Det Nationale Forskningscenter for Arbejdsmiljø

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VDC, technologies, and monitoring in the construction industry

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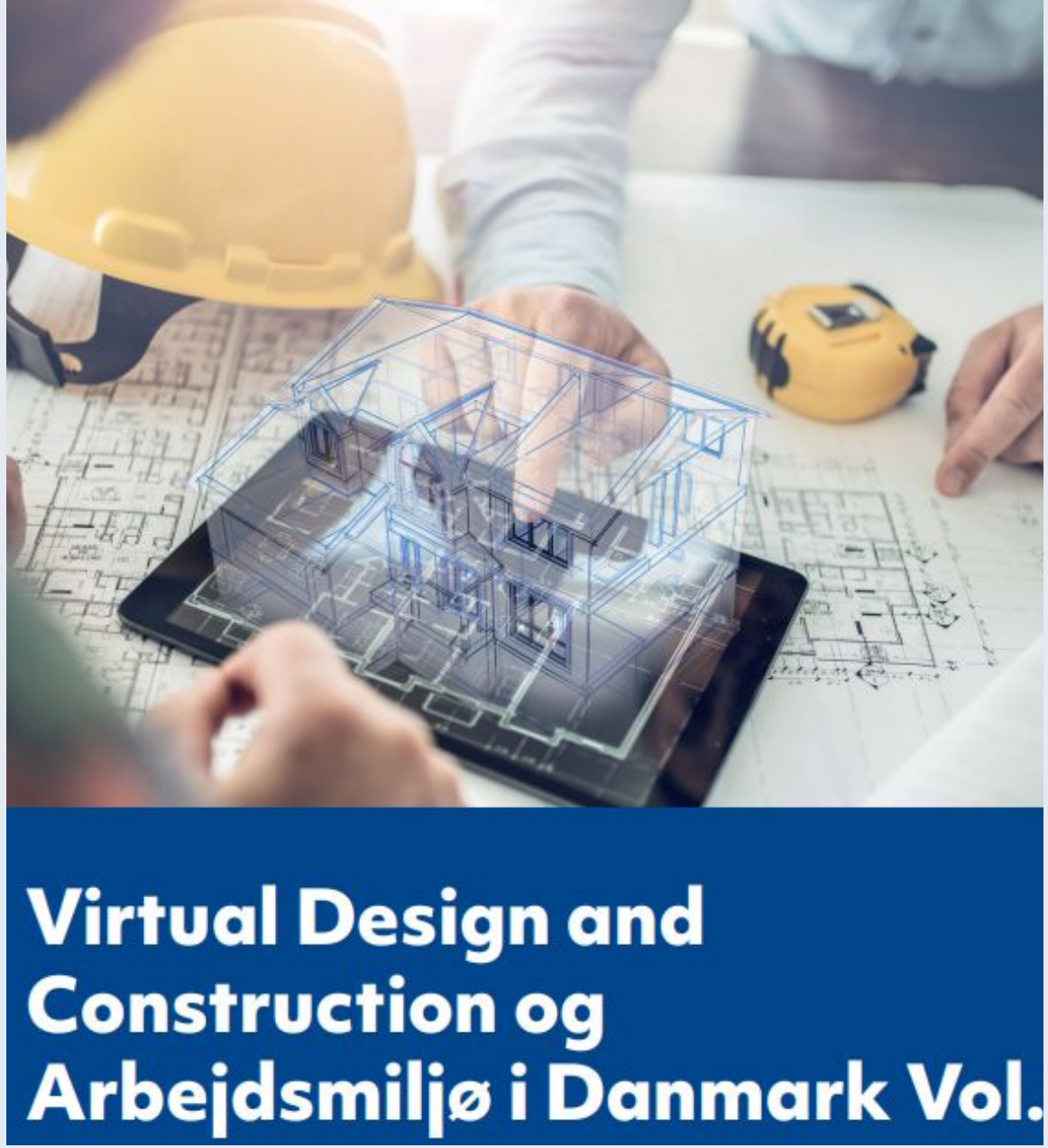
Content

