

Benefits of sprinklers for a stay-in-place strategy



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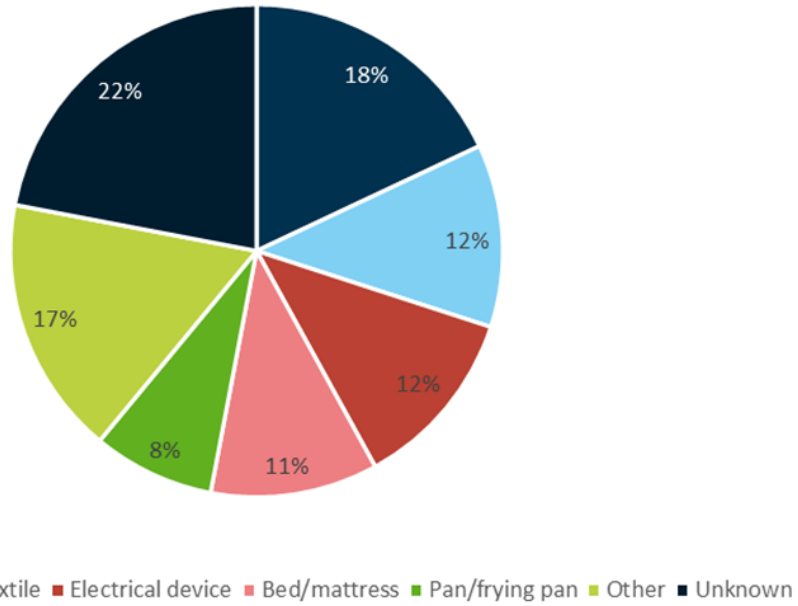
NL Academy for Crisis
Management and Fire
Service

Introduction and content

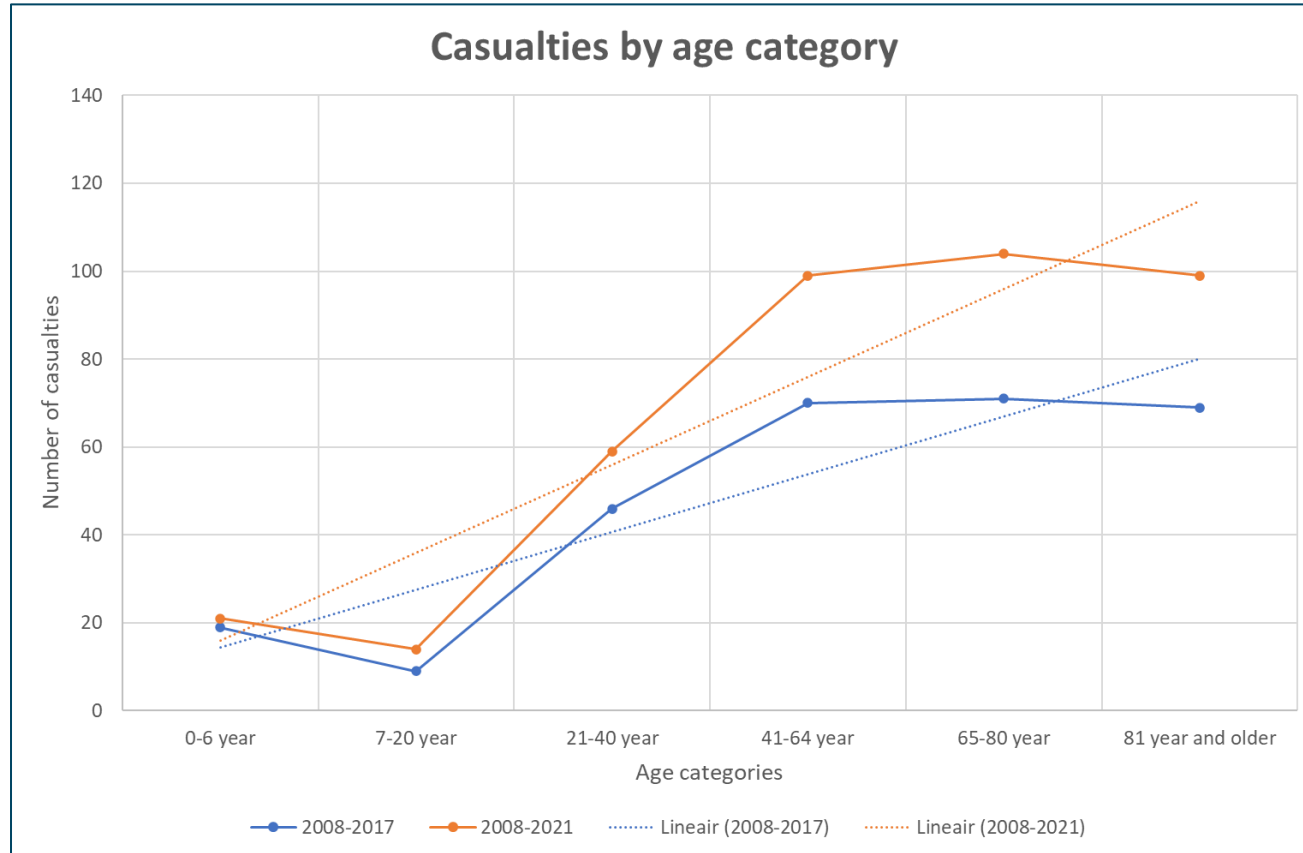
1. Context
2. Stay-in-place strategy
3. Research stay-in-place
4. Human behaviour
5. Benefits of sprinklers
6. Conclusions



