# Security Risk Assessment III – Part 1

## Scales

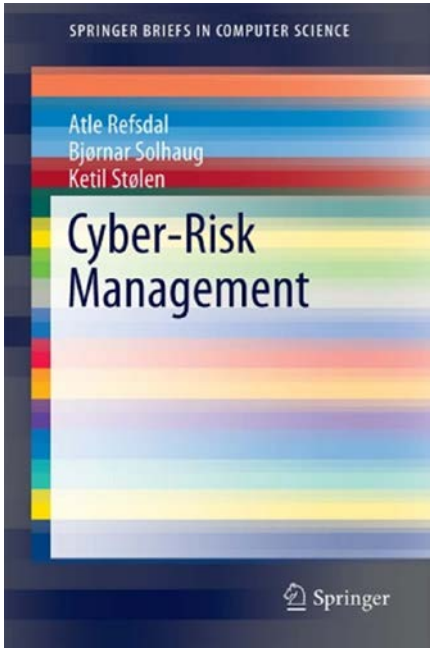
Ketil Stølen

# Motivation

- Measurements and estimates are important to priorities risks
- This requires well-designed and carefully thought through scales

**BUT**

- What does it mean that a scale is good or well-suited?
- How to select and/or define scales?




See Chapters 11 and 12

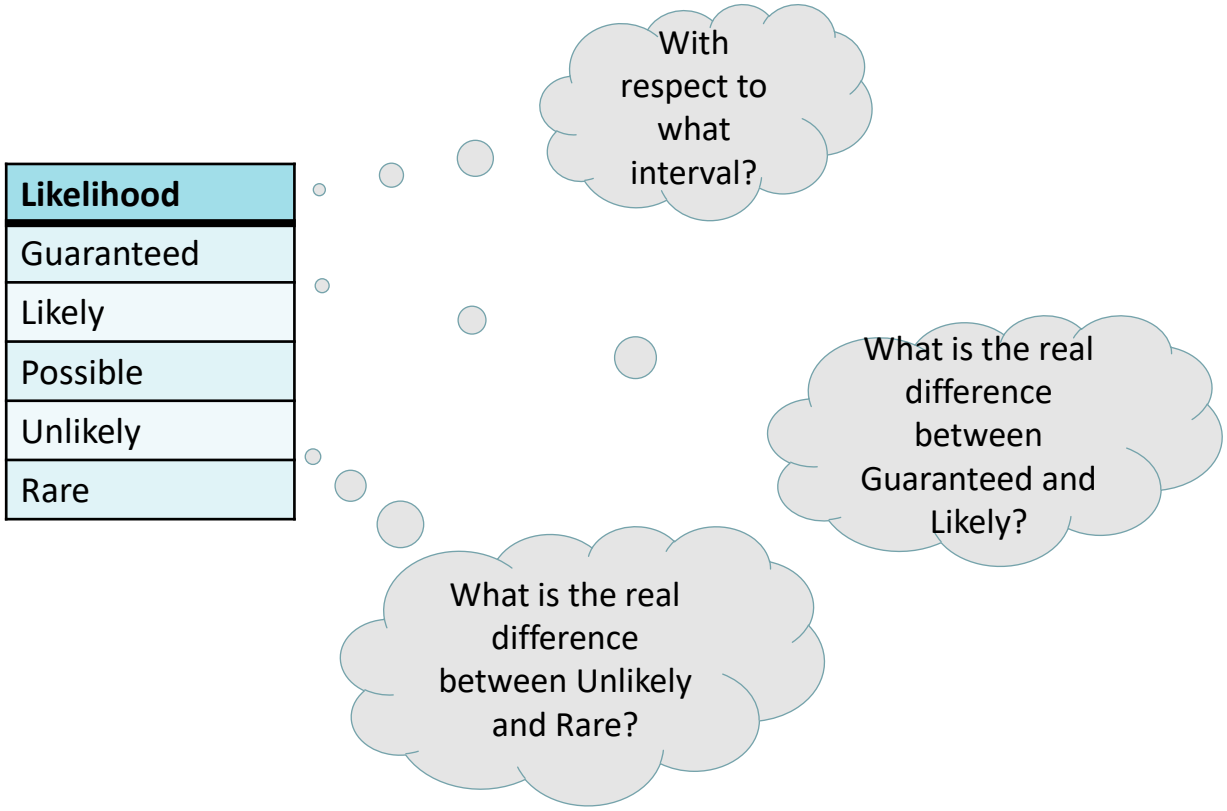
Security risk level is a measurement of the seriousness of a negative or harmful potential incident