1. The VDC project
   OSH potentials of new technologies
   Corporate support for new technologies for OSH purposes.
   Professional identities as opportunities and constraints

2. Monitoring, new technologies, and ethics
   Monitoring in literature and in companies
   Ethical considerations

The VDC project

- Scoping review
- Interviews and observation studies
- Workshops with stakeholders



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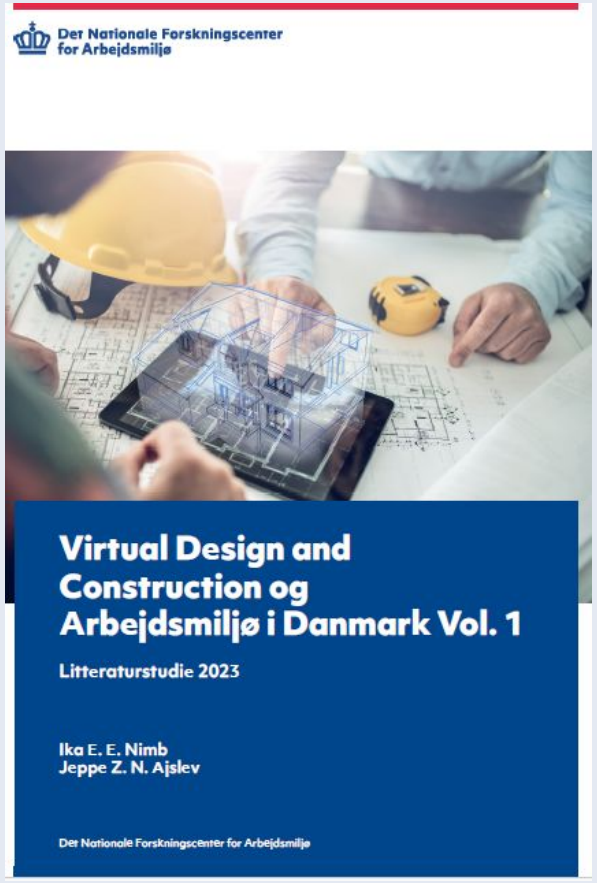
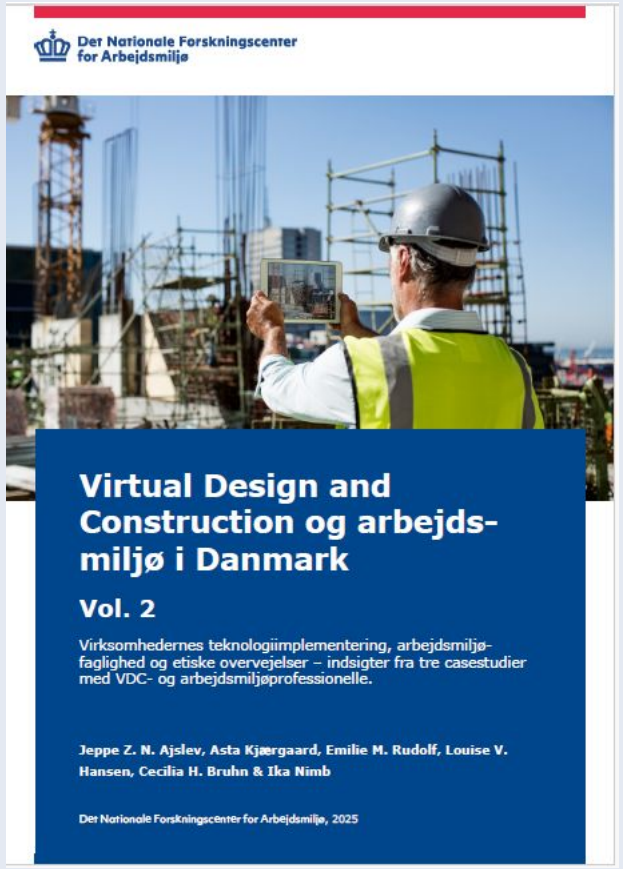
Publications