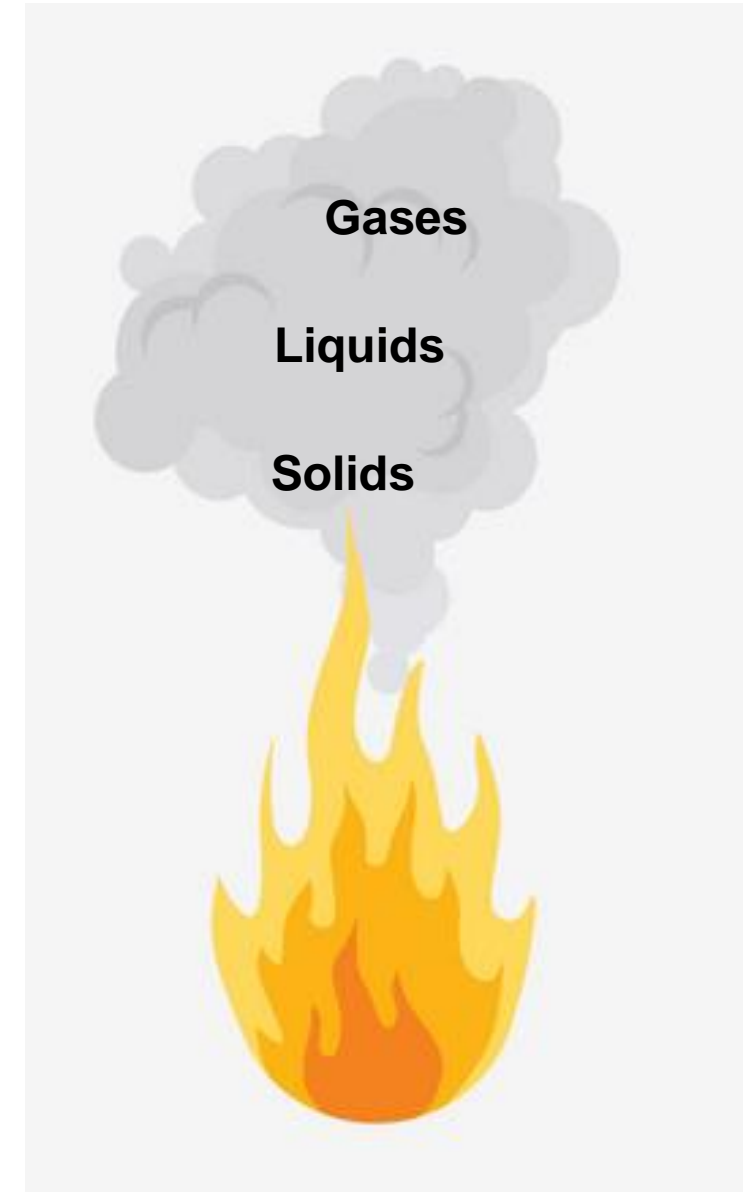
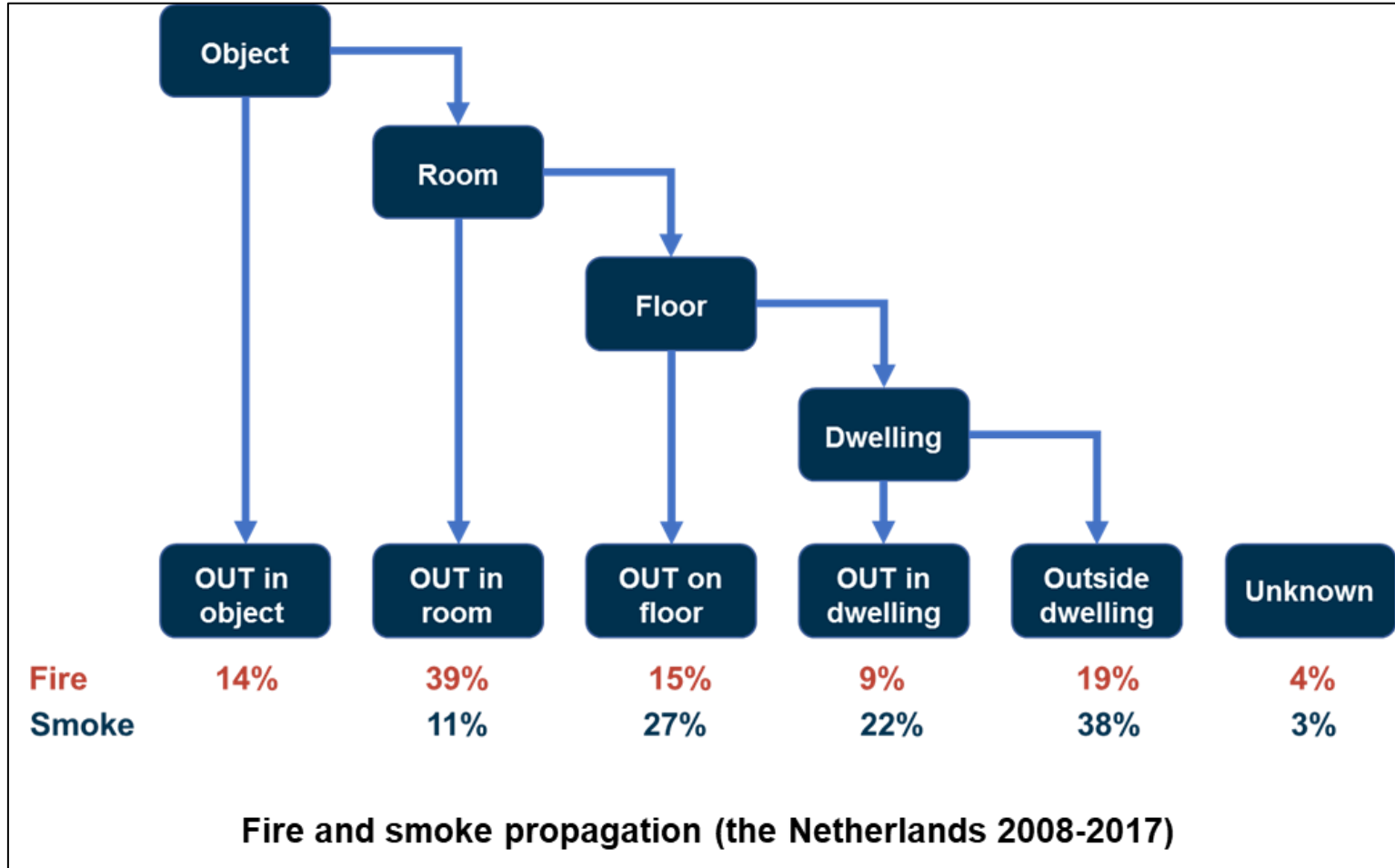
1. Context – fatal residential fires



