National Research Centre
for the Working Environment

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Recent safety studies on safety interventions and systematic OHS efforts

- are such efforts helpful in reducing accidents at work?

SÄKU

16. November 2023

Online, 10.00 a.m. to noon

National Research Centre for the Working Environment Copenhagen, Denmark (NFA)

- The psychosocial working environment
- Musculoskeletal disorders and physical work load
- **Safety culture and Accidents**
- Chemical working environment, toxicology, nano safety and microbiology
- Interdisciplinary: Senior workers and young workers, and economic evaluations of interventions, R2P

About 164 employed at NFA

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SYSTEMATIC REVIEW / PUBLICATIONS

CAMPBELL SYSTEMATIC REVIEWS
BETTER EVIDENCE FOR A BETTER WORLD
Campbell Collaboration

Article DOI : 10.1002/cl2.1234

SYSTEMATIC REVIEW

Safety interventions for the prevention of accidents at work: A systematic review

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THE GLOBAL GOALS
For Sustainable Development

This research contribute to the fulfillment of the UN global goals

3 GOOD HEALTH AND WELL-BEING

8 DECENT WORK AND ECONOMIC GROWTH

SYSTEMATIC REVIEW – Preventing accidents at work – what works?

OBJECTIVES:

- Evaluate effects of various types of safety interventions
- Identify effective components

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SYSTEMATIC REVIEW – STUDY SELECTION

Litterature search: PubMed (1966), Embase (1980), CINAHL (1981) , OSH ROM (NIOSHTIC 1977, HSELINE 1977, CIS-DOC 1974), PsycINFO (1806), EconLit (1969), Web of Science (1969) and ProQuest (1861), grey litterature.

Identified references (assessed by two independent researchers)

- 60.466 references (total hits)
- 42.927 references (after removing duplets)
- 485 (after relevance screening)
- 194 studier (after quality assessment)
- 100 studier (Incl. RCT, CBA or ITS study designs)
- 120 safety interventions

Number of studies or safety interventions included, for each study design.

Study design	Studies included	Safety interventions
RCT	16	20
CBA	30	43
ITS	54	57
Total	**100**	**120**

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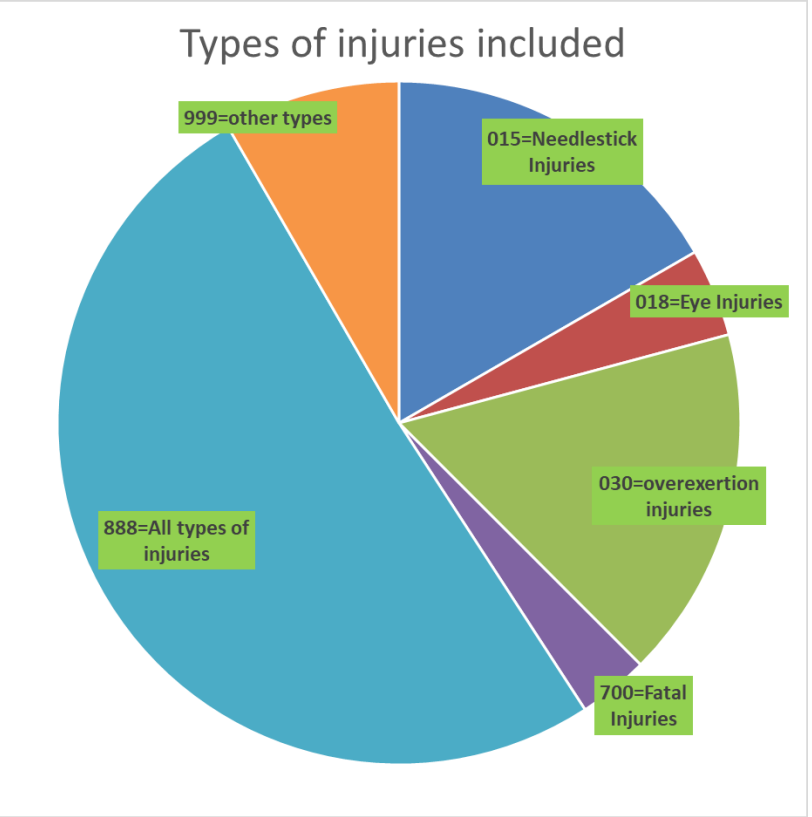
Proportion of studies by business activity and types of injuries

The proportion of safety interventions by business activity and study design				
Business activity	**RCT**	**CBA**	**ITS**	**All**
A - Agriculture, forestry and fishing	25%	9%	9%	12%
B - Mining and quarrying	5%	0%	2%	2%
C - Manufacturing	25%	19%	16%	18%
F - Construction	5%	5%	12%	8%
G - Wholesale and retail trade	5%	5%	2%	3%
H - Transporting and storage	5%	14%	7%	9%
N - Administrative and support service activities	0%	2%	0%	1%
O - Public administration and defence	0%	16%	5%	8%
Q - Human health and social work activities	30%	14%	40%	29%
All or mixed industries	0%	16%	7%	9%
Number of safety interventions	**100%**	**100%**	**100%**	**100%**



Number of studies spread across six continents

All	58
RCT	6
CBA	17
ITS	35

All	27
RCT	5
CBA	8
ITS	14

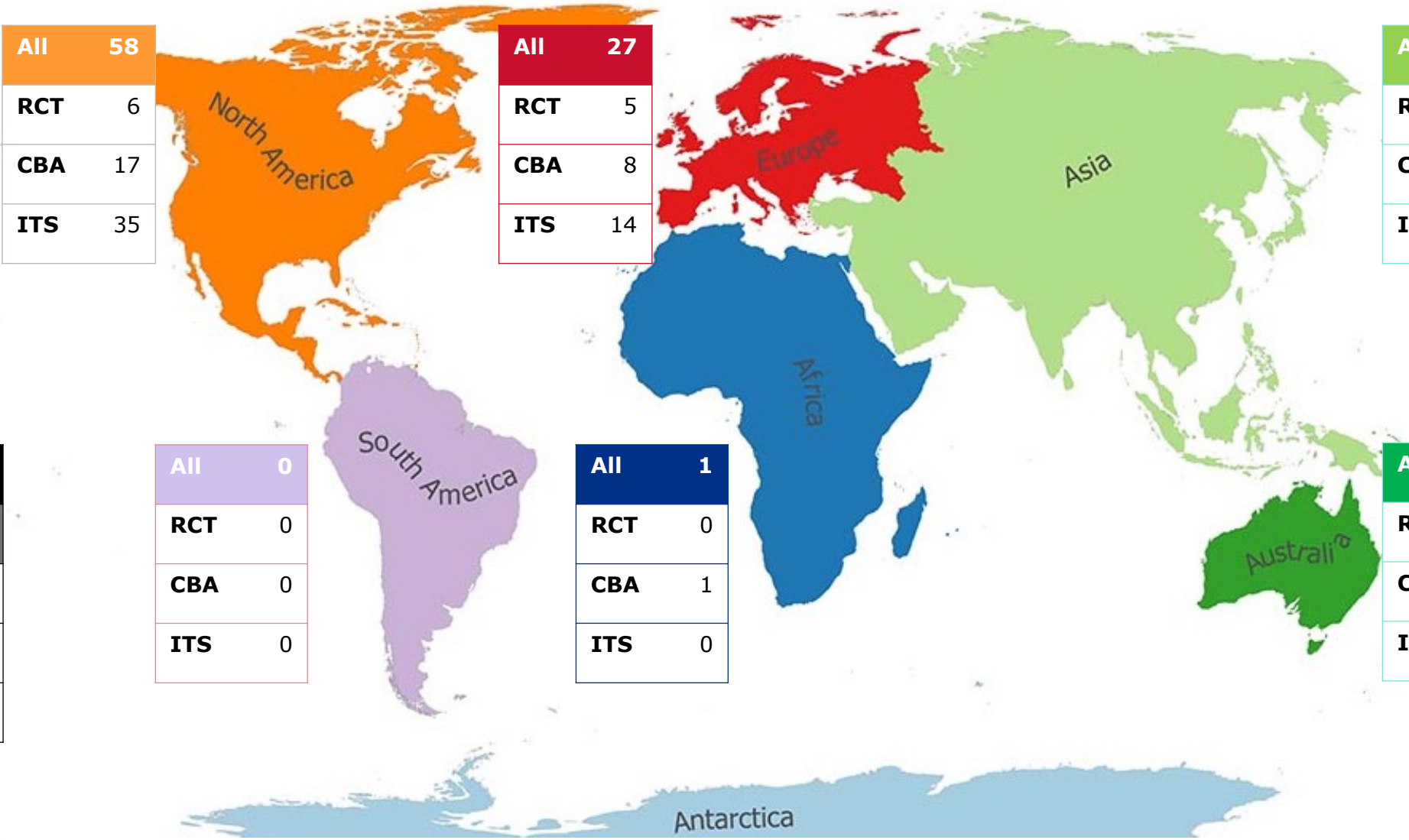
All	7
RCT	4
CBA	2
ITS	4

World	
Alle	100
RCT	16
CBA	30
ITS	55

All	0
RCT	0
CBA	0
ITS	0

All	1
RCT	0
CBA	1
ITS	0

All	7
RCT	1
CBA	2
ITS	4



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Dyreborg, J., Lipscomb, H. J., Nielsen, K., Törner, M., Rasmussen, K., Frydendall, K. B., Bay, H., Gensby, U., Bengtsen, E., Guldenmund, F., & Kines, P. (2022). Safety interventions for the prevention of accidents at work: A systematic review. Campbell Systematic Reviews, e1234. https://doi.org/10.1002/cl2.1234

What is a safety intervention?

We have used this definition:

Any attempt deliberately applied to promote safety and decrease the frequency or severity of accidents at work (Robson et al., 2001).

