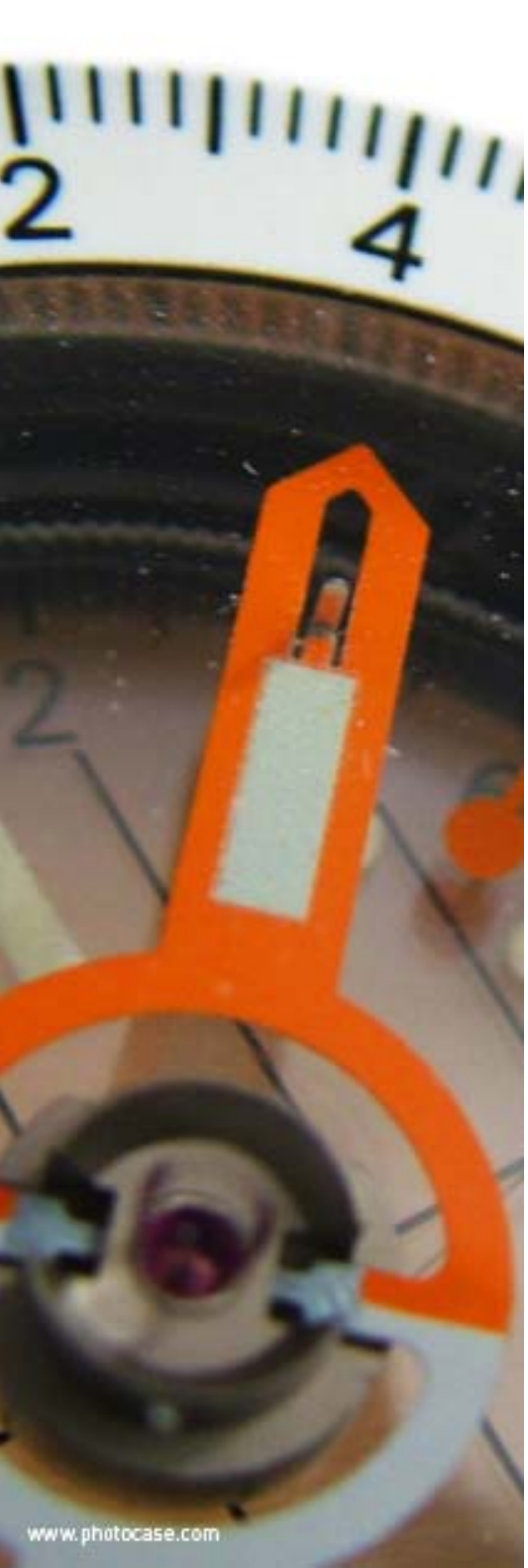

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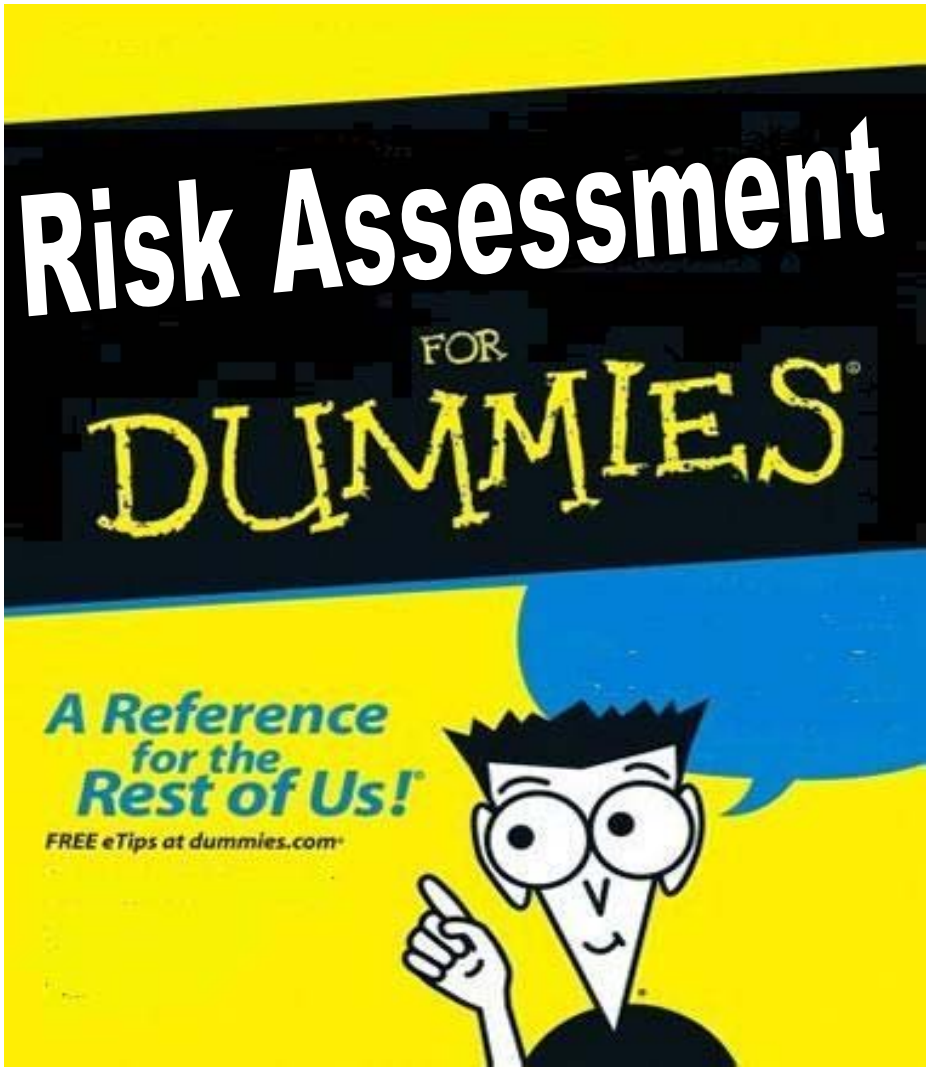

