

# › IMPROVING HSE MANAGEMENT – DEVELOPING A NEW LMRA METHOD

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**TNO** innovation  
for life

# AGENDA

- › TNO LMRA+ project
  - › Why? Current practice
  - › What? Knowledge project: goals, research questions, experiment
  - › How? Combining knowledge with new technologies

# CURRENT LMRA PRACTICE

- › Questions to generic (see Fig.)
- › Mainly focused on enforcing compliance with regulations, instead of helping employees demonstrably identify / address specific risks quickly.
- › Worst case: LMRA becomes a tick-box exercise
- › Side effect: the LMRA is not always applied in the same way in practice despite good intentions to manage risks by using it.
- › **Aim project TNO:** to develop a new and innovative generation of LMRAs that are offered tailor-made, risk scenario-specific and digital (in a training situation or in practice).

Client:		Supervisor:								
Location:		Weather:	Fine	Wet	Ice	Wind	Snow			
Permit type:	Confined space	Cold work	Hot work	None	Other:					
Number:										
Job description:										
<b>Before you start (Tick [✓] the appropriate box)</b>							<b>Yes</b>	<b>No</b>	<b>N/A</b>	
Do you have the right documentation for the task										
Do you have the right PPE for the task										
Have you the right tools for the task - HAVs tags fitted / PAT tested										
Are scaffolds and ladders tested - check scaftag										
Is lifting equipment tested / certified										
Is testing equipment tested / certified										
<b>Activity related hazards (Tick [✓] where applicable)</b>										
Working at height		Tripping hazards								
Poor lighting		Contact with stationary objects								
Chemicals / harmful substances		Moving loads								
Risk to you from others working near		Hand tools - check								
Risk to others from you working near		Manual handling								
Hot work		Machinery in motion								
Cold work		Welding in close proximity to task								
Work place temperature - high / low		Dangerous liquid, solid, sludge								
Housekeeping		Lifting								
Insecure load		Entry into confined space								
Poor access / egress		Dust / fumes								
Noise		Risk to environment								
Electricity		Other								
Comments:										
Risk assessment complete: are suitable controls in place for all identified risks							<b>Yes</b>	<b>No</b>		
If you require any assistance or have any doubts - ASK your supervisor or line manager.										
ADDITIONAL REFERENCE INFORMATION the effects of exposure to the hazards listed above can be found in THE HAZARD CHECKLIST at the back of the booklet.										
<b>WORKING SAFELY IS A STORK CONDITION OF EMPLOYMENT</b>										
Signature:				Time:		Date:				

# KNOWLEDGE QUESTIONS

- › The *central question* that is answered with our research is:
  - › *To what extent do risk specific questions (supported by training software) help the employee to better recognize (and address) unsafe situations in the execution of the work?*
- › The following sub-questions are important:
  - › *In what way do risk specific questions help to process the (observed / identified) risks more effectively?*
  - › *Are risk specific questions more effective than general questions or guiding keywords?*
  - › *What is the effect of work experience and formal safety training in recognizing risks in the workplace (better)? And should risk specific questions be tailored to complement such training and to what extent?*
  - › *What is the effect of work stressors in recognizing risks in the workplace?*

## WHAT WE KNOW FROM THEORY

- › No systematically performed (quantitative) scientific research done on LMRA practice
- › However, a new form of LMRA can be scientifically substantiated based on current theories, namely:
  - › We have a *processing capacity* of 6 x 10<sup>6</sup> bits / sec to detect new information but can only process 100 b / sec in our working memory (cognitive load theory)
    - › That is why we want to make optimum use of the limited work capacity by guiding the *selective attention* of the employee to that information that is relevant for the safe fulfillment of his work or duties.
  - › People are inclined to show *habitual behavior* instead of learning / applying new behavioral strategies based on new information, which often means that intentions for safe(r) behavior do not always succeed. This may also explain why changing situations in the workplace often go unnoticed.
    - › The circumstances in which employees operate must be adjusted in such a way that habitual behavior ("we carry out the work as normal because it looks the same as always") does not come available in their memory first.

# OUR GOAL

- › Creating the preconditions for good information processing (observing vs. seeing) and preventing habitual behavior from contributing to the fact that (changing) risk situations go unnoticed
  
- › We want to achieve this by:
  - › Providing the right (risk-relevant) and optimal (quantity) safety information (as cue) to the employee at the right time (that is, at the start of work, or in changing circumstances during work).
  - › By developing work-specific LMRA questions relating to a certain risk scenario (with regard to the top 10 high-risk activities in NL).
  
- › Long term:
  - › The (co-) development of supporting task guidance / software with which such questions can be presented to the employee in advance for use in practice or training situations. Using real time data to proactively alert employees on (changing) risk situations .

