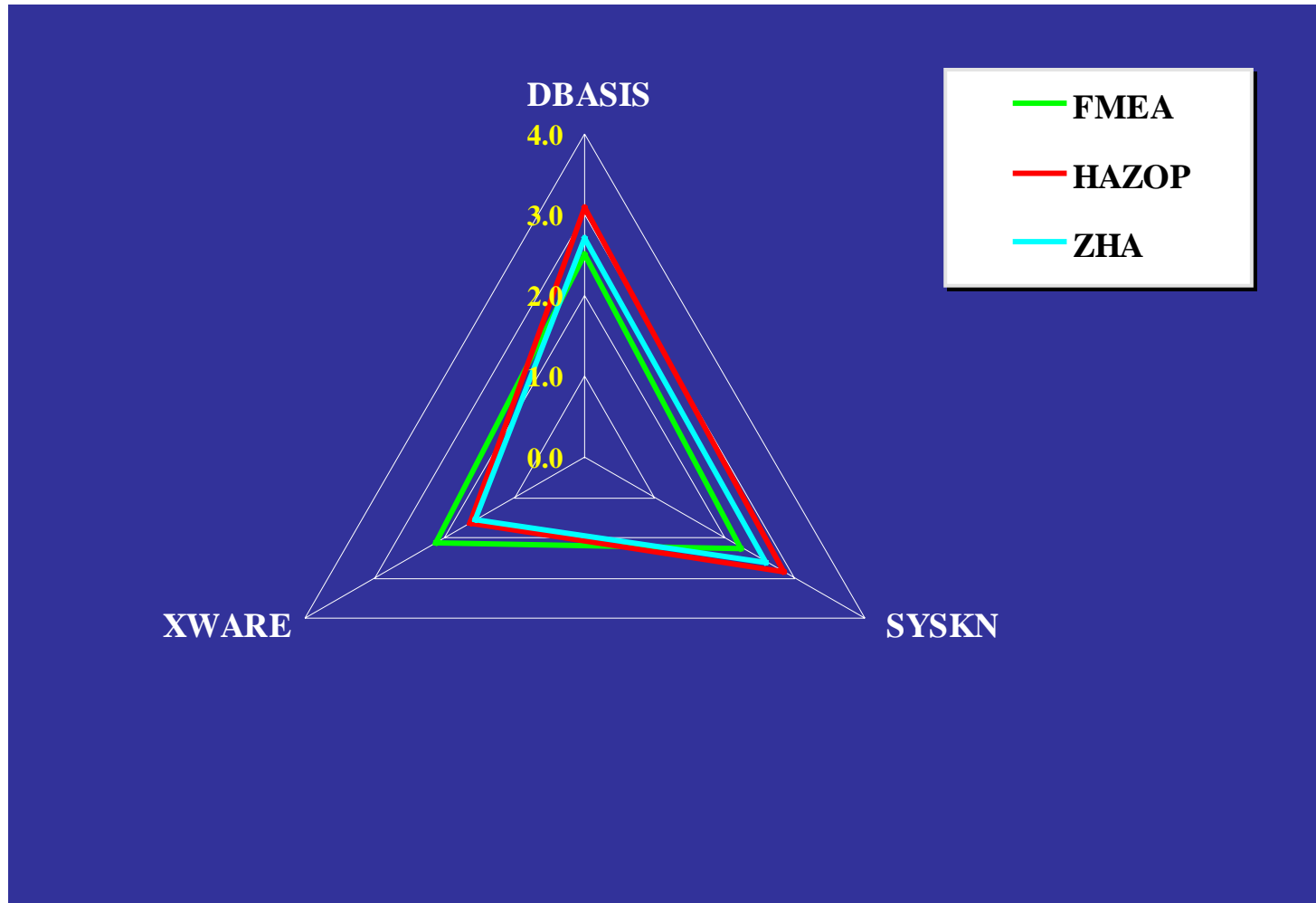• D: Academic institutions

Difference to "Academic" Positions

"RA-methods take well into account the inclusion of dependencies and human actions"