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Content

- Background information
  - What are we talking about ?
  - Origin of the method
  - Link with GPSD
- Principles of the RAG
  - Basic principles
  - Example

What is risk ?

- Risk is generally understood as a possibility to loose something
  - Losing money
  - Losing credibility
  - Losing health or your life
- Risk assessment is one of our daily activities
  - Crossing the street
  - Climbing on a chair or use a ladder ?

Which risk is assessed by the RAG ?

- The risk, linked to physical hazards, presented to consumer(s) by a single product
- NOT: risk for the population
- NOT: risk for authorities
- NOT: cost of material damage
- NOT: conformity assessment

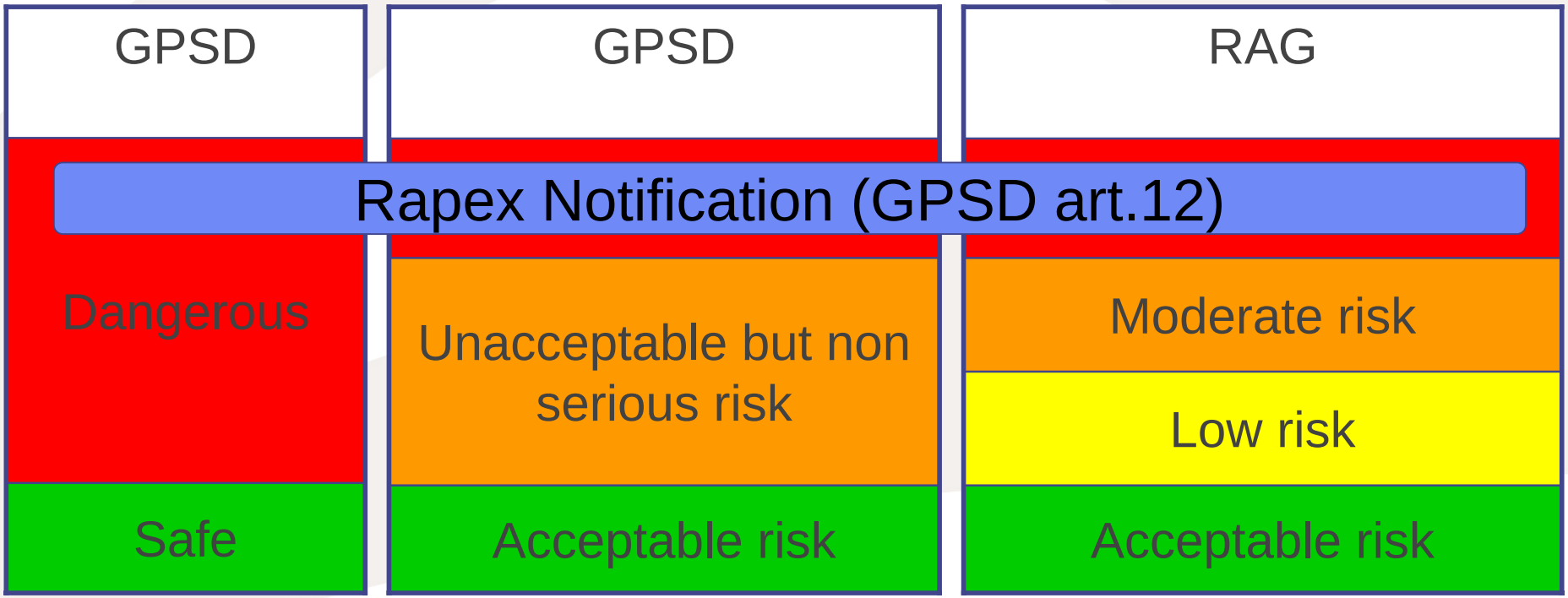
Kinney method

- Professional environment
- Risk = Severity x Exposure x Probability
- Severity of injury linked to hazard
- Exposure to the hazard
- Probability of the hazard to occur when exposed
- Numerical method