Object of origin of the fire (the Netherlands, 2008-2017)



1. Context – fatal residential fires



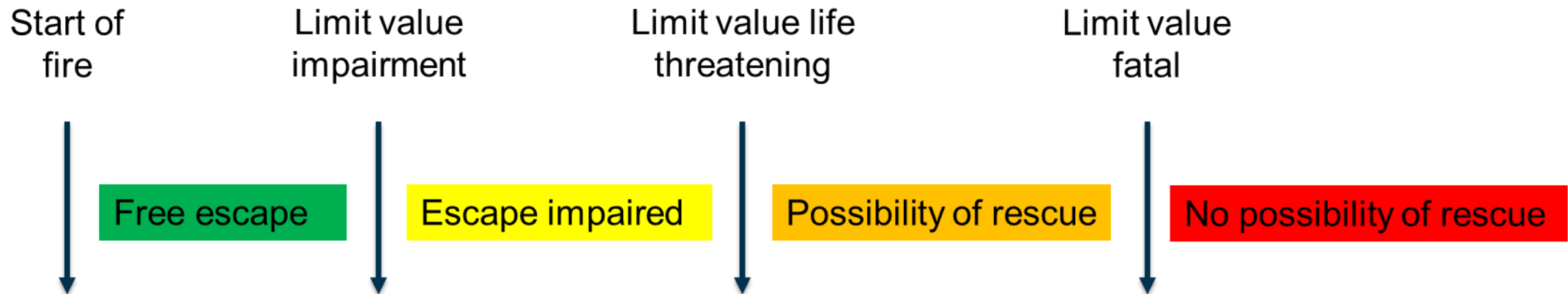
Corridor 1.5 m



1. Limit values

- ▶ Fire conditions (gasses, heat and visibility)
- ▶ Method by concentration (FIC) or doses (FED)
- ▶ Different factors for population groups
 - ▶ Median (50%)
 - ▶ Vulnerable (11%)
 - ▶ Very vulnerable (1%)

Fire condition	Method	Target group		
		Median	Vulnerable	Very vulnerable
Asphyxiant gases	FED _{IN}	0.3	0.1	0.03
Heat	FED _{heat}	0.3	0.1	0.03
Visibility	FEC _{smoke}	1	0.33	0.1



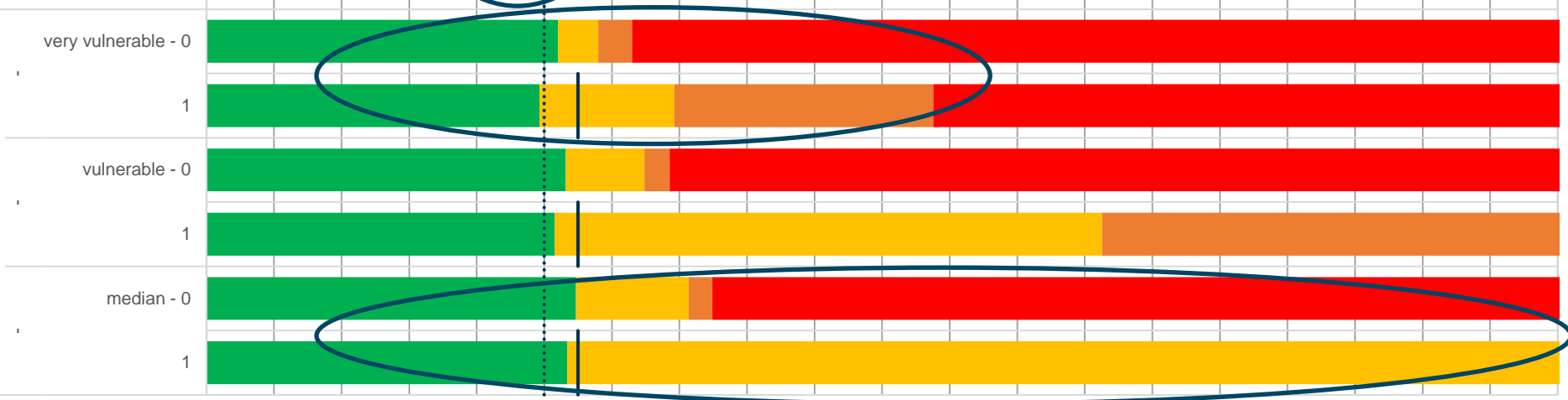
Overview 0 and 1

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

FR




G1.2 (1,5 m)

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

Time [min.]