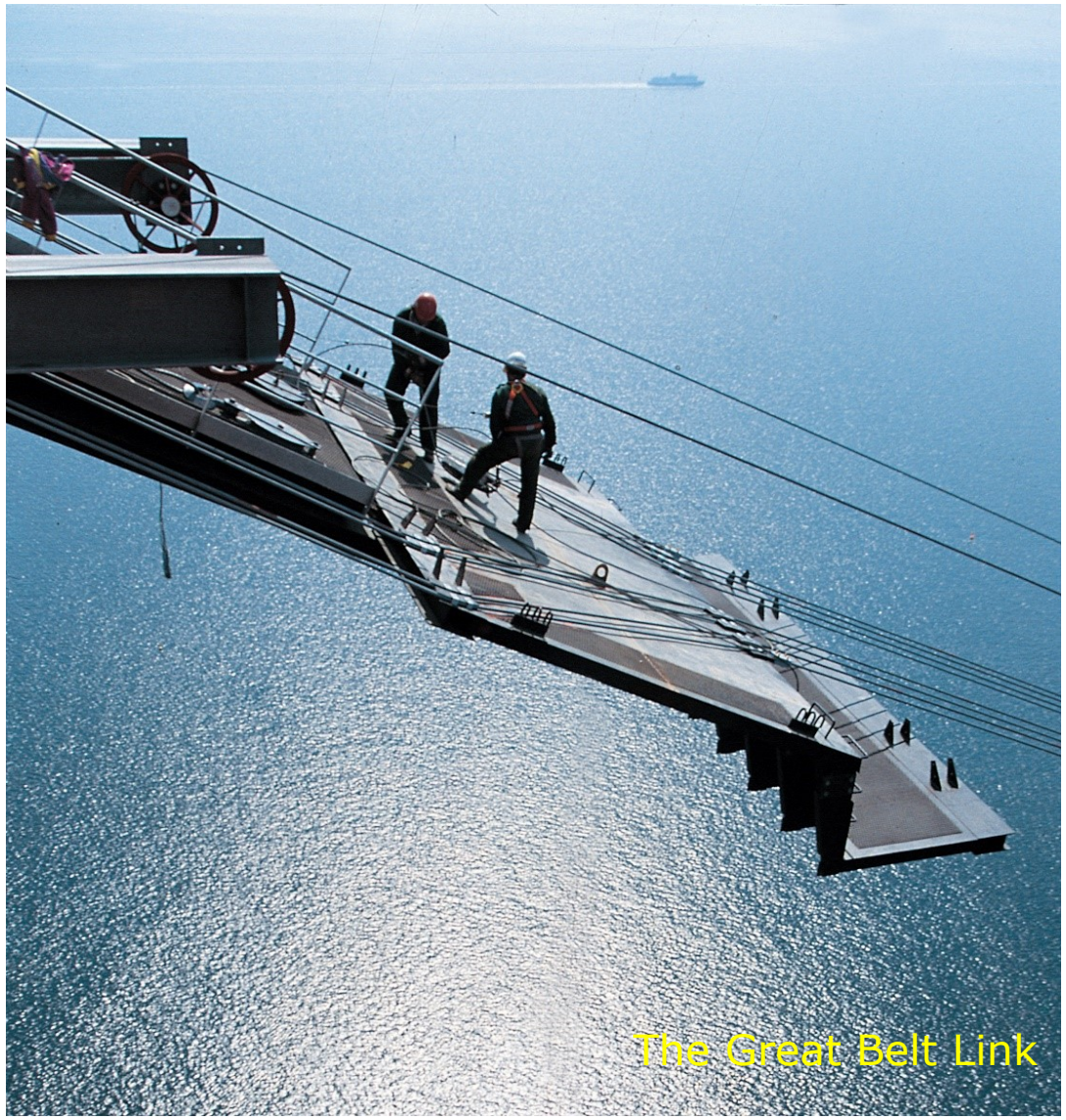
This includes also the initiatives that you implement in your industries or organisations.

WHAT TYPES OF SAFETY MEASURES DO WE HAVE IN THE TOOLBOX?

Attitude modification:

This may be achieved by means of information and persuasive messages in campaigns, leaflets, booklets, films, posters, direct mail, guidelines, by teaching or various counseling approaches. (Lund & Aarø, 2004).

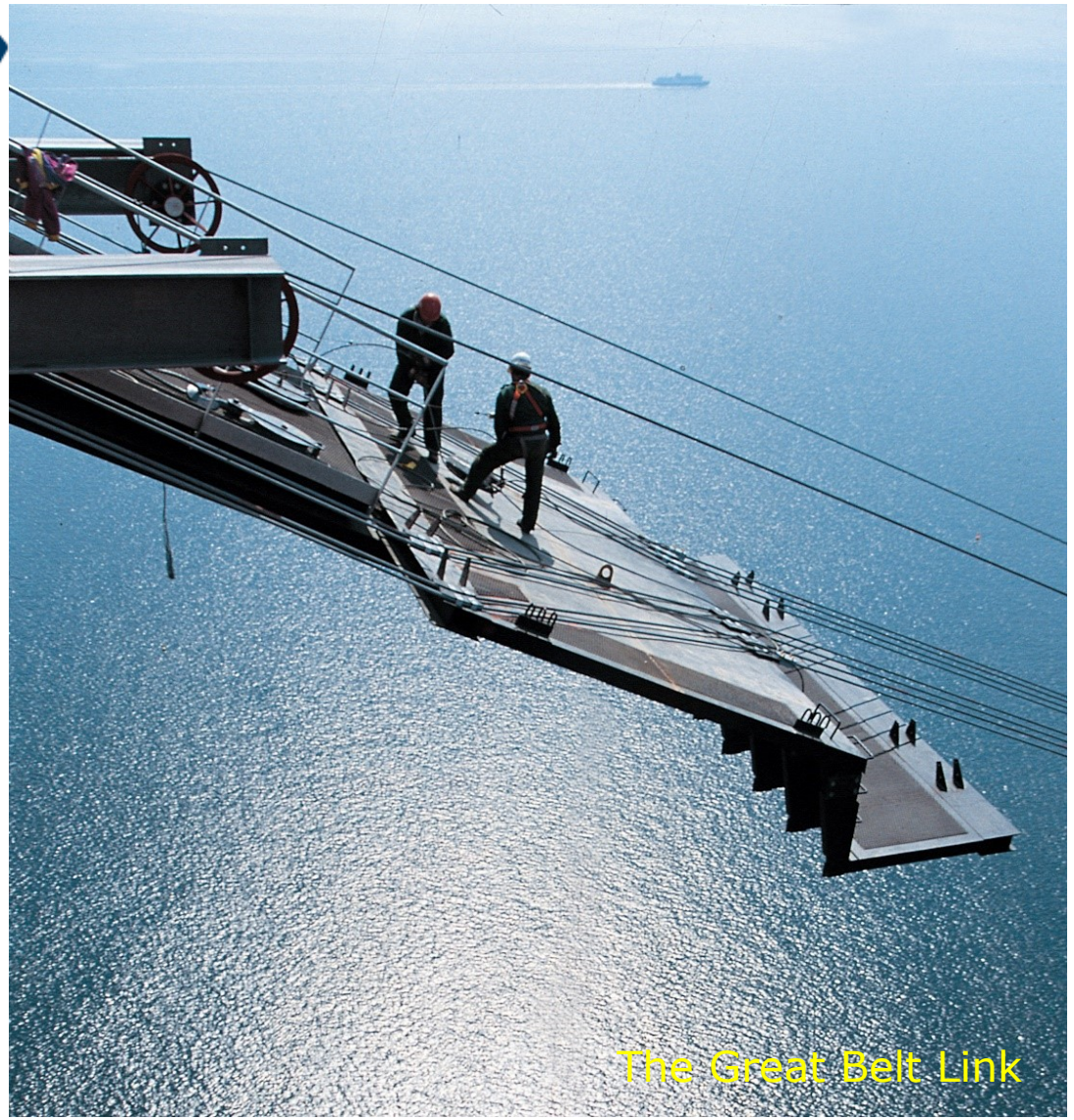
Attitude modification mainly explains behaviour in terms of internal mental states and cognitive processes (e.g., knowledge-attitudes-behaviour).



Behavior based approach

The so-called '*Stick & Carrot*'-method'. Is about changing behavior through influence from the environment, e.g. using incentives for safe behavior ('carrot') or punishment ('stick') for unwanted behavior (Luthans & Kreitner, 1985).

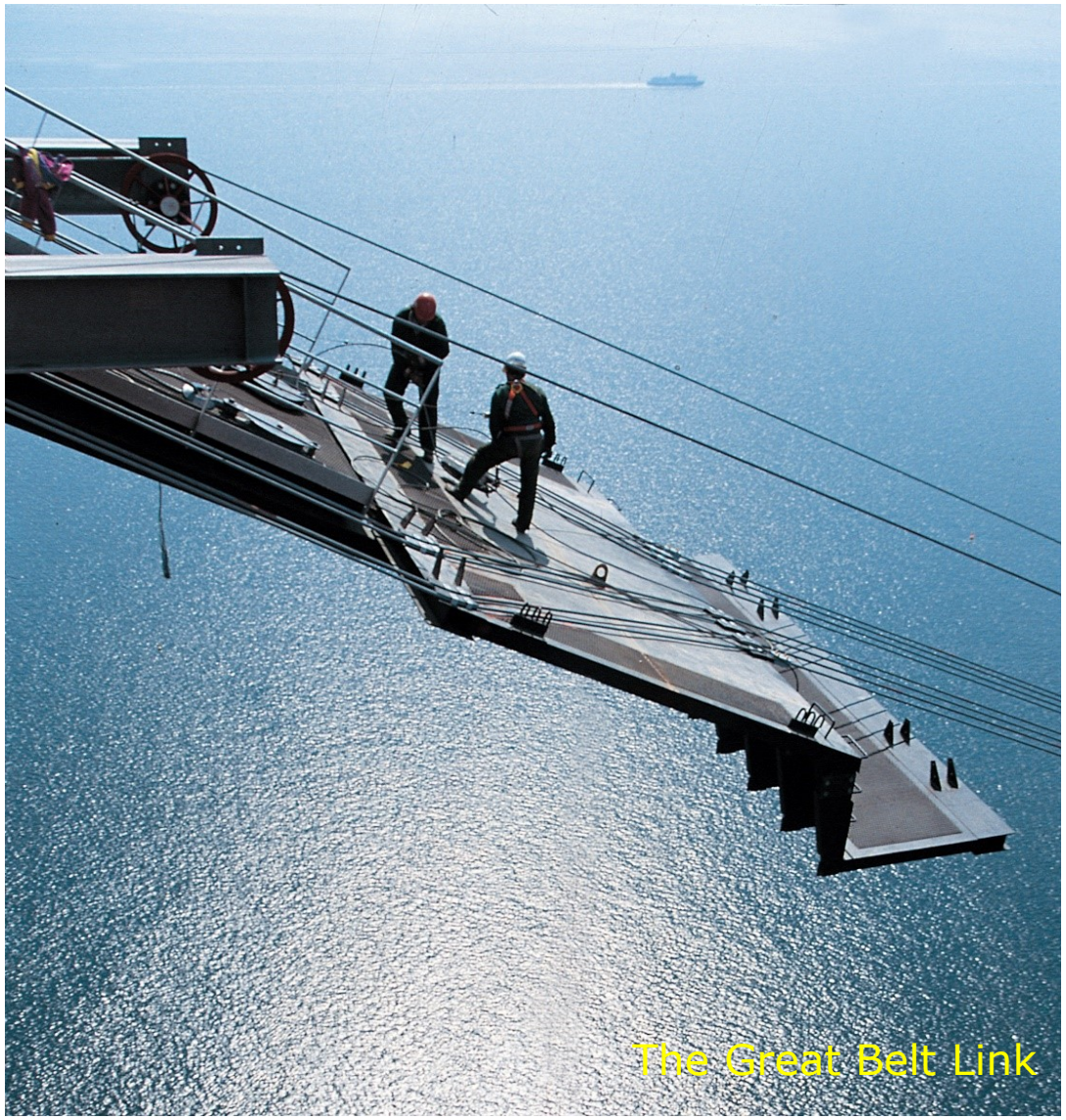
This approach originates from B. F. Skinner (1969), who proposed that a desired behavior (e.g. a safe work practice) is conditioned by certain incentives or consequences of action. This conditionality is formulated as the Antecedent-Behavior-Consequence (A-B-C) model.



