

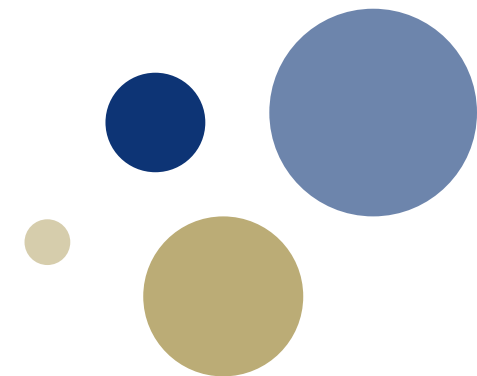


**Norwegian Labour
Inspection Authority**



NTNU

Norwegian University of
Science and Technology