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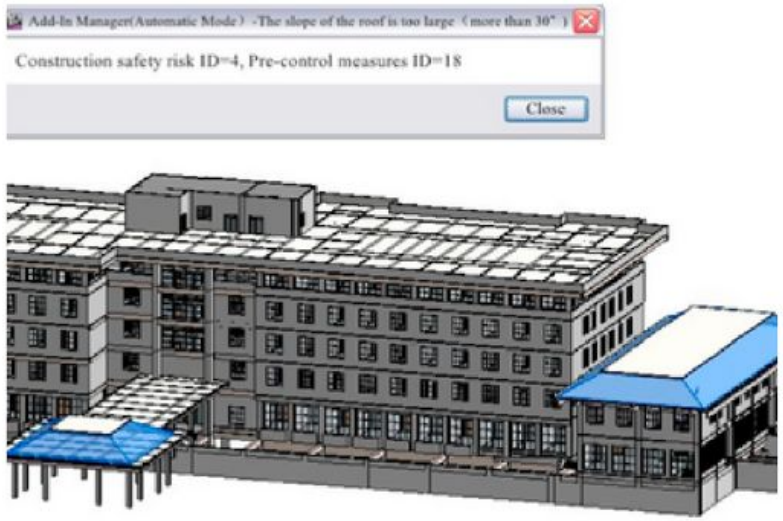
Identificering af risici

På baggrund af sikkerhedsregler kan risici automatisk identificeres i 3/4D model

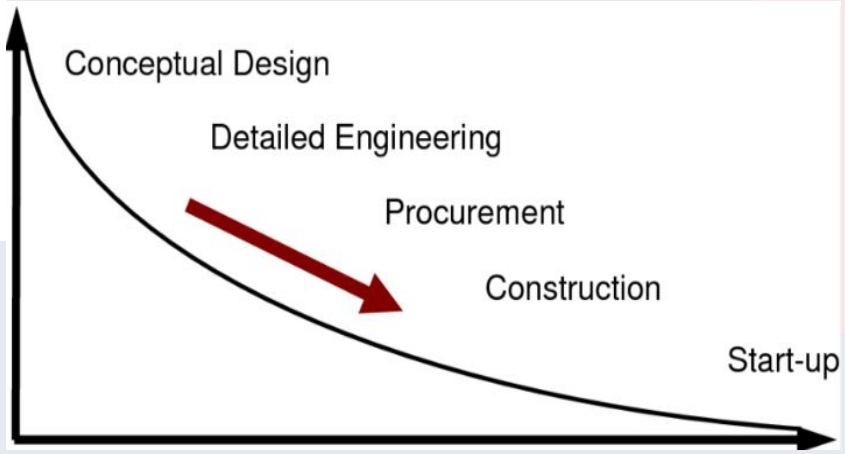


Billede 4. Resultatet af et sikkerhedsplugin. Fordi hældningen på taget er mere end 30 grader er dette identificeret som en risiko og markeret med blå - fra Yuan m.fl. (2019).

Building Information Modelling - plugins

20 studies.

Automated safety controls.