Fysiologiske tiltag

The physiological approaches are usually directed at individual workers, and are intended to increase workers' mobility and agility through various training methods.

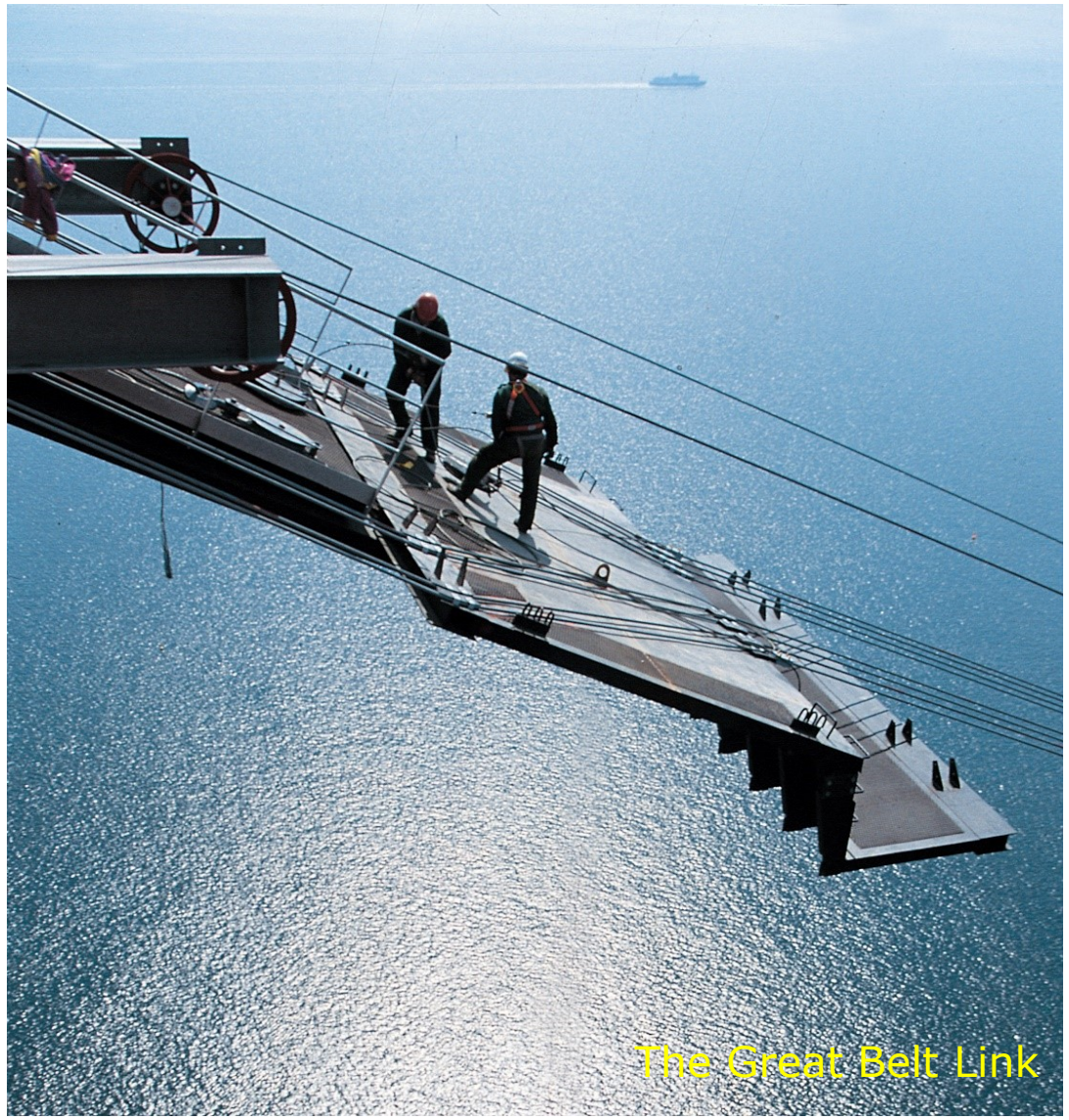
The underlying assumption of these training methods is that a stronger or more flexible body can better withstand loads and thus avoid a potential accidental injury.



Safety climate

This approach is aimed at changing the shared perceptions among managers and employees in an organization, or in a group, to influence the relative priority of safety adopted in the organization or in the group (Zohar, 2010).

We are talking about a good safety climate in the construction industry, when managers and employees give high priority to the adopted safety standards, even when things are busy!

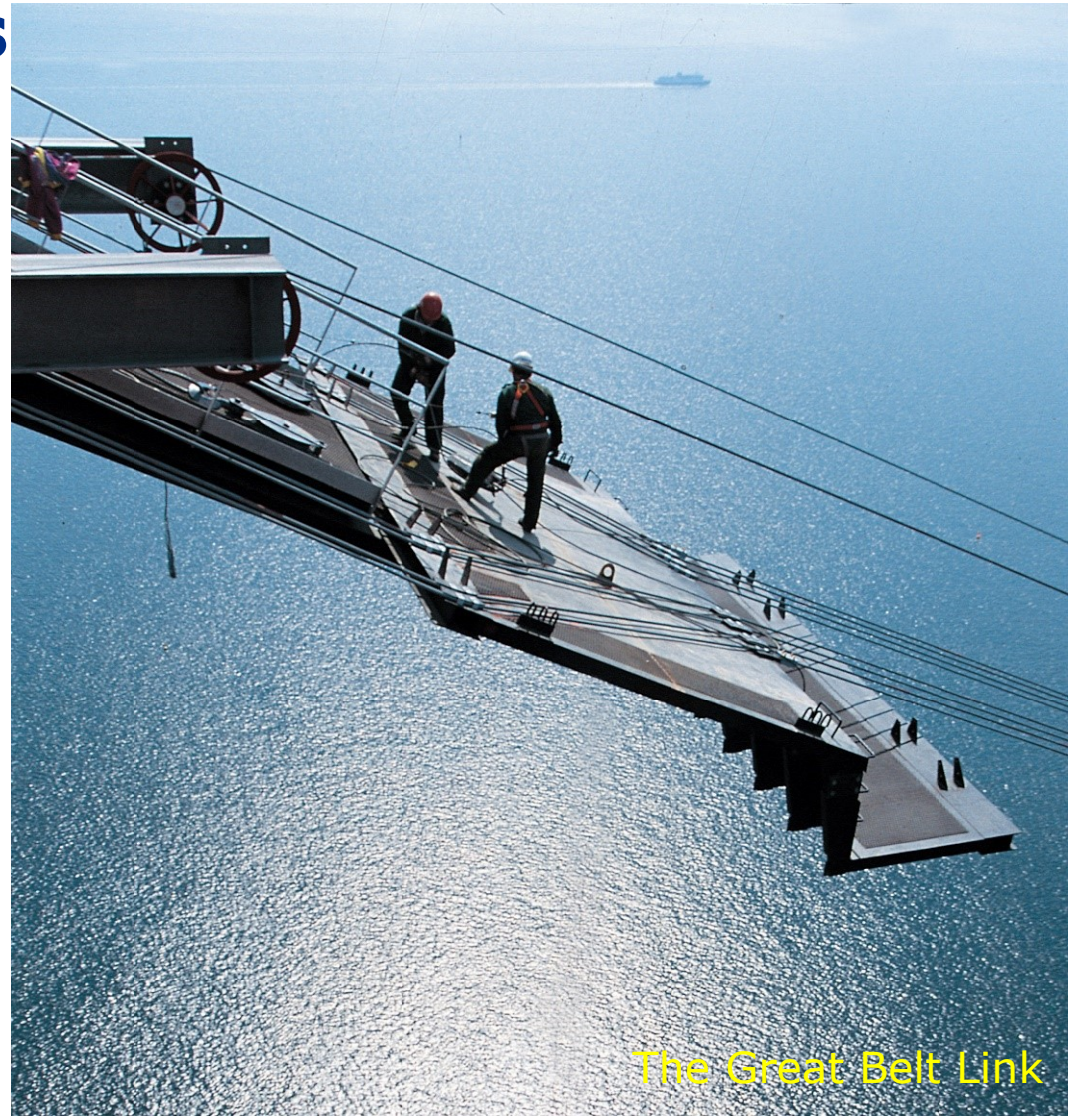


Organizational level approaches

Organizational level efforts, such as improved design, work organization, policies, procedures, and strengthening of the systematic work environment efforts, etc.

Technical measures, such as machine shielding, fall protection, elimination of hazardous substances or materials.

Multifaceted measures integrate two or more types of measures in the prevention of occupational accidents.


The Great Belt Link

MENTI METER QUESTION

I: What is the most *effective* approach to accident prevention?

a) Attitude modification

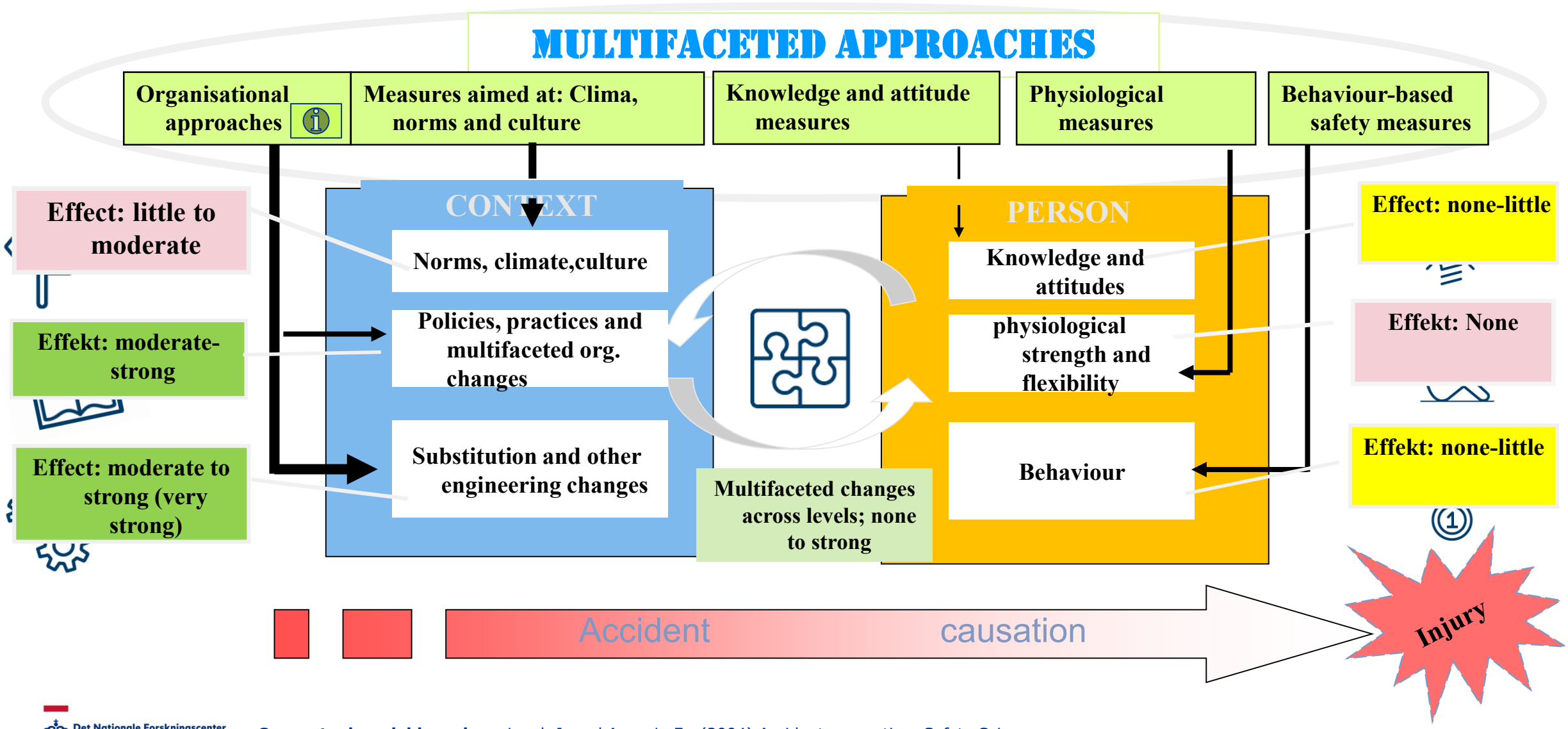
b) behavior modification

c) safety climate and safety culture

d) Engineering control

e) multifaceted safety interventions

What works in accident prevention? OVERVIEW



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Conceptual model based on: Lund, J. and Aarø, L. E., (2004) Accident prevention, Safety Science