| One factor | Two factor | Three factor | *** | Many factor |
|---|---|---|---|---|
| Consequence | Consequence<br>Likelihood | Consequence<br>Threat<br>Vulnerability | | e.g. OWASP |

Independent of the number of factors:

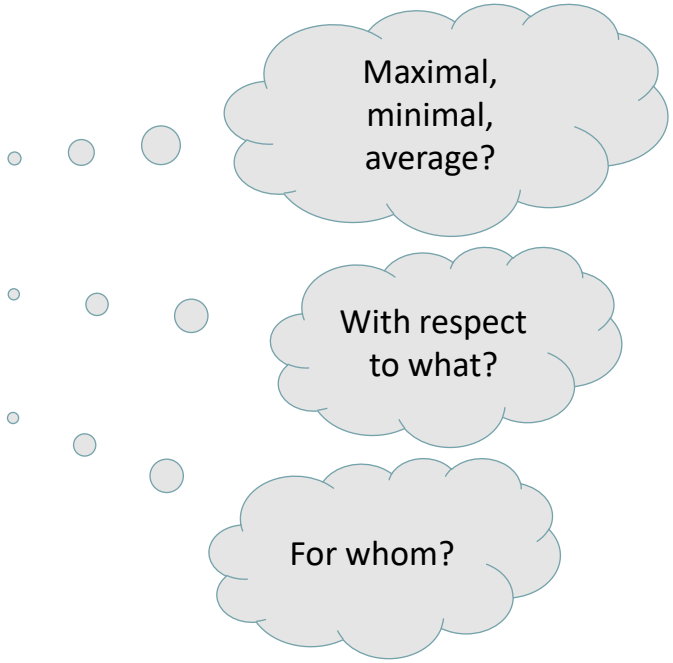
**Good and well-suited scales is a prerequisite for a satisfactory result**

# Is this a good scale?



# What about this?

| Consequence |
| --- |
| Catastrophic |
| Large |
| Moderate |
| Small |
| Insignificant |



# And this?

| Value | Probability interval |
|---|---|
| 5 | 0.9-1.0 |
| 4 | 0.7-0.9 |
| 3 | 0.3-0.6 |
| 2 | 0.1-0.2 |
| 1 | 0.0-0.1 |

Probability with respect to what?

Is 0.9 equal to 4 or 5?

What about 2.5?

# What kinds of scales are there?

# Two main kinds of scales

Qualitative: Values defined or exemplified in natural language

Quantitative: Values defined in such a way that conventional rules calculation are well-defined

# To variants of qualitative scales

Nominal scale:

Values correspond to different categories

Ordinal scale:

Values correspond to different categories and these values are ordered

# Nominal scale

| Activa category | Description |
|---|---|
| Information | Digital information; in storage as well as under transportation |
| Software | Source code, binary code, documentation |
| Hardware | Computer equipment, but also other equipment of relevance |
| Services | External as well as internal |
| People | Customers, employees |
| Immaterial values | Reputation, external trust |

# Ordinal scale

| Consequence | Description |
|---|---|
| Catastrophic | Leakage of information that can be exploited by terrorists |
| Large | Leakage of information of legal relevance |
| Moderate | Leakage of information that may easily be exploited by competitors |
| Small | Leakage of anonymous information about employees |
| Insignificant | Leakage of information that to a large extent is public |