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Safety Training

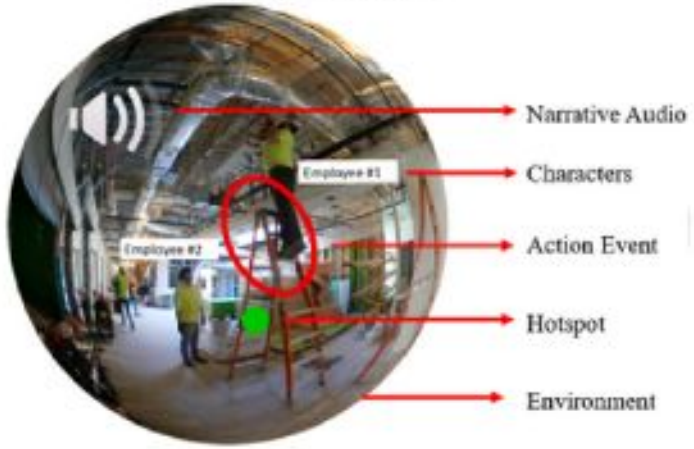
15 studies

Occupational safety training in virtual environments.

Limited training effectiveness

360 graders panorama + Augmented (AR)

360 billeder af den faktiske byggeplads, hvor AR anvendes til præsentation af sikkerhedsinformation.



Billede 15. Sikkerhedsplatform. En bruger med VR briller, går virtuelt rundt på den faktiske byggeplads, hvor augmented sikkerheds information og historiefortælling er inkorporeret - fra Eiris m.fl. (2020).

Virtual Reality (VR)

Arbejdsopgaver kan trænes i virtuelle scenarier, hvor brugeren kan interagere med relevante problemstillinger.

Billede 16. Brugeren har kontrol over en stor maskine, og træner arbejdsprocesser i VR - fra Vahdatikhaki m.fl. (2019).

Key Points from the Review (2022)

1. There is a need for general development of OSH-oriented solutions in new digital technologies.

2. There is a lack of standards in how to address OSH factors and digital safety checks, data collection, concepts, etc.

3. Data collection, management, and analysis for safety purposes are very limited.

4. Stronger collaboration is needed between stakeholders: researchers, safety professionals, developers, companies, managers, IT professionals to support the integration and testing of VDC solutions for safety purposes.

5. Political organizations should take an interest in how digital technologies can support safety in the construction and civil engineering sector.

Key Points from the Review (2022)

6. There is a great need for education in VDC and OSH thinking.

7. There is a lack of studies investigating VDC technologies and their impact on workers and safety professionals.

8. Ethical discussions regarding the implementation of technologies to improve both safety and other VDC functions are necessary.

The Case Studies

- Case studies in three major construction companies:

- A total of 27 interviews.
  - 12 OSH professionals.
  - 10 IT professionals.
  - 5 others.

- Observations in two out of three cases.

OSH Professionals See Potential in Technologies

- "I have no doubt we can always improve. For example, with some VDC work beforehand. But I actually think we are quite far ahead. However, I don't believe we will ever have a risk-free workplace because we work with people. There's always someone who thinks, 'This is helpful,' but it's not. Yet, no one does this with bad intentions.
- I think we'll never get rid of people like me going around talking about safety. That's not going away. But my work could be easier if I could see many things earlier using VDC, identifying issues earlier with production folks. Maybe then I wouldn't have to be on-site as much as I am now. But I can't imagine we'll ever completely avoid this."

- (OSH Professional 3, Case 1)

Technologies Are Peripheral Today – Technology vs. Contact

- No OSH professionals mentioned technologies when asked about the essential competencies or characteristics required for an OSH coordinator.

- **However:**
  "Well, it's really basic stuff, you could say. It's the computer, then the phone, and I sit with the VDC team, join focus groups, where we look at [company software] and Dalux, and explore how we can utilize these technologies. But it's not something I personally work with directly. It's very hands-on—just a PC and a phone, sometimes a piece of paper, drawing on the back of a cardboard sheet on site. It's often just that basic. I also see some OSH professionals relying on some scheme or sending red, yellow, and green registration forms around to seven people by email. I think it's more effective to go out and talk to people about why we do these things."

  - (OSH Manager 2, Case 3)

Key Points Summarized

- VDC and digital technologies are not central to OSH coordinators' professional identity.
  - Technology vs. human contact.
  - OSH coordinators see great potential in new technologies.