Johnny Dyreborg, Kent Nielsen, Pete Kines, Angelika Dziekanska, Karen Bo Frydendall, Elizabeth Bengtsen og Kurt Rasmussen. Review af ulykkesforebyggelse - - review af den eksisterende videnskabelige litteratur om effekten af forskellige typer sikkerhedstiltag til forebyggelse af arbejdsulykker.

Summary individual level approaches

- *Overall, we only found a weak link between individual level approaches and reducing accidents at work. It seems that knowledge, attitudes or incentives, are overruled by the social or organisational practices at the workplace.*

- *We found limited evidence for a little to moderate effect of leader-based safety climate improvement and no effect of goal setting and feedback at group or organizational level.*

Summary organisational level approaches

- *This review shows that safety interventions combining group or organizational level components provide moderate evidence of a strong effect at medium-term follow-up, and limited evidence of moderate effect at long-term follow-up*

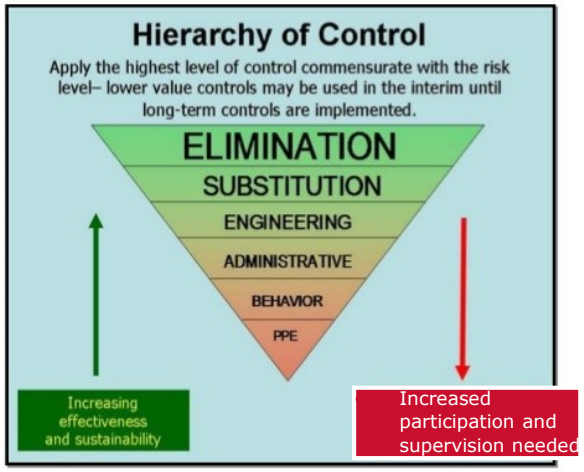
- *This review found that engineering controls overall provide moderate to strong effects on reducing accidents at work. Strong effects were in particular seen in cases where the safety intervention works independently of human decision making or work practices, or where the risks were "designed out."*

Prevention of accidents
Important principles in workplace prevention efforts

SIPAW results support the hierarchy of hazard controls

And the S.T.O.P. principle.

HIERARCHY OF CONTROLS



Substitution

1. Eliminate hazards
2. Replace dangerous with less dangerous

Technical/ Engineering

3. Combating risks where they arise
4. Engineering solutions

Organisational level

5. Adm. policies, and practices are changed, changes in the organisation of work,
6. Adaptation of the work to the person: layout, methods, machines and tools

Personal level

7. Individual measures and protection (including protective equipment)
8. Instructing workers, changing the individual's attitude and knowledge

9. multi-pronged initiative, contains several steps on the latter

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Hierarhy of hazard control OR the prevention latter

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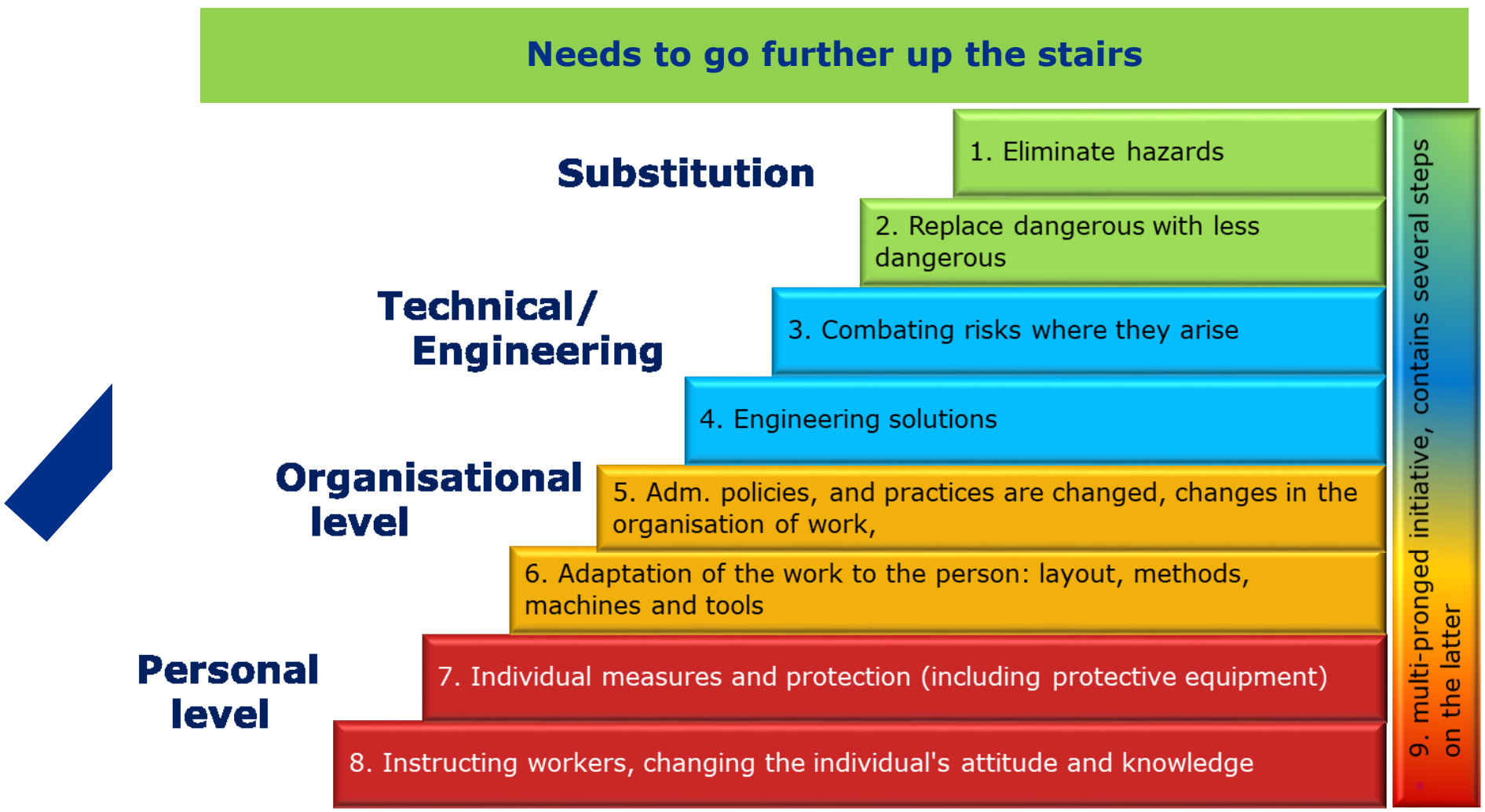
37 prevention programs in Building industry – effective?



Implementet programs (37)	
4	10 %
8	22 %
25	68 %

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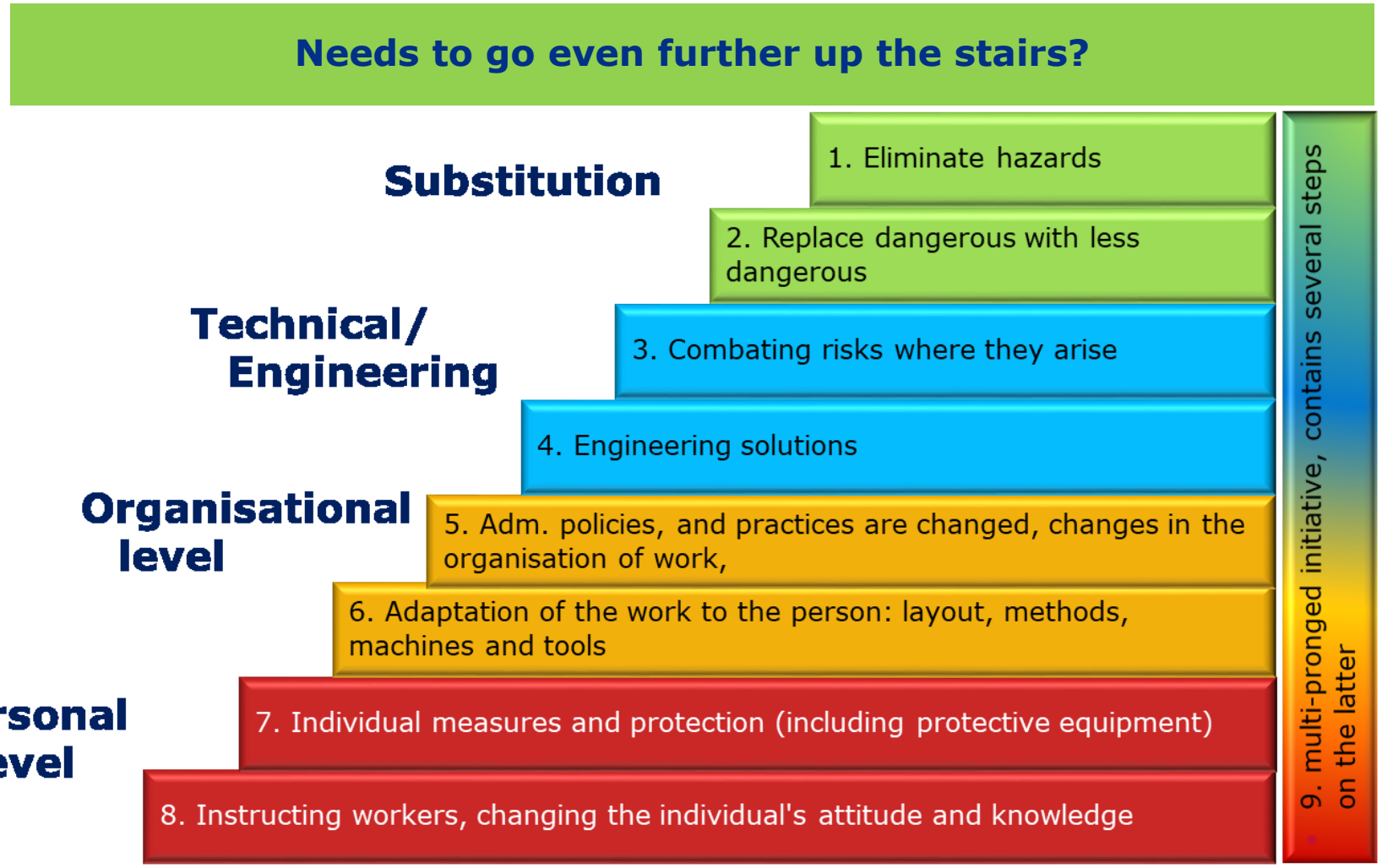
Flemming Pedersen, Hans Jørgen Limborg, Rikke Voss Andersen og Marchen Winding Pedersen, Evaluering af samtlige 50 indsatser – programteorier og de enkelte indsatser, Team Arbejdsliv og Cowi, December 2016

Safety coordinators in Building industry - effective approaches?