Free escape Impairment Life threatening Fatal Door opened Door closed

	Free escape
	Impaired situation
	Life threatening situation
	Fatal situation

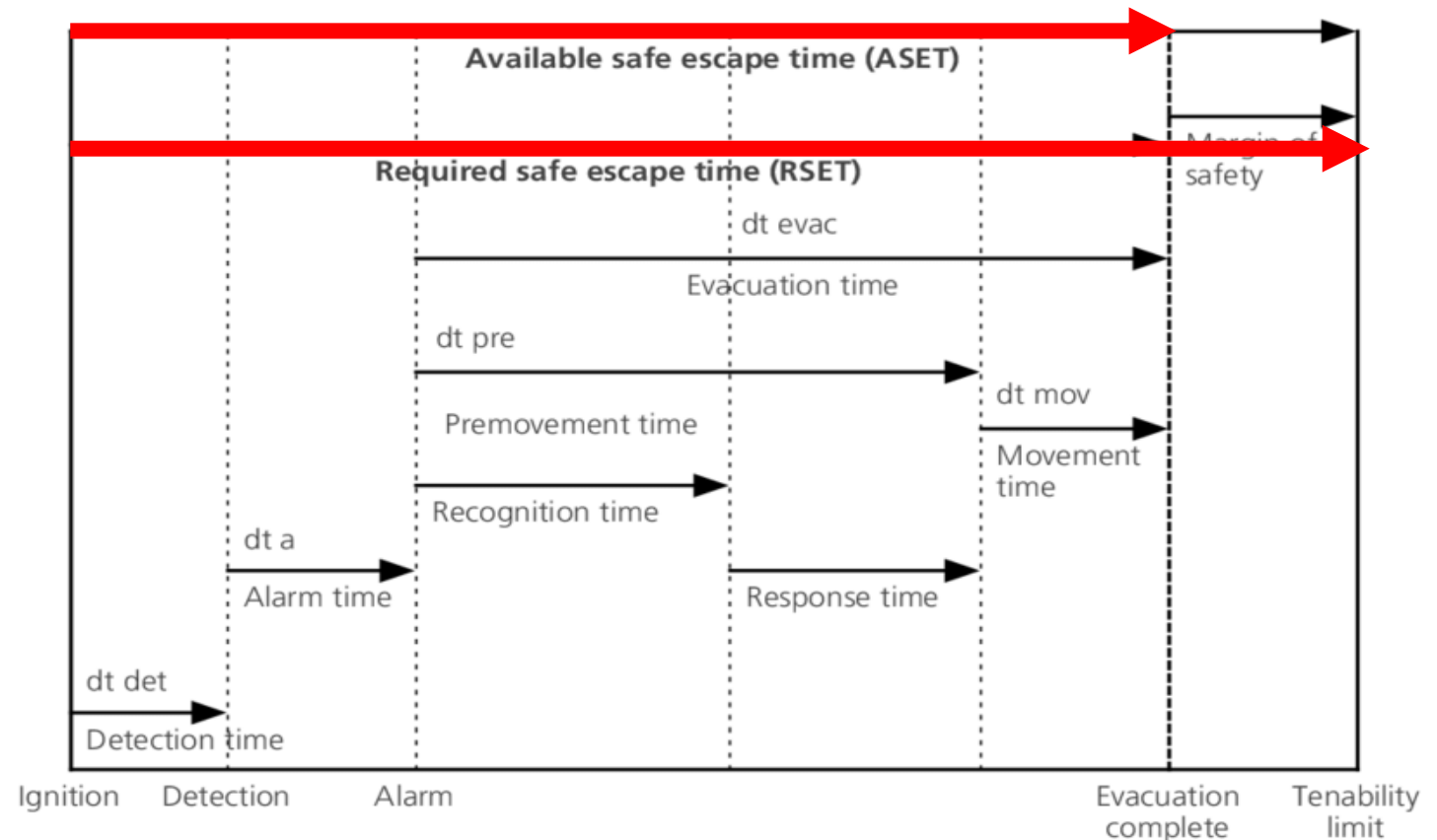
1.21 brandruimte



gang 1.2

2. Stay-in-place strategy

- ▶ Escape concept = starting point
- ▶ Other strategies/concepts:
 - ▶ Stay put
 - ▶ Defend/shelter in place
 - ▶ Stay-in-place