# Things to remember when defining qualitative scales

- Fully exploit the natural language so that the values are easy to understand and differentiate
- Make sure that definitions and formulations make use of words suited for the users of the scale
- Examples are often helpful
- If the scale is ordered this should be reflected in the definitions of the values
- The values should cover the full sample space

# To variants of quantitative scales

Difference scale:

Subtraction (and addition) is well-defined

Ratio scale:

Division (and multiplication) is also well-defined

# This is a quantitative difference scale – measures the frequency per year

| Occurrences | Interval |
|---|---|
| Real non-negative number | Year |

5 – 3 = 3 – 1 = 2

frequency of 5 - frequency of 3 =
frequency of 3 - frequency of 1=
frequency of 2

Subtraction is well-defined

# The very same frequency scale is also a ratio scale

| Occurrences | Interval |
|---|---|
| Real non-negative number | Year |

6 / 3 = 2 / 1 = 2

frequency of 6 / frequency of 3 =
frequency of 2 / frequency of 1 =
twice as much in frequency

# This is also a ratio scale

| Value | Description |
|---|---|
| Non-negative real number | Number of journals leaked |

6 / 3 = 2 / 1 = 2

6 journals leaked / 3 journals leaked =
2 journals leaked / 1 journal leaked =
twice as many journals leaked

# A difference scale that is not a ratio scale has a zero value selected "arbitrarily"

Consider three days in a row with maximum temperature 250, 275 and 277.75 degrees Kelvin:

- The increase in temperature from day 1 to day 2 is: ((275-250)*100)/250=10%
- The increase in temperature from day 2 to day 3 is: ((277.75-275)*100)/275=1%

Consider three days in a row with maximum temperature -23, 2 and 4.75 degrees Celsius. If we do the same calculations we get:

- The increase in temperature from day 1 to day 2 is: ((2-(-23))*100)/-23=-108.695…
- The increase in temperature from day 2 to day 3 is: ((4.75-2)*100)/2=137.5%

Kelvin is a ratio scale, while Celsius is only a difference scale.

**BUT** can't we just calculate with the numbers we have?

If the arithmetic operations are not well-defined then the utility of the calculation may have to be checked empirically

# Example of calculation that requires empirical underpinning

The first step is to select one of the options associated with each factor and enter the associated number in the table. Then simply take the average of the scores to calculate the overall likelihood. For example:

| Threat agent factors | | | | | Vulnerability factors | | | |
|---|---|---|---|---|---|---|---|---|
| Skill level | Motive | Opportunity | Size | | Ease of discovery | Ease of exploit | Awareness | Intrusion detection |
| 5 | 2 | 7 | 1 | | 3 | 6 | 9 | 2 |
| Overall likelihood=4.375 (MEDIUM) | | | | | | | | |

Next, the tester needs to figure out the overall impact. The process is similar here. In many cases the answer will be obvious, but the tester can make an estimate based on the factors, or they can average the scores for each of the factors. Again, less than 3 is low, 3 to less than 6 is medium, and 6 to 9 is high. For example:

| Technical Impact | | | | | Business Impact | | | |
|---|---|---|---|---|---|---|---|---|
| Loss of confidentiality | Loss of integrity | Loss of availability | Loss of accountability | | Financial damage | Reputation damage | Non-compliance | Privacy violation |
| 9 | 7 | 5 | 8 | | 1 | 2 | 1 | 5 |
| Overall technical impact=7.25 (HIGH) | | | | | Overall business impact=2.25 (LOW) | | | |

https://www.owasp.org/index.php/OWASP_Risk_Rating_Methodology

# Things to remember when defining quantitative scales

- Make sure there are no intervals between values
- Avoid overlapping values
- Cover the full sample domain
- Be explicit with definitions and assumptions
- Make sure you are aware of which arithmetic operations are well-defined
- Be  aware of that many utility functions require empirical underpinning

# Summary

- To measure risk level we need suitable scales
- Crap-in gives crap-out
- Quantitative is not better than qualitative – what is best suited depends on the case
- Independent of kind of scale, try to be precise