Implementerede tiltag (280)	
2	(0,7 %)
8	(2,9 %)
98	(35 %)
151	(53 %)
21	(7,5 %)

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Ajslev, J.Z.N. ; Møller, J.L.; Andersen, M.F.; Pirzadeh, P.; Lingard, H. The Hierarchy of Controls as an Approach to Visualize the Impact of Occupational Safety and Health Coordinators at Work Int. J. Environ. Res. Public Health 2022, 19, 2731.

SIPAW

END OF PART 1!

- Thanks to co-authors:
- Hester Johnstone Lipscomb,Kent Nielsen,Marianne Törner,Kurt Rasmussen,Karen Bo Frydendall,Hans Bay,Ulrik Gensby,Elizabeth Bengtsen,Frank Guldenmund,Pete Kines

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Target the organization before the individual, when preventing accidents at work

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SOME MORE RESSOURCES:

Part II: Systematic OHS efforts and certification

- Systematic OHS efforts – are such efforts helpful in reducing accidents at work?

- Are adopters of OHS management systems better than non-adopters?

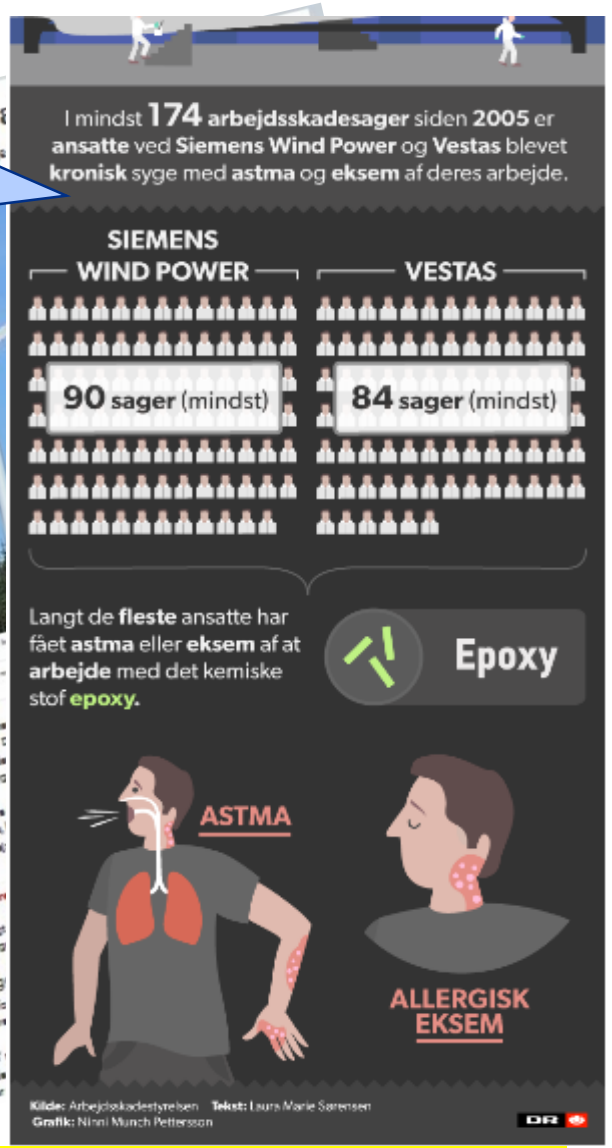
Background and contextual information

NEWS MEDIA REVEAL POOR OHS IN LARGER COMPANIES IN DENMARK

174 cases of chronically ill workers in the wind turbine industry since 2005, because of occupational asthma and eczema

OHSAS 18001, Vision Zero, or Zero Harm, and the smiley scheme – did not capture serious OSH problems!

Workplaces had positive smileys, even they contributed to many cases of injuries in the compensation board



Faith in safety monitoring and control systems collapsed

New tripartite agreement on OHS efforts

Tripartite agreement on prioritized national goals for the OHS effort

The workplaces work systematically with the work environment, so that it becomes healthy and safe for everyone to go to work in Denmark

A successful systematic work environment effort means that the workplaces identify and prevent risks in the work environment, that they act on them, and finally that they follow up that the implemented measures work as intended. The systematic effort includes the cooperation between employers, managers and employees in all workplaces.

The government and the social partners agree on the importance of systematic OHS efforts.

New tripartite agreement on OHS efforts

NATIONAL MONITORING STRATEGY FOR WORKPLACE OHS EFFORTS

FROM: REACTIVE INDICATORS (such as accidents / injuries)

TO: PROACTIVE INDICATORS (such as workplace risk assessment, worker involvement, preventive initiatives, instruction and follow-ups, etc.)

This PART II presentation

The two dimensions of workplace OHS efforts: Systematic and content-related OHS efforts

Can high levels of systematic and content-related OHS efforts predict accidents at work? — Yes

Do adopters of Certified OHS management systems (COHSMS) have higher levels of OHS efforts compared to non-adopters? — Yes

Does the introduction of COHSMS lead to lower risk of accidents? — No

Concluding points

Enterprises OSH efforts: two dimensions

I. Systematic (process-related) OSH efforts (decisional implementation**):**

Coherent systems of policies, plans and procedures, coordinated activities to improve and systematize overall OHS activities (Bluff, 2004; Nielsen, 2000; Robson et al., 2007). E.g.:

- Prioritation and integration of OHS into other management activities
- Employee involvement, competence development, etc.
- Policies for the workplace risk assessment (WPA), instruction and guidance, etc.

II. Content-related OSH efforts (behavioural implementation**):**

The specific control measures carried out in practice to eliminate or reduce specific work environment risks (Dahler-Larsen et al., 2020; Øystein Saksvik et al., 2003), can focus on:

- Measures to reduce risk of falling, tripping and crashing etc.
- Instruction, training and supervision of safe execution of the work
- WPA activities and measures to reduce psycho-social, ergonomic, etc. hazards at work

OSH efforts and accidents at work

- Can high levels of systematic and content-related OHS efforts predict accidents at work?

- Do adopters of Certified OHS management systems (COHSMS) have higher levels of OHS efforts compared to non-adopters?

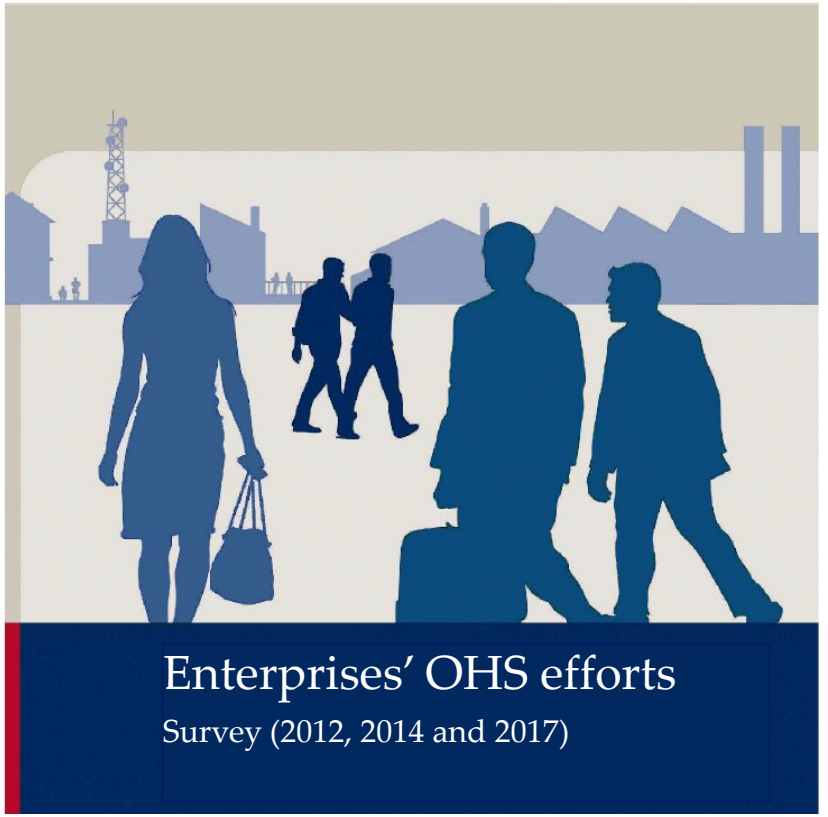
2. Data and methods

Nation wide survey:

Working Environment Activities in Danish Workplaces (WEADW)

Sample

- The survey has been conducted in 2012, 2014 and 2017
- Send out to about 8000 enterprises in each round
- in total 23,971 workplaces included – (local unit of the enterprise
- Response rates of 47%, 44% and 47%, respectively



Sampling method

- The VAI survey is based on a stratified sample of workplaces (the local unit of the enterprise),
- The survey is representative within each strata (36 industry group, 3 size categories, 75 enterprises).
- Covers all industries and enterprise sizes in Denmark, with at least one employee
- 2 questionnaires pr. workplace > 9 employees (management and employee representative)

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Thorsen, S. V., et.al (2017). Associations between the workplace-effort in psychosocial risk management and the employee-rating of the psychosocial work environment–a multilevel study of 7565 employees in 1013 workplaces. *Scandinavian journal of public health*, *45*(5), 463-467.