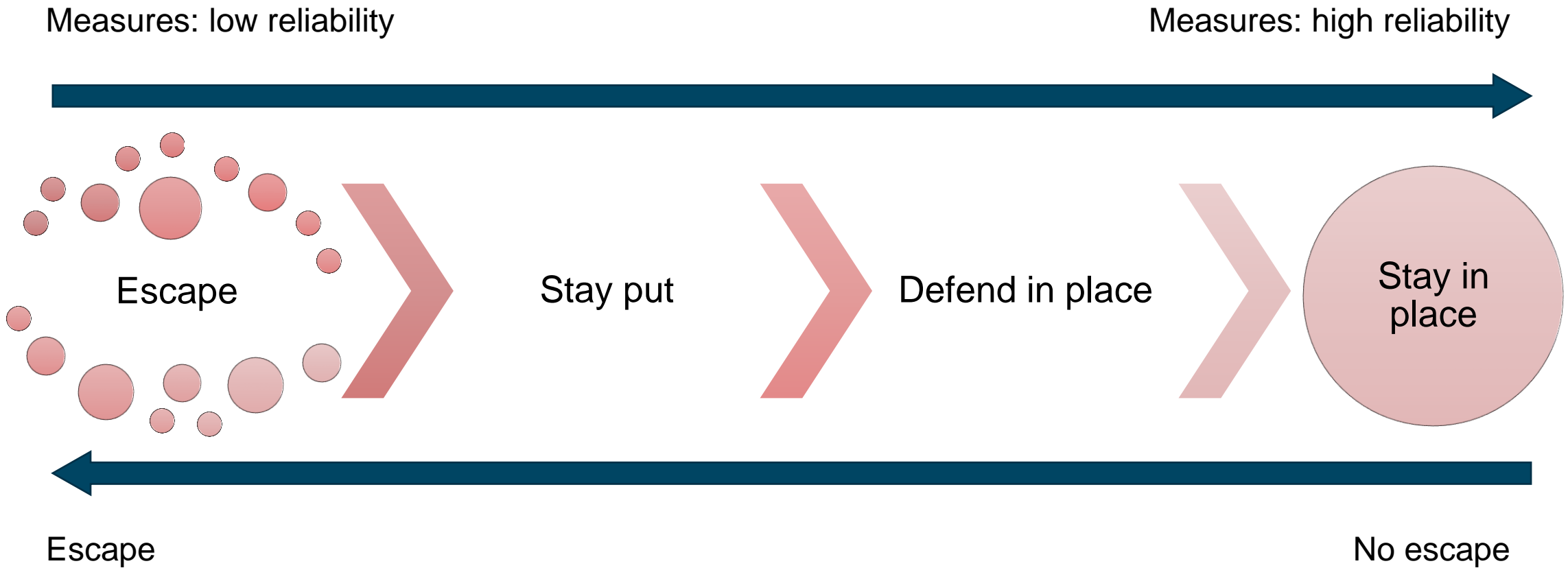
2. Stay-in-place strategy

- ▶ No clear definition
- ▶ Lack of determination method, limit values and criteria
- ▶ Behavior and action perspective
- ▶ Vulnerable groups
- ▶ Strategy, concept and reality
- ▶ Role fire service?