- **Dalux** is widely used for safety purposes—**BIM 360** is more sporadic.

- Technologies are less accessible to site workers.
- Occupational safety is not central to VDC professionals' identities but remains relevant.
  - Who oversees the work environment of VDC professionals?

- Significant barriers exist for developing occupational safety functions, particularly due to financial constraints.

New types of monitoring

Billede 10. Personbårne RFID til identifikation af brugen af PPE - fra Barro- Torres m.fl. (2012).

Quote

- "With the help of camera-based analysis technology, it is possible to automatically detect abnormalities in workers, materials, and machinery on site and extract relevant documentation images. The entire process does not require extensive human intervention to analyze and monitor the results. Therefore, [...] video monitoring systems are more acceptable in the construction industry."
  (Guo et al. 2019)

Monitoring and Psychosocial Work Environment

- Tasks become standardized.
- Increased performance management.
- Reduces influence, and employee skills are structured based on data (Dyreborg et al. 2022; Ball, 2021).
- Algorithmic management makes leadership invisible.
  - Decisions become opaque.
- Relationships disappear—risk of dehumanization (Walker et al. 2021).
- Industrial robotics reduced accidents by 6.7% but increased stress related hospitalization by 28.1% (Humlum et al 2024)
- Calls for ethical reflections.

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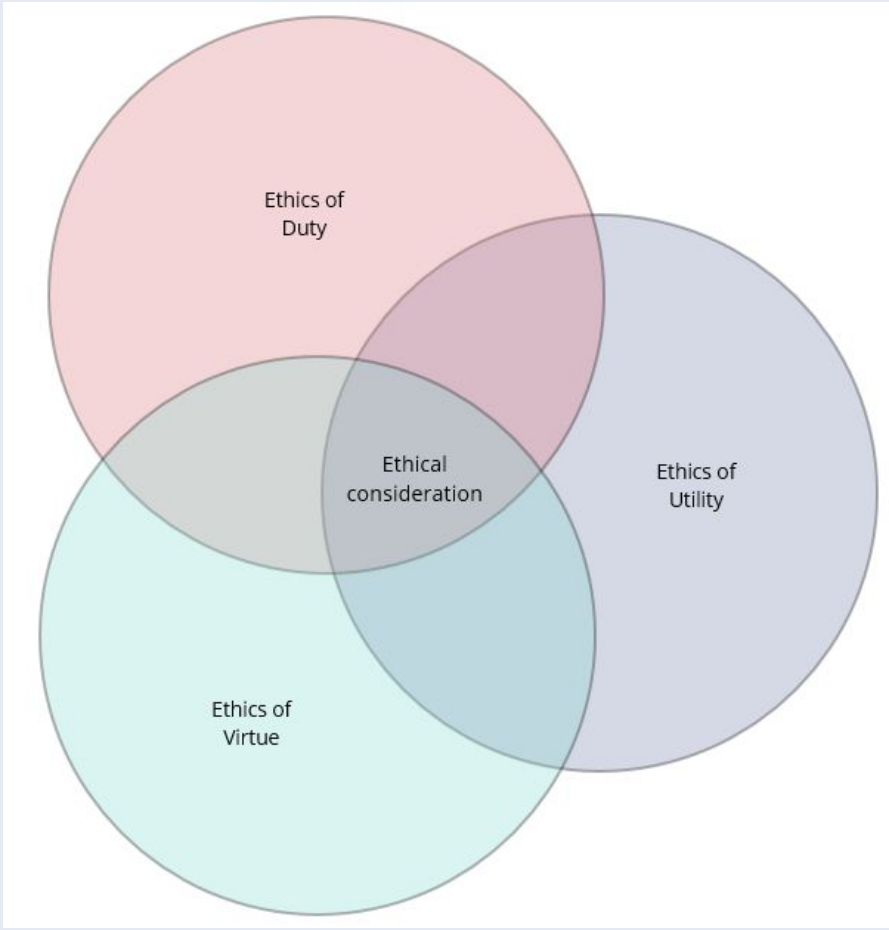
DUV - A Concrete and Common Frame of Reference