Five OSH indicators related to accidents at work

Table 1: Indicators for each of the two dimensions of enterprises' occupational safety and health (OSH) efforts

Indicators for enterprises' systematic OSH efforts	Indicators for enterprises' content-related OSH efforts
• Prioritization of OSH	• Risk reduction measures
• Integration of OSH activities into other business activities	• Safety instruction (and follow up on safe work practices)
	• Accident prevention measures

Scoring of the indicators:

- A simple arithmetic mean of the workplace score, if at least half of the questions are answered, otherwise excluded
- Scoring goes from 0 (lowest OSH efforts) to 100 (highest OSH efforts)

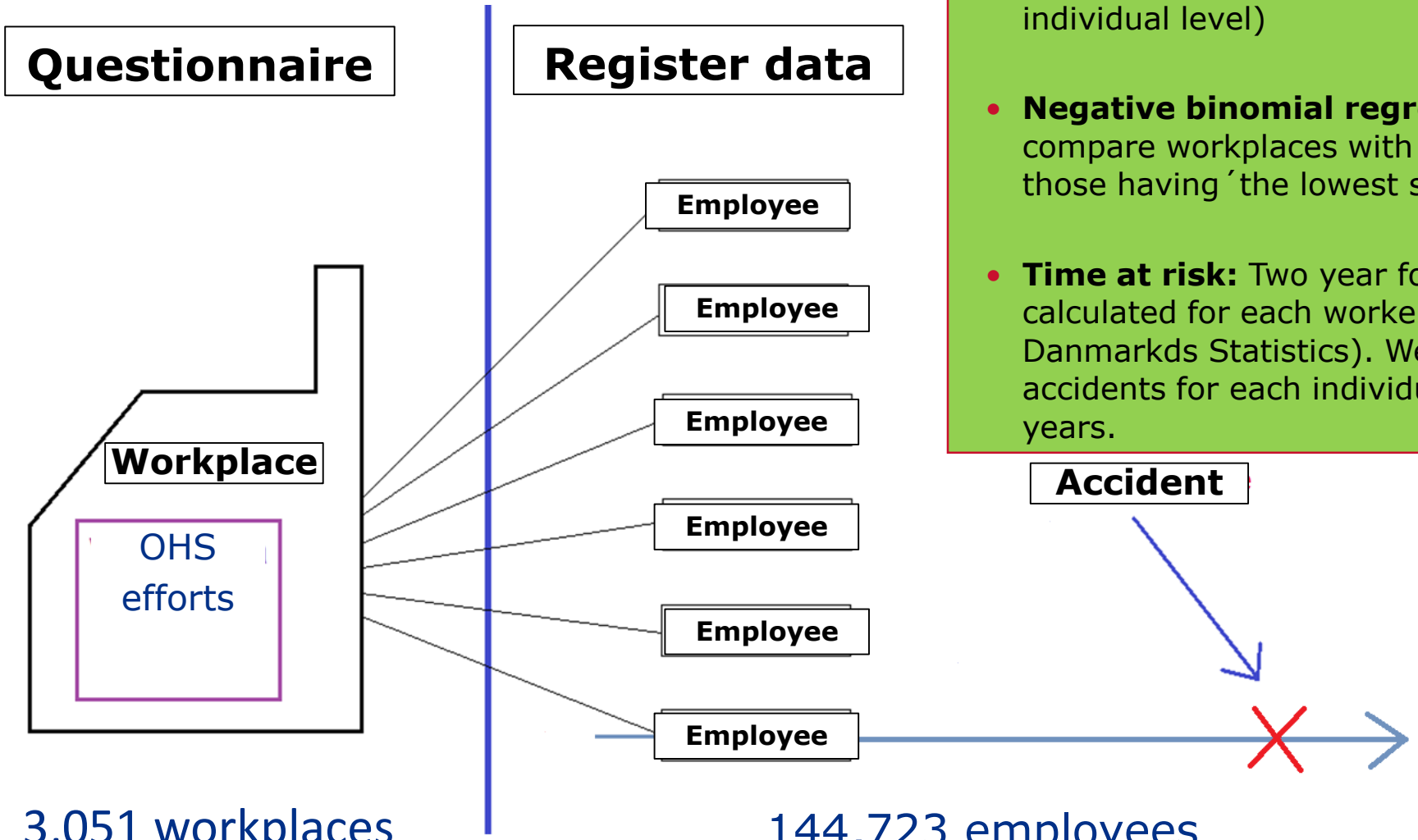
?
Management commitment to safety b) integration of safety with other activities c) middle management engagement d) implement concrete preventive activities

MENTI METER QUESTIONS

III: What management practices contribute most to systematic work environment efforts?

a) Management commitment to safety
b) Integration of safety with other activities
c) Middle management engagement
d) Implementing concrete preventive activities

Study design: Can OSH indicators predict accidents at work?



Statistical model:

- **Multi-level model** (workplace level and individual level)
- **Negative binomial regression model:** compare workplaces with highest score with those having ´the lowest score
- **Time at risk:** Two year follow-up – calculated for each worker (register data, Danmarkds Statistics). We count number of accidents for each individual in these two years.

3,051 workplaces

144,723 employees

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Predictive validity of OHSM indicators

OSH efforts and Serious accidents at work [1)]	Incidence Rate Ratio	CI: Lower level	CI: Upper level	P-value
Systematic OHS efforts:				
Prioritization of OSH	0,47	0,30	0,73	0,0007
Integration of OSH activities	0,66	0,45	0,97	0,0327
Content-related OHS efforts:				
Safety instruction and follow up	0,97	0,58	1,61	0,9088
Risk reduction measures	0,55	0,34	0,91	0,0204
Accident prevention measures	0,60	0,41	0,88	0,0089

(1) Accidents resulting in more than 30 days' sickness absence

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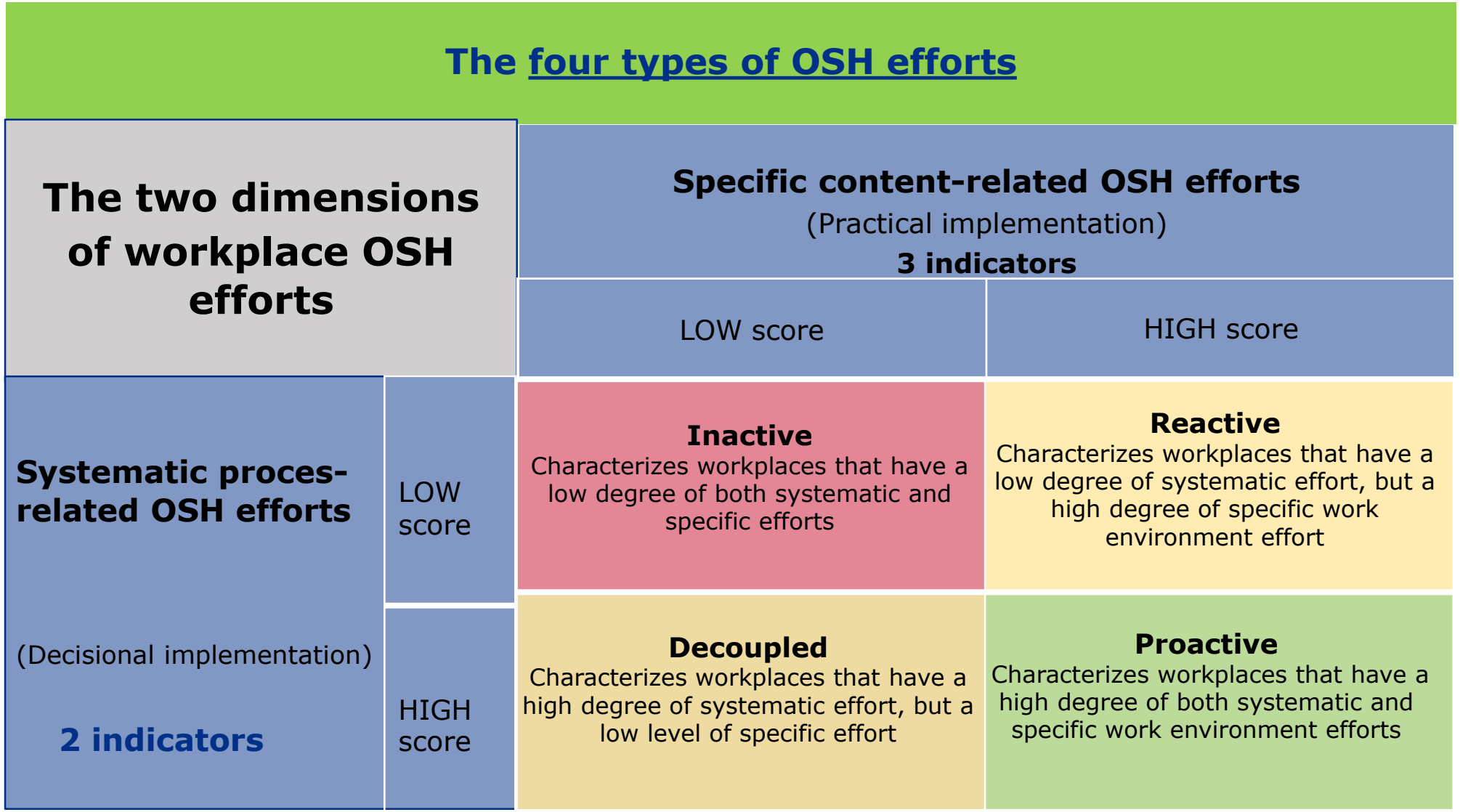
Covariates: sex, age, size of local unit of the enterprise, genereal risk of accidents in the job

Four types of workplace OHS efforts



Workplace OHS efforts and accidents at work?

How is the relationship between OSH efforts and serious accidents?

The two dimensions of workplace OSH efforts WEADW survey + register data		**Specific content-related OSH efforts** (Practical implementation) **'the what'** **3 Indicators** LOW score	HIGH score
Systematic proces related OSH effort **'the how'** (Decisional implementation) **2 Indicators**	LOW score	**Inactive** (IRR=1)	**Reactive (+2 %)** (IRR=1,02; CI: 0,64-1,65)
	HIGH score	**Decoupled (-22 %)** (IRR=0,78; CI: 0,59-1,04)	**Proactive (-33 %)** **(IRR=0,67; CI: 0,52-0,88)**