- ▶ Other developments

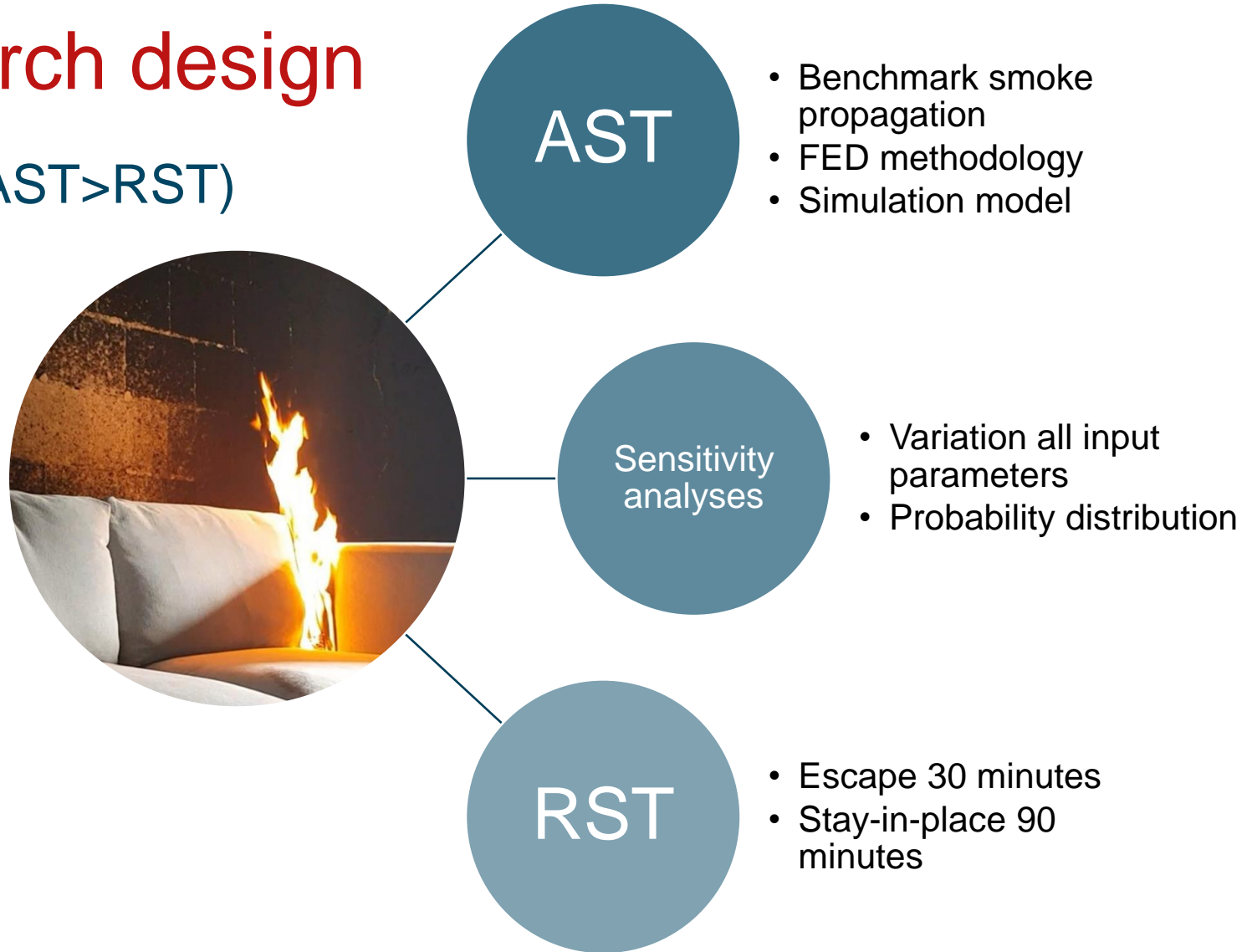


2. Stay-in-place strategy



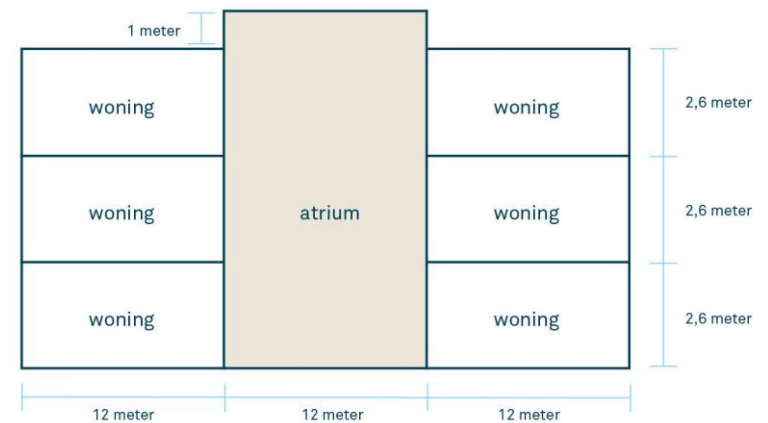
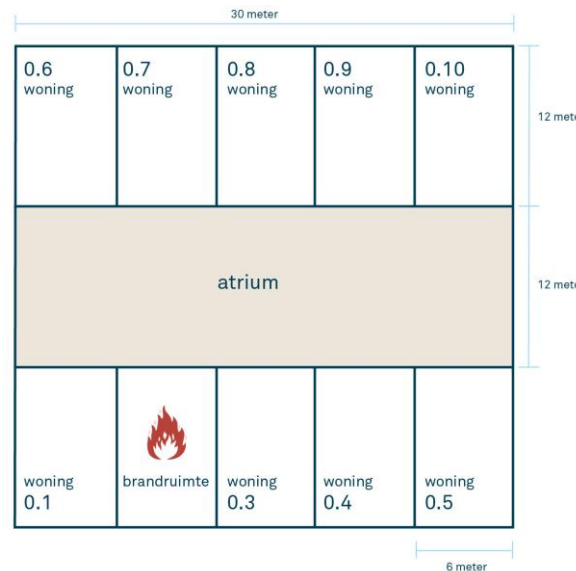
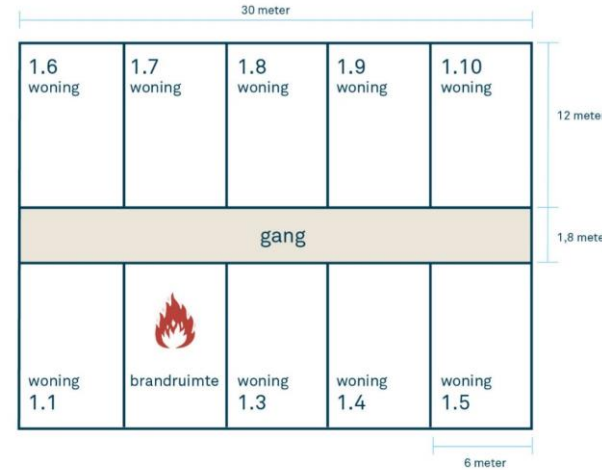
3. Research design

► Probability (AST>RST)



3. Boundary conditions

- ▶ Two concepts:
 - ▶ Escape
 - ▶ Stay-in-place
- ▶ Three building types
- ▶ Fire scenario and location
- ▶ Simulations



3. Assumptions and criteria

- ▶ Dimensions
- ▶ Leakage area
- ▶ Door fire compartment
- ▶ Heat release rate
- ▶ Fire parameters
- ▶ Fuel and yields
- ▶ RST

Fire condition	Method	Target group		
		Median	Vulnerable	Very vulnerable
Asphyxiant gases	FED _{IN}	0.3	0.1	0.03
Heat	FED _{heat}	0.3	0.1	0.03
Visibility	FEC _{smoke}	1	0.33	0.1

3. Results personal safety

- ▶ Probability AST>RST
- ▶ All variations
- ▶ Individual risk – with prescriptive measures
- ▶ Reliability