Differences between Kinney and RAG

- Severity scale – change of scale
- Integrate Exposure into Probability
- Probability = probability that the hazard occurs with the foreseen severity during the foreseeable lifetime of the product
- Non numerical method – (but all classifications are based on the figures behind the method)

Link between risk categories and the GPSD



Basic principles of the RAG

- Products present hazards.
- A hazard can lead to different injuries, each with there own severity, each with their own probability.
- Severity of injury
- Probability
- Risk = S x P

STEP 1: Determine the Severity of Injury

- Identify the hazards.
- Imagine accident scenarios to determine the injuries to which the hazards can lead.
- Determine the severity of these injuries (Slight, Moderate, Serious, Very Serious)
- Tables exist to help the risk assessors

Table 1. Hazards, typical injury scenario and typical injury

Hazard group	Hazard (product property)	Typical injury scenario	Typical injury
Size, shape and surface	Product is obstacle	Person trips over product, falls and hits the floor; or person bumps into product	Bruising; fracture
	Product is impermeable to air	Product covers mouth and/or nose of a person (typically a child)	Suffocation
	Product is or contains small part	Person (child) swallows small part; the part gets stuck in larynx and blocks airways	Internal airway obstruction
	Sharp corner or point	Person hits sharp corner or is hit by moving sharp object; this causes a puncture or penetration injury	Puncture; blinding, foreign body in eye; hearing, foreign body in ear
	Sharp edge	Person touches sharp edge; this lacerates skin or cuts through tissues	Laceration, cut; amputation
	Slippery surface	Person walks on surface, slips and falls hitting the floor	Bruising; fracture
	Rough surface	Person slides along rough surface; this causes friction and/or abrasion	Abrasion
	Gap or opening between elements	Person puts a limb or body in opening and is trapped with finger, arm, neck, head, body or clothing; injury occurs due to gravity or movement	Crushing, fracture, amputation, strangulation
Potential energy	Low mechanical stability	Product tips; person on top of product falls from height, or person near product is hit by the product; electrical product tips, breaks and gives access to live parts, or continues to work heating nearby surfaces	Bruising; dislocation; sprain; fracture; crushing; electric shock; burns
	Low mechanical strength	Product collapses by overloading; person on top of product falls from height, or person near product is hit by the product; electrical product tips, breaks and gives access to live parts, or continues to work heating nearby surfaces	Bruising; dislocation; fracture; crushing; electric shock; burns
	High position of user	Person at high position on the product loses balance, has no	Bruising; dislocation; fracture; crushing

Example: bicycle – broken fork

Bike example

Table 1. Hazards, typical injury scenario and typical injury

Hazard group	Hazard	Typical injury scenario	Typical injury
Rotating p			
Rotating p			
Acceleration			
Flying objects			
Vibration			

Hazard

Injury scenario

Person on the bicycle loses balance and falls with some speed

Possible injuries

Dislocation; fracture; bruising; concussion

Table 3. Severity of injury

Type of injury	Severity of injury			
	Slight	Moderate	Serious	Very serious
Laceration, Cut	Superficial	External (deep) (>10cm long on body) (>5cm long on face) Tendon or into joint White of eye Tongue (deep) Cornea Abdomen (deep but no organ damage)	Optic nerve Thyroid gland Bladder Nerve root cut Brain Larynx Neck artery Trachea Intestines Kidney Liver Spleen Lungs (superficial) Penis	Bronchial tube Oesophagus Aorta Spinal cord (low) Deep lung laceration Deep laceration of intestines, kidney, liver, spleen Severed throat, high spinal cord Completely severed aorta Brain (severe lesion/dysfunction)
Bruising (abrasion/ contusion)	Superficial ≤25 cm² on face ≤50 cm² on body	Major >25 cm² on face >50 cm² on body oesophagus larynx	Trachea Bladder, colon, kidney, liver, spinal cord (minor) Lung (minor) Heart Brain Lung, with blood or air in chest	Brain stem Spinal cord causing paralysis
Concussion		Under 1 hour	Over 1 hour	Coma
Sprain, strain, musculoskeletal disorder	Extremities Joints Spine (no dislocation or fracture)	Knee ligaments (sprain)	Ankle ligament rupture/ tear Achilles tendon rupture/ tear Knee ligament rupture/ tear Ripped muscle/ tear	-