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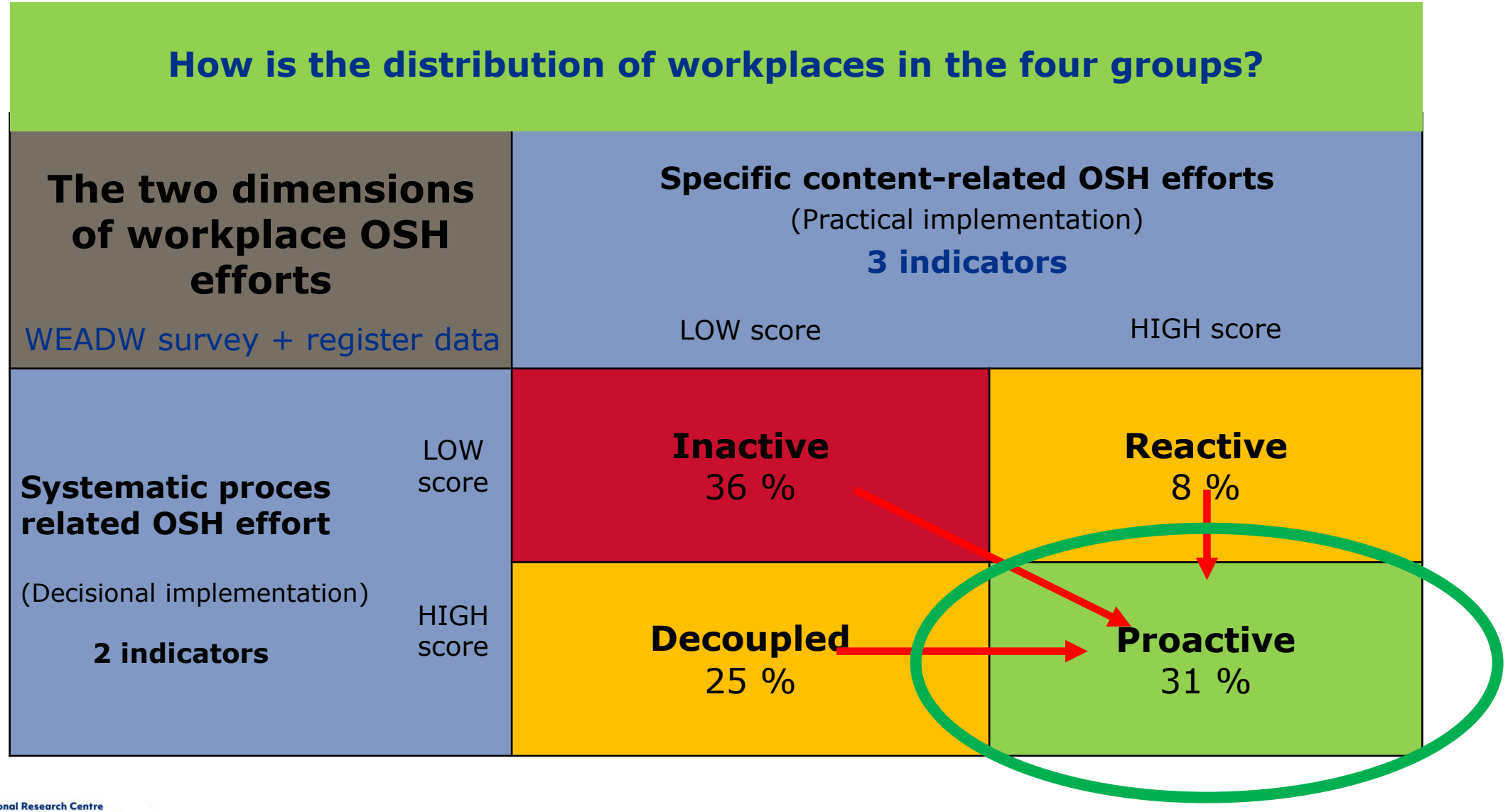
Workplace OHS efforts and accidents at work?



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Workplace OHS efforts all workplaces?

How is the distribution of workplaces in the four groups?

The two dimensions of workplace OSH efforts WEADW survey + register data		**Specific content-related OSH efforts** (Practical implementation) **7 indicators** LOW score	HIGH score
Systematic proces related OSH effort (Decisional implementation) **5 indicators**	LOW score	**Inactive** 25 %	**Reactive** 15 %
	HIGH score	**Decoupled** 15	**Proactive** 45 %

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OHS efforts in adopters of COHSMS?

How is the distribution of workplaces in the four groups?

Enterprises with a certified OSH system (COHSMS survey)

The two dimensions of workplace OSH efforts COHSMS survey		**Specific content-related OSH efforts** (Practical implementation) **7 dimensions** LOW score	HIGH score
Systematic proces related OSH effort (Decisional implementation) **5 dimensions**	LOW score	**Inactive** 7 %	**Reactive** 9 %
	HIGH score	**Decoupled** 15 %	**Proactive** 69 %

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Effects of COHSMS

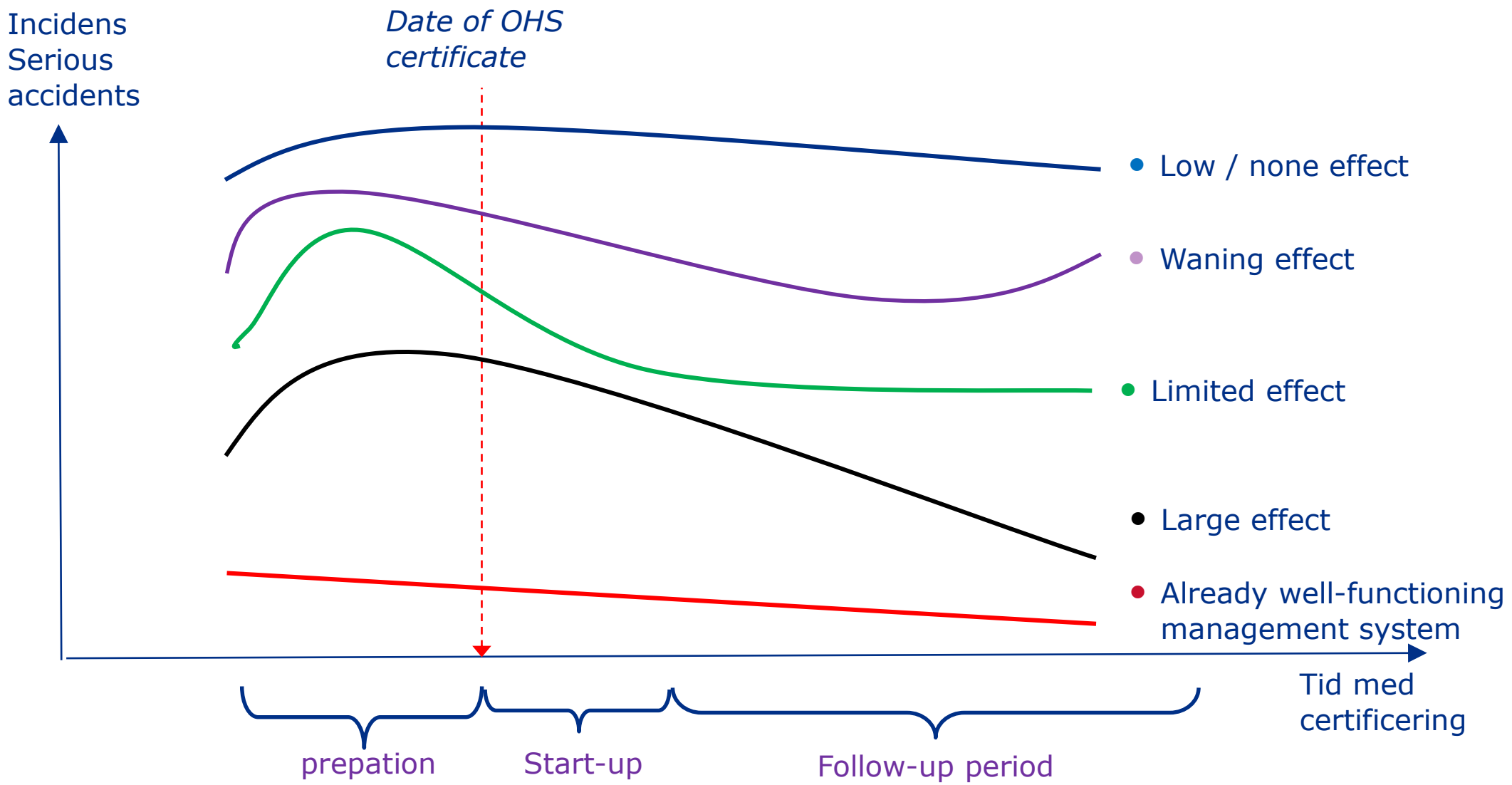
- **Does the introduction of COHSMS lead to lower risk of accidents?**

Method

- Register-based longitudinal study comparing adopters of COHSMSs with non-adopters of COHSMSs to examine whether the first performs better in terms of reducing accidents at work, compared to the latter.

- We followed the COHSMS workplaces from 2 years before certification to 3 years after certification and non-adopters (matched control group) of COHSMS similarly for 5 years in total.

Assumptions about possible courses of effect of COHSMS



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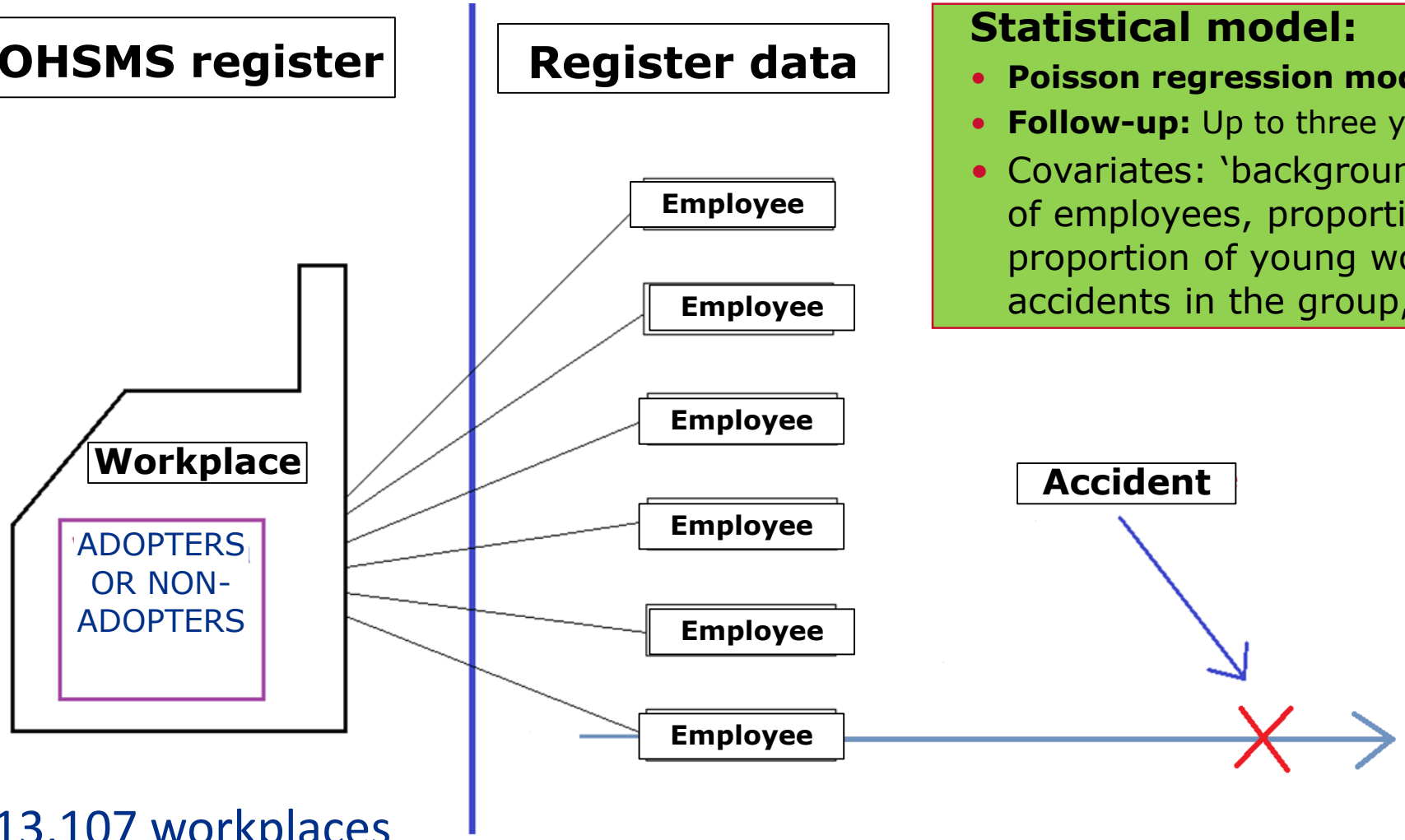
Study design: COHSMS and matched control group

Does COHSMS lead to lower risk of accidents at work?