Escape concept			
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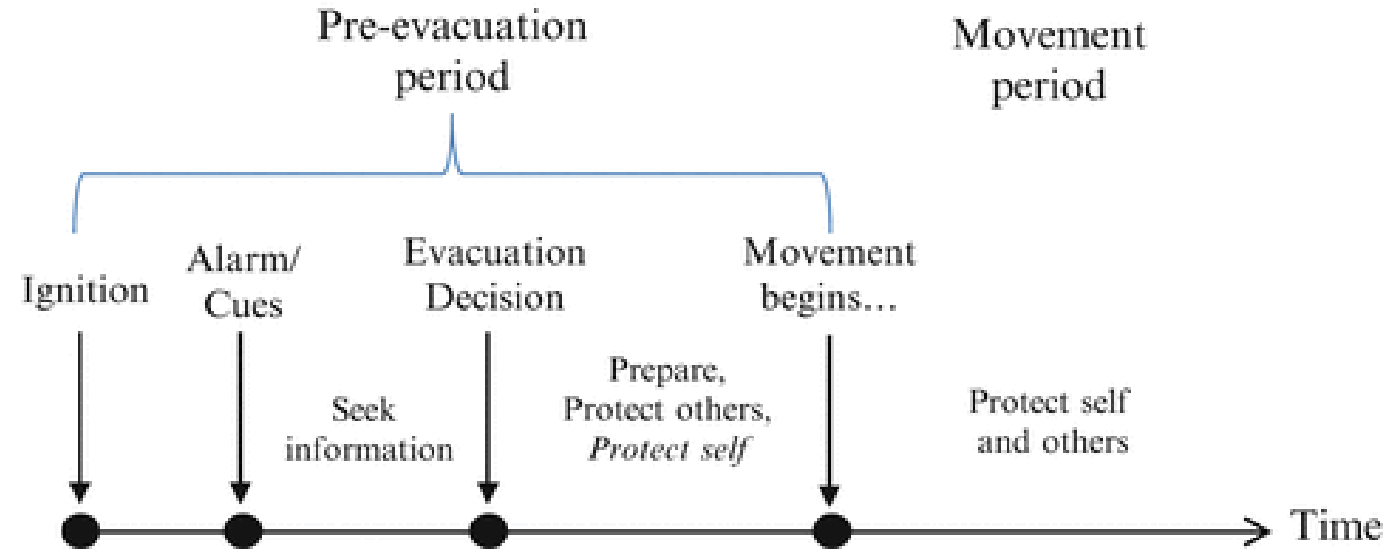
Building type	P (AST>RST)		
	General	Vulnerable	Very vulnerable
Corridor	0.71	0.16	0
Corridor with void	0.77	0.44	0
Atrium	0.93	0.92	0.66

Stay in place concept			
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Building type	P (AST>RST)		
	General	Vulnerable	Very vulnerable
Corridor	0.23 – 0.54	0 – 0.12	0
Corridor with void	0.23 – 0.54	0 – 0.12	0
Atrium	0.19 – 0.46	0 – 0.06	0

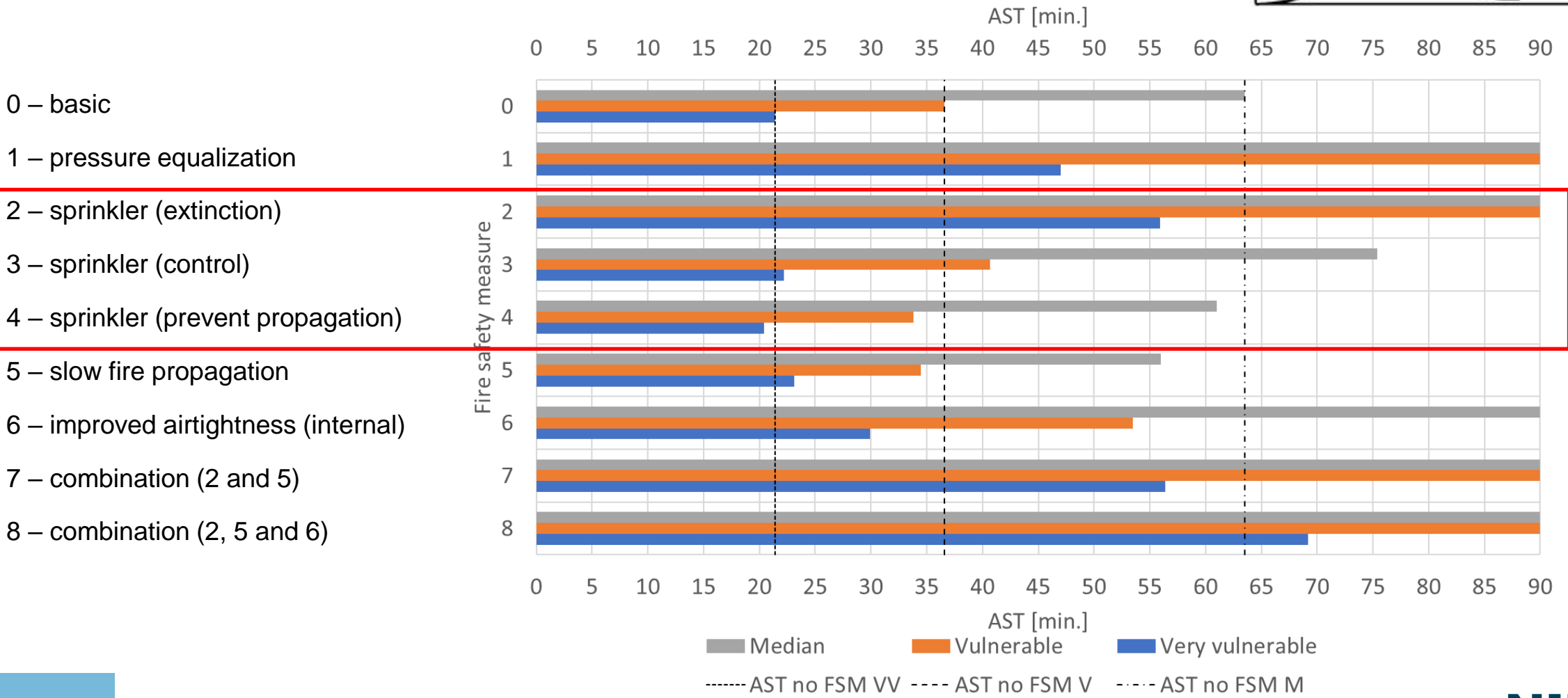
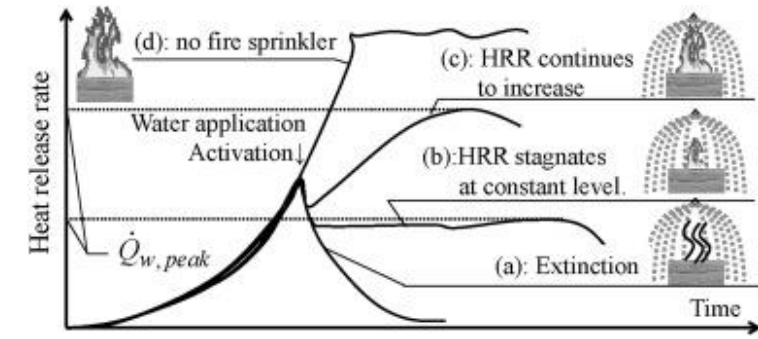
4. Human behaviour