# LMRA+ EXPERIMENT: RISK-SPECIFIC LMRA

## Example items/ questions LMRA+ (based on Storybuilder data)

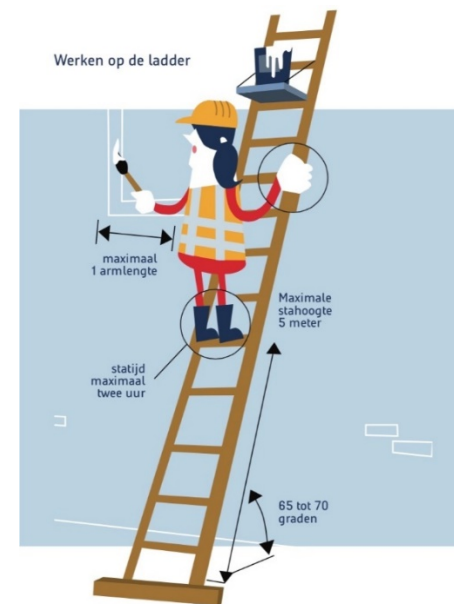
### WORKING AT HEIGHT

#### Proactive questions:

- › Is the ladder / scaffold installed correctly?
- › Is the ladder in good condition? (age, wear and tear)
- › Do you have the right equipment (e.g., ladder or scaffolding) for the situation?
- › Do you use the ladder as intended?
- › Is the ladder placed in a safe place? (think of possible collision, bumping into people, doors, moving loads, or contact with electricity)
- › Is the surface suitable for the installation of the work equipment? (e.g., slope, wet or soft surface)
- › Do you feel fit enough to do the job?

#### Tips:

- › When using a ladder, consider the positioning of yourself in relation to the ladder. (balance, overreaching, external force that acts on the body).
- › Make use of (adequate) fall protection if necessary. (from 2.5 meters height)



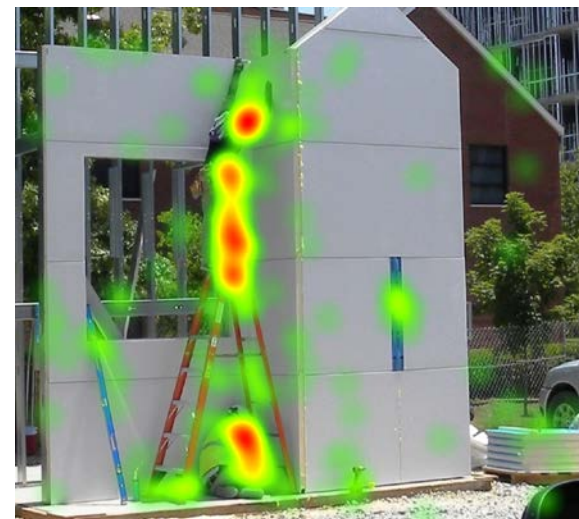
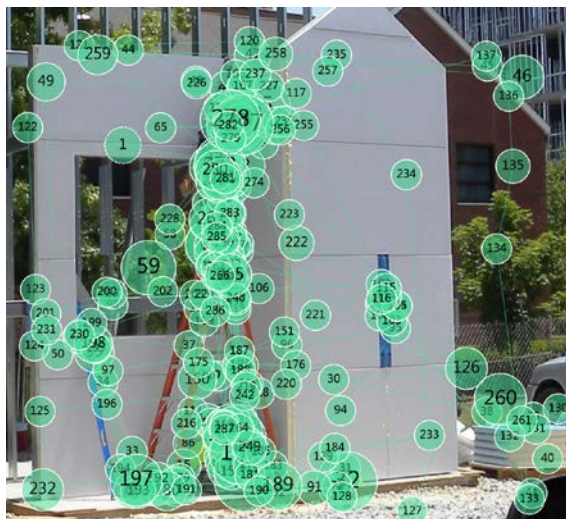
# EYE TRACKING EXPERIMENT

- › Identify spotting behavior employees (eye movement tracking)
- › Using several photo's representing dangers in relation to working at heights
- › Common hazards relate mainly to the fall of ladders, stairs or scaffolding
- › Condition 1: standard LMRA card or LMRA +
- › Condition 2: introducing time pressure / no time pressure
- › Participant notes spotted hazards which are compared to their eye movement data





# LMRA+ EXPERIMENT OUTPUT



# LMRA APPLICATIONS

- › Combing knowlegde on LMRA with (Augmented Reality) Technology to improve situational awareness, e.g.:
  - › Daqri Smart Helmet
  - › Microsoft Remote Assist (HoloLens)
  - › Google Glass



Personalised Job coaching



# NEW TECHNOLOGIES DISRUPT HSE MANAGEMENT

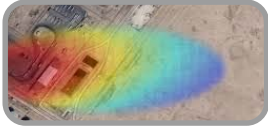
## Combinations of new technologies....



Smart data collection



Wearable sensors



Exposure modelling



Big data



Advanced analytics

## ...enable new opportunities...

### Data

- Faster, cheaper, longer duration
- Multiple sources & stressors
- Personalized
- Real time update and integration



### Models / inference

- Combining multiple routes
- Exposure profiles
- 3D Exposure hazard/ mapping
- Decision trees / logic



### Prevention/management

- Personalized
- Real-time
- Data driven & Health relevant
- Automated



Virtual HSE monitoring and management  
+



Personalised Job coaching

# SOME RECENT INITIATIVES & DEVELOPMENTS

REALTIME PM SENSING IN THE  
CONSTRUCTION INDUSTRY



BENZENE POC DEVELOPMENT



PERSONAL JOB COACH



REAL TIME EXPOSURE TRACKING



SHIFT WORK SLEEP COACH



STRESS COACH



A nighttime photograph of a city street. On the left is a brick building with lit windows. On the right is a modern building with a curved facade and lit windows. A road with a metal railing runs across the middle. Green light trails from a moving object are visible in the upper right. A white horizontal bar is at the bottom.

› THANK YOU FOR YOUR  
ATTENTION

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