Final Impression

Companies are "satisfied customers" of "their" RA-methods

Research and development in this area is not regarded as urging
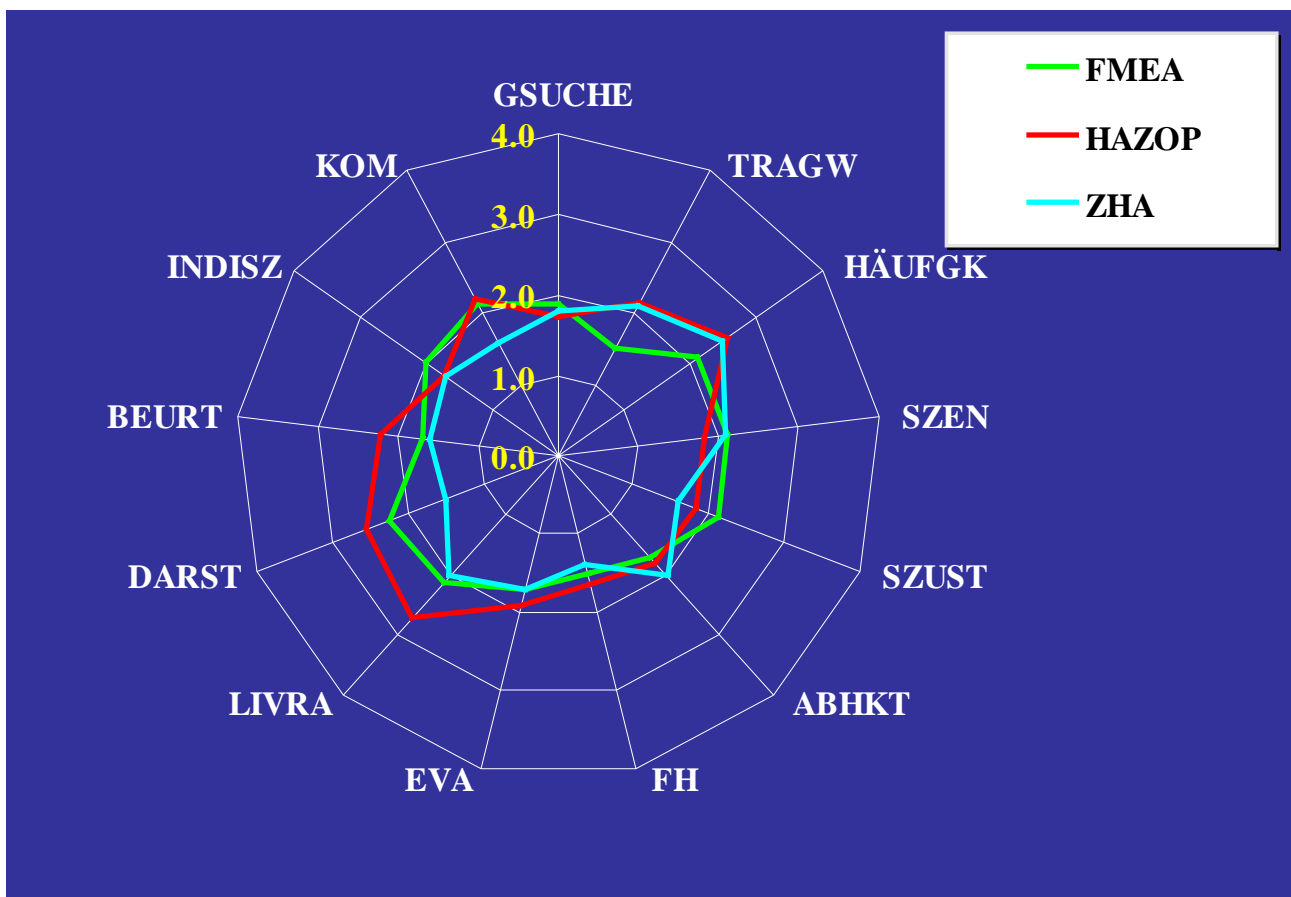
Judgement of Methods