Bike example

Table 3. Severity of injury

Type of injury	Severity of injury			
	Slight	Moderate	Serious	Very Serious
Bruising (abrasion/ contusion)	Superficial	Major		
Dislocation Fracture	Nose Finger Teeth Rib Toe	Skull Wrist Forearm Jaw and teeth Upper arm	Hip Thigh Jaw (severe) Multiple rib fractures Severe skull fracture	Neck Spinal column
Concussion		Under 1 hour	Over 1 hour	Coma

STEP 2: Determine the Probability of the injury to occur during the products lifetime

- Determine for each injury in each scenario the steps that are necessary for the injury to occur with the foreseen severity
- Estimate the probabilities of each of these steps.
- The overall probability is the multiplication of each of these sub-probabilities
- Is this probability realistic ?
- Choose the probability class out of the table

Table 4. Probability of injury (to occur within the products lifetime)

Description of the probability	**Indicative statistical value of the probability**
Almost certain, might well be expected	> 50 %
Quite possible	> 1/10
Unusual but possible	> 1/100
Only remotely possible	> 1/1.000
Conceivable, but highly unlikely	> 1/10.000
Practically impossible	> 1/100.000
Impossible unless aided	> 1/1.000.000
(Virtually) Impossible	< 1/1.000.000

Which factors influence the probability ?

- Product properties including the presentation and the presence of warnings
- Intended users and foreseeable users
  - Children, elderly, disabled, professional
- Intended use and foreseeable (mis)use
- Frequency and duration of use
- Hazard recognition and ensuing protective behaviour and equipment
- Consumer behaviour in case of an incident
- Consumer's cultural background

How to deal with information, (accident) statistics or the lack of such information to determine the probability ?

- Manufacturers with a quality system should be able to give a lot of usefull statistics.
- When accident statistics for specific products exist, they can directly be used to determine the probability.
- A search in newspapers or on the internet might help to find some useful information
- Even finding nothing might help to estimate the probability.

Bike example

Probability of the injury to occur - superficial bruising

- Conditions for superficial bruising (severity = slight)
  1. a leg of the fork breaks;
  2. the user looses balance and falls;
  3. the fall results in superficial bruising.
- Sub-probabilities
  1. 1/100;
  2. 1/20;
  3. 1/1.
- Overall probability = P1 x P2 x P3 = 1/2.000

Bike example

Probability of the injury to occur – hip fracture

- Conditions for hip fracture (or other injuries with the same severity) (severity = serious)
  1. a leg of the fork breaks;
  2. the user looses balance and falls;
  3. the fall results in serious injury.
- Sub-probabilities
  1. 1/100;
  2. 1/20;
  3. 1/50.
- Overall probability = P1 x P2 x P3 = 1/100.000

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STEP 3: Determine the risk by combining Severity and Probability for each scenario and severity.

Probability of damage during the foreseeable lifetime of the product		Severity of Hazard			
		Very Serious	Serious	Moderate	Slight
Almost certain, might well be expected	> 50 %	S		S	M
Quite possible	> 1/10	S		S	M
Unusual but possible	> 1/100	S		S	M
Only remotely possible	> 1/1.000	S		M	A
Conceivable, but highly unlikely	> 1/10.000	S	M	L	A
Practically impossible	> 1/100.000	M	L	A	A
Impossible unless aided	> 1/1.000.000	L	A	A	A
(Virtually) Impossible	< 1/1.000.000	A	A	A	A

The highest risk found, is the risk of the product.

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Tips and Techniques

- Work in groups – different inputs lead to more realistic results
- Let experts participate to the risk assessment
- Use all available (statistical) information
- Split the probability up into sub-probabilities – discussions often only focus on a sub-probability
- In case of doubt, make a sensitivity analysis – to see if the result you found is stable or if a more detailed examination is needed

Sensitivity analysis

Probability of damage during the foreseeable lifetime of the product		Severity of Hazard			
		Very Serious	Serious	Moderate	Slight
Almost certain, might well be expected	> 50 %	S	S	S	M
Quite possible	> 1/10	S	S	S	L
Unusual but possible	> 1/100	S	S	S	L
Only remotely possible	> 1/1.000	S	S	M	A
Conceivable, but highly unlikely	> 1/10.000	S	M	L	A
Practically impossible	> 1/100.000	M	L	A	A
Impossible unless aided	> 1/1.000.000	L	A	A	A
(Virtually) Impossible	< 1/1.000.000	A	A	A	A

Test results

- First tests show that the RAG
  - are rather easy to use
  - result in less difference between risk assessors than other methods
  - permit to focus on specific aspects in case of different risk assessment results
  - can result in realistic risk classifications

Conclusions

- The RAG give good results if you
  - work in group
  - use your imagination
  - but … stay realistic

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Thanks for your attention !