- Duty –(Immanuel Kant, Knud E. Løgstrup)
- Utility – (Jeremy Bentham)
- Virtue – (Aristoteles, Michel Foucault)



The 7 Questions Summarized

1. What purposes or intentions are associated with the technology?
2. How can the technology serve as a principle for general practice?
3. Who or what does the technology care for?
4. What advantages and disadvantages are related to the technology?
5. What new needs, opportunities, and desires will arise from the use of the technologies?
6. How are power relations within the organization affected?
7. How will the technology or its principles affect those who implement or develop it?

Purpose

Unclear How Occupational Safety Becomes Digital

- "In our department, we have ambitions and digital goals for our construction projects. We have criteria to label a project as ‘digital.’ There’s a point called ‘occupational safety use of 3D,’ but it’s not well-defined. I was pressured to check the box for ‘digital in occupational safety,’ but no one could tell me how occupational safety became more digital."

- (OSH Professional 2, Case 2)

Technologies as a Principle for the Greater Good

Some technologies pose few challenges – others do.

- **Dalux, BIM360** – Communication and risk identification – no obvious challenges.

- Video surveillance, drone flyovers, and image documentation present certain challenges:

- *"There's just a completely different level of monitoring and documentation of everything happening on a construction site. I can definitely see some ethical dilemmas here. For example, we sometimes document the site weekly with photos, which are accessible to everyone. (…) Sure, it's good that people can't hide what they're doing, but ethically, I think there are issues that aren't always considered."*

  - (VDC Professional 2, Case 1)

Monitoring Just for Fun

- **I:** "What about real-time video recording on-site? Do you use that?"
  R: "I know they do it at a construction site [...] Cameras are installed on two neighboring buildings. I'm not entirely sure what they're used for, to be honest. Initially, I think it was so site management, located far away, could monitor progress. I don't use it."
  I: "Okay, but are you also on that site?"
  R: "I've been there […]. I don't use it myself, but I know it's still there. I think some people occasionally look at it, but honestly, probably just for fun."
    - (OSH Professional 3, Case 1)

Influence and Employee Involvement
In Cases 2 and 3, involvement is limited to supervisors.

- **I:** "Do you feel included in decisions about using these technologies?"
  R2: "Not really."
  R1: "No, we've been forced into it."
  R2: "It's determined before we even get involved. We have no say."
  I: "Do you think if you made suggestions for technologies, they'd be heard?"
  R1: "No."
  R2: "No, not really. If it's not something they've already thought of, there's no interest."
  R1: "Exactly. We're just carpenters. We don't know about anything else."
  R2: "The company only listens if it's their idea; otherwise, forget it."

  - (Construction Workers 3 and 4, Case 3)

Up to the Individual to Handle

- "I think it’s often forgotten whether things are ethically sound. There’s a task for me here—to consider, before passing anything on, whether I think it’s acceptable. That responsibility rests heavily on me as an employee. I don’t think everyone is aware of the ethical responsibility involved when documenting people without explicit consent or using photos elsewhere."

  - (VDC Professional 2, Case 1)

Summary of Ethics and Monitoring in the Three Cases

- The overarching goals of technologies are to optimize time, efficiency, earnings, and productivity.
- Some technologies point towards sensible occupational safety directions—improving communication, risk identification, etc.
- However, surveillance technologies introduce challenges and are increasingly used.
  - Unclear purposes – "for fun."
  - Unlimited usage.
  - No employee involvement (are they informed?).
  - It's left to individual OSH coordinators, VDC professionals, site managers, etc., to handle.

Thank you for today.

- What’s to come?
  - Accimapping in construction and civil engineering.
  - Technology development – automation of safety rules and guidance.
    - If this interests you, contact:
      - jza@nfa.dk

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