Legend: **Method requires ....**

DBASIS: a big (low) data and knowledge base

SYSKN: few (much) knowledge of systems from an analyst

XWARE: few (much) soft/hardware

Judgement of Methods

Legend: **Method supports ....**
GSUCHE: the hazard identification (does not)
TRAGW: the consequence assessment sufficiently (insufficiently)
HÄUFGK: the frequency assessment sufficiently (insufficiently)
SZEN: the determination of scenarios (does not)
SZUST: the consideration of system states (does not)
ABHKT: the inclusion of dependent failures (does not)
FH: the inclusion of human mis-actions (does not)
EVA: the inclusion of external events.. (does not)
LIVRA: an easy up dating... (does not)
DARST: an easy representation of results (does not)
BEURT: the judgement of results (does not)
INDISZ: the interdisciplinary team work of different departments (does not)

sra.ppt/R. Mock/07.10.98

Cluster Analysis
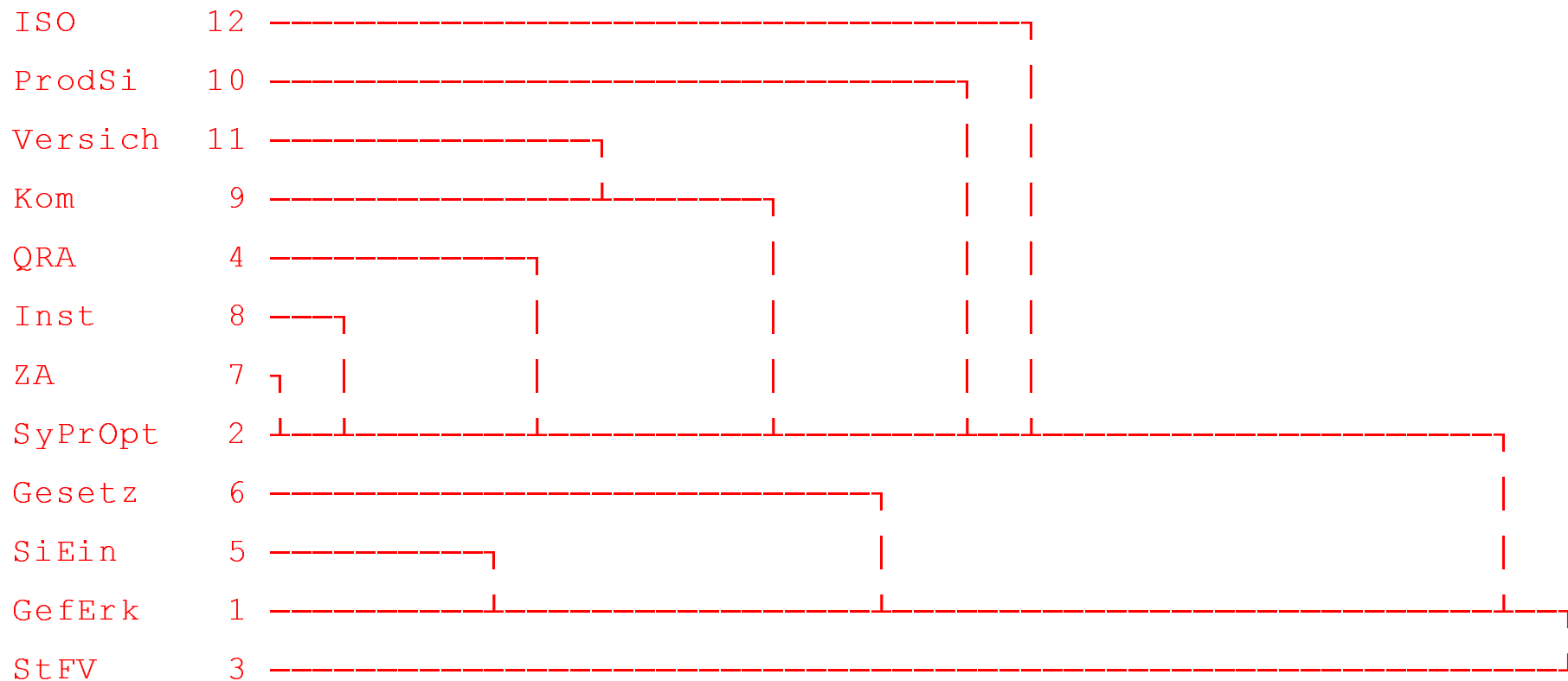
Legend

ISO:	Certifications according to ISO 9001 or 14001
Kom:	Communication with authorities
ZA:	Reliability analysis
SiEin:	Optimisation of safety and protection installations
ProdSi:	Product safety
QRA:	Quantitative risk assessment

SyPrOpt:	Optimisation of system-/products
GefErk:	Hazard identification
Versich:	Fulfilment of insurance demands
Inst:	Optimisation of maintenance
Gesetz:	Fulfilment of legal demands
StFV:	Fulfilment of "Ordinance for the Protection Against Major Accidents"