Statistical model:

- **Poisson regression model**
- **Follow-up:** Up to three yers
- Covariates: 'background' risk; Number of employees, proportion of women, proportion of young workers, risk of accidents in the group, risk time.

13,107 workplaces

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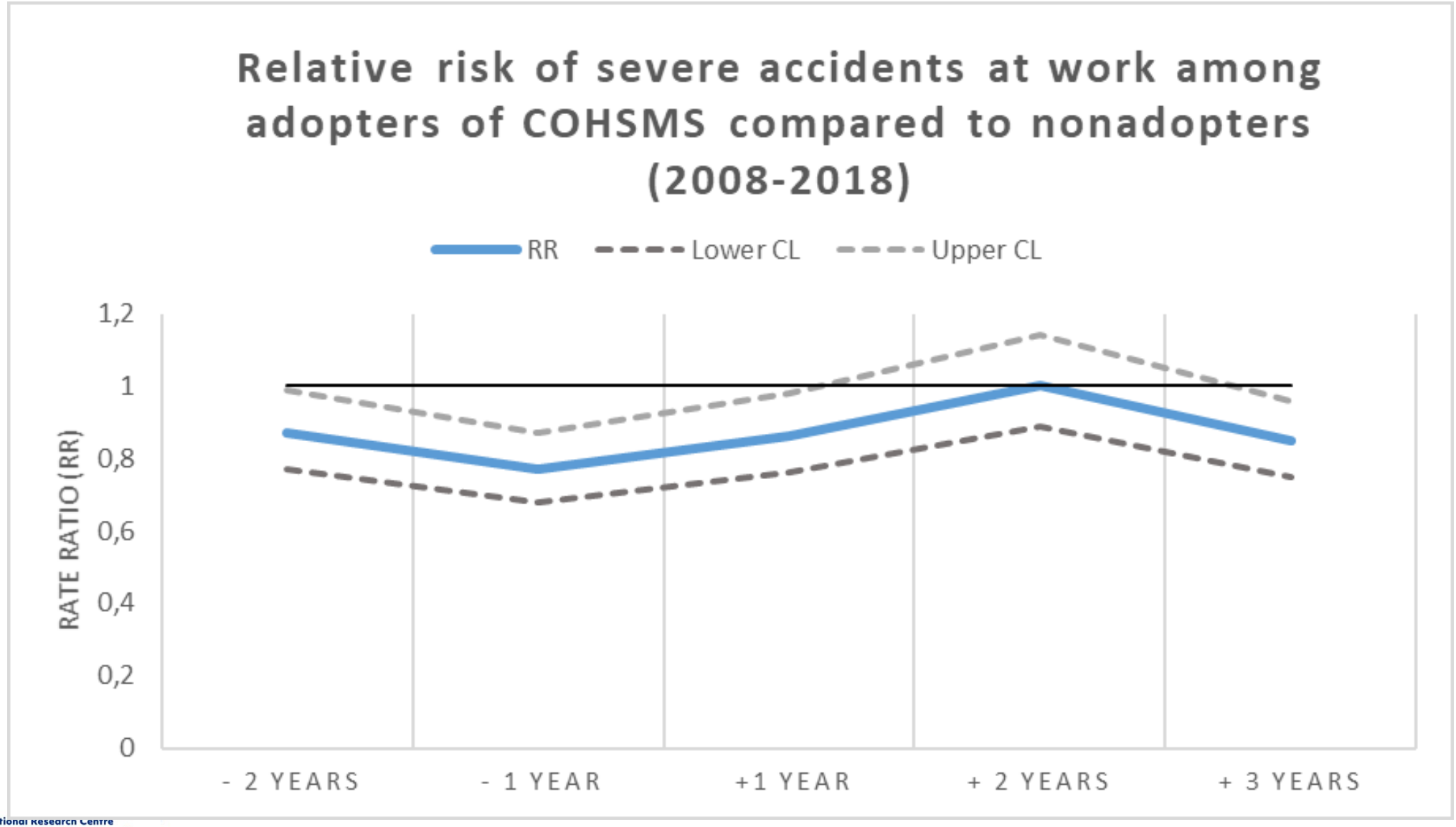
Effekts of COHSMS compared to non-adopters



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Concluding points 1

- Proactive safety can be understood as a high level of both systematic and content related OSH efforts.
- Workplaces with proactive safety efforts are predictive of lower risk of accidents.
- Both systematic (process-related) and specific (content related) OSH efforts are needed for decreasing risk of accidents at work.
- Workplaces adopting COHSMS scored better on OHS efforts compared to non-adopters

Concluding points 2

- This study could not confirm that workplaces adopting COHSMS reduces severe accidents at three years follow-up.
- The adopting workplaces already had a OHS performance higher than the average workplaces, but could not further reduce the risks of severe accidents at work.
- These results indicate that companies do not adopt COHSMS to improve their OHS efforts, but rather to show the institutional environment that they prioritize the working environment.

MENTI METER QUESTIONS

IV: In your opinion – what has been the most important factors for the advancement of systematic working environment in Sweden?

If you want to read about it:

Contents lists available at ScienceDirect

Safety Science

journal homepage: www.elsevier.com/locate/ssci

The causal relation between lead and lag indicators

Johnny Dyreborg Researcher, PhD *

National Research Centre for the Working Environment, Lerso Parkalle 105, 2100 Copenhagen, Denmark

journal homepage: www.elsevier.com/locate/safety

Making occupational health and safety management systems 'work': A realist review of the OHSAS 18001 standard☆

Christian Uhrenholdt Madsen[a,c,*], Marie Louise Kirkegaard[b], Johnny Dyreborg[a], Peter Hasle[d]

journal homepage: www.elsevier.com/locate/safety

Differences in occupational health and safety efforts between adopters and non-adopters of certified occupational health and safety management systems

Christian Uhrenholdt Madsen [a,b], Sannie Vester Thorsen [b], Peter Hasle [c], Line Leonhardt Laursen [b], Johnny Dyreborg [b,*]

Relationsships between workplaces' OHS efforts and accidents at work (with an English summary). Results from the 'VAI-accident' project, NFA 2021

National Research Centre for the Working Environment

Grant from: The Danish Working Environment Authority (2019); and the Danish Work Environment Research Fund (2017/2022).

Thank you for your attention!

Contact: Johnny Dyreborg
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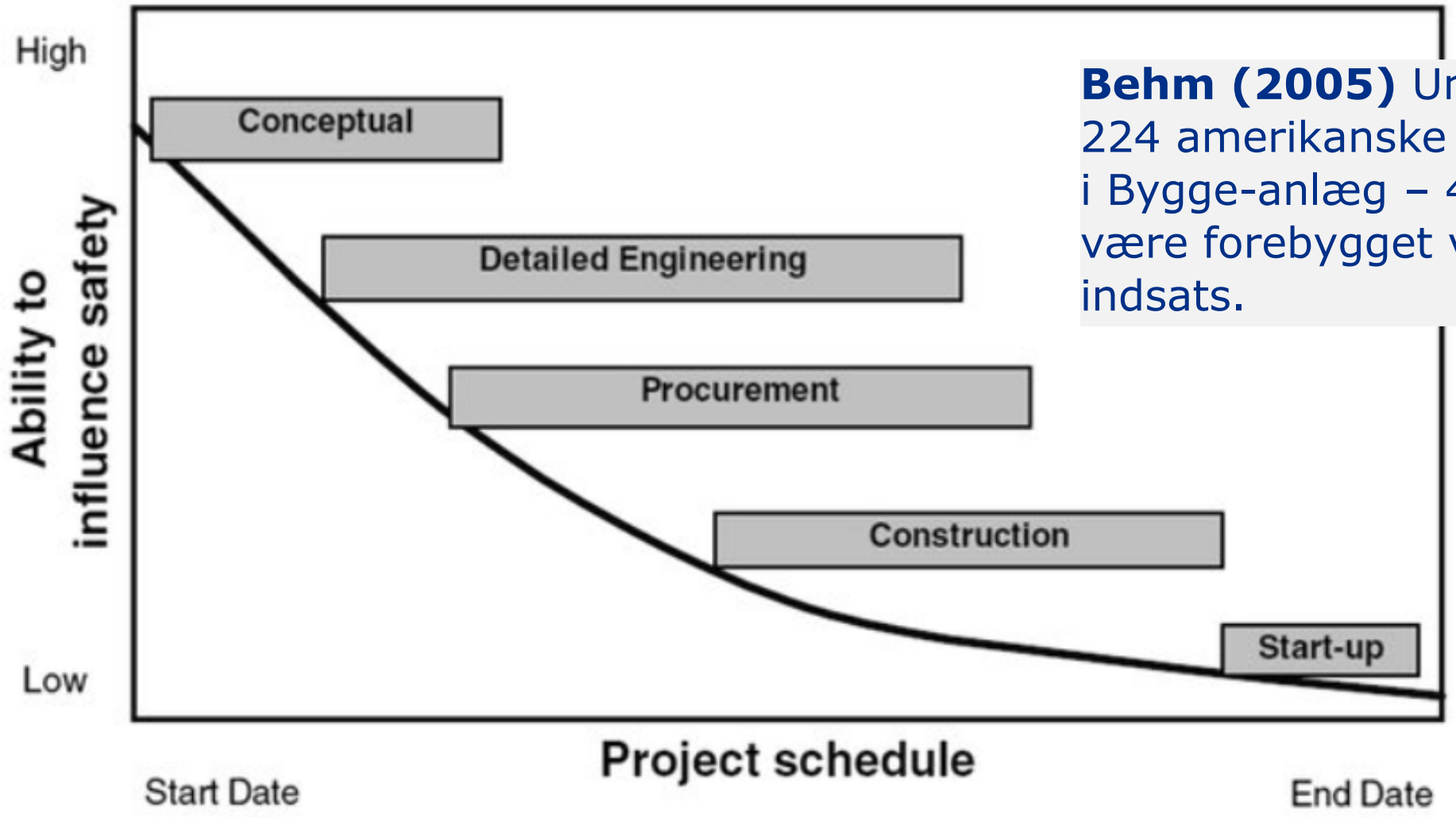
National Research Centre for the Working Environment

Grant from: Danish Working Environment Authority (2019)

Szymberski kurven – TIDLIGERE INDSATS!



Behm (2005) Undersøgte 224 amerikanske dødsulykker i Bygge-anlæg – 42% kunne være forebygget ved tidlig indsats.

Det Nationale for Arbejdsmil...

Szymberski (1997) Construction project safety planning. TAPPI Journal 80 (11): 69–74.

Systematic and specific OHS efforts

Scale	
	Systematic OHS processes
1.	Prioritization of OHS activities
2.	Integration of OHS in management and operations
3.	Organization of OHS
4.	WPA for psycho-social and physical risks
5.	WPA for chemical risks
	Process mean
Specific preventive OHS efforts	
6.	Safety guidance and instruction
7.	Efforts to prevent accidents
8.	Psycho-social prevention efforts
9.	Efforts to reduce conflicts and bullying
10.	Efforts to reduce threats and emotional demands
11.	Efforts to reduce physical risks
12.	Efforts to reduce chemical risks
	Content mean