- ▶ Escape concept:
 - ▶ Signal/interpretation
 - ▶ Walking speed and mobility
 - ▶ Group formation and familiarity
- ▶ Stay-in-place concept:
 - ▶ Experienced as unsafe
 - ▶ General resistance, unnatural
- ▶ Consequences:
 - ▶ Expected behaviour
 - ▶ Influence on measures
 - ▶ Importance of different measures in the concept



Kuligowski, E.D. (2016). Human Behavior in Fire. In: , et al. SFPE Handbook of Fire Protection Engineering

5. Benefits sprinklers stay-in-place



5. Benefits sprinklers stay-in-place

- ▶ Relative reliability
- ▶ Goal of sprinkler
- ▶ Different groups
- ▶ Discussion:
 - ▶ Method
 - ▶ Criteria
 - ▶ Fire safety level

Concept and measure	P(AST>RST)		
	Median	Vulnerable	Very Vulnerable
EC - basic	0.71	0.16	0
SIP - basis	0.23	0	0
SIP – sprinkler (control)	0.31	0.02	0
SIP – sprinkler (extinction)	1	0.98	0.03
SIP – sprinkler (control) + improved airtightness	0.71	0.11	0

Tolman, F. (2023). Brandveiligheidsmaatregelen als voorwaarde voor het stay-in-place concept. NIPV en Hogeschool Saxion, Enschede

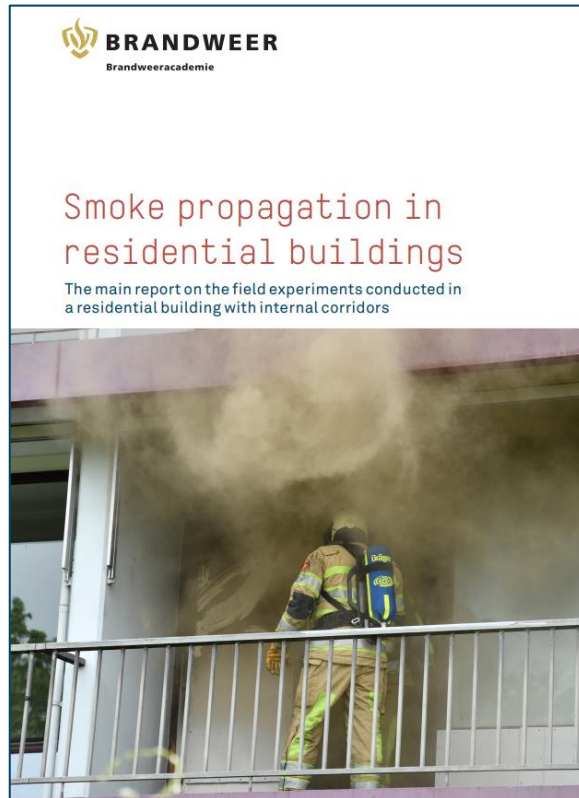
6. Conclusions stay-in-place

- ▶ Lack of framework – research first start
- ▶ Individual and group safety
- ▶ Human behaviour important factor
- ▶ Sprinklers = essential as boundary condition for:
 - ▶ Vulnerability (any concept)
 - ▶ Stay-in-place concept
 - ▶ Lowering influence of human behaviour
 - ▶ Flexibility in safety concept (future developments)
- ▶ Overall: discussion about acceptance of source!



Thanks for your attention

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► <https://nipv.nl/publications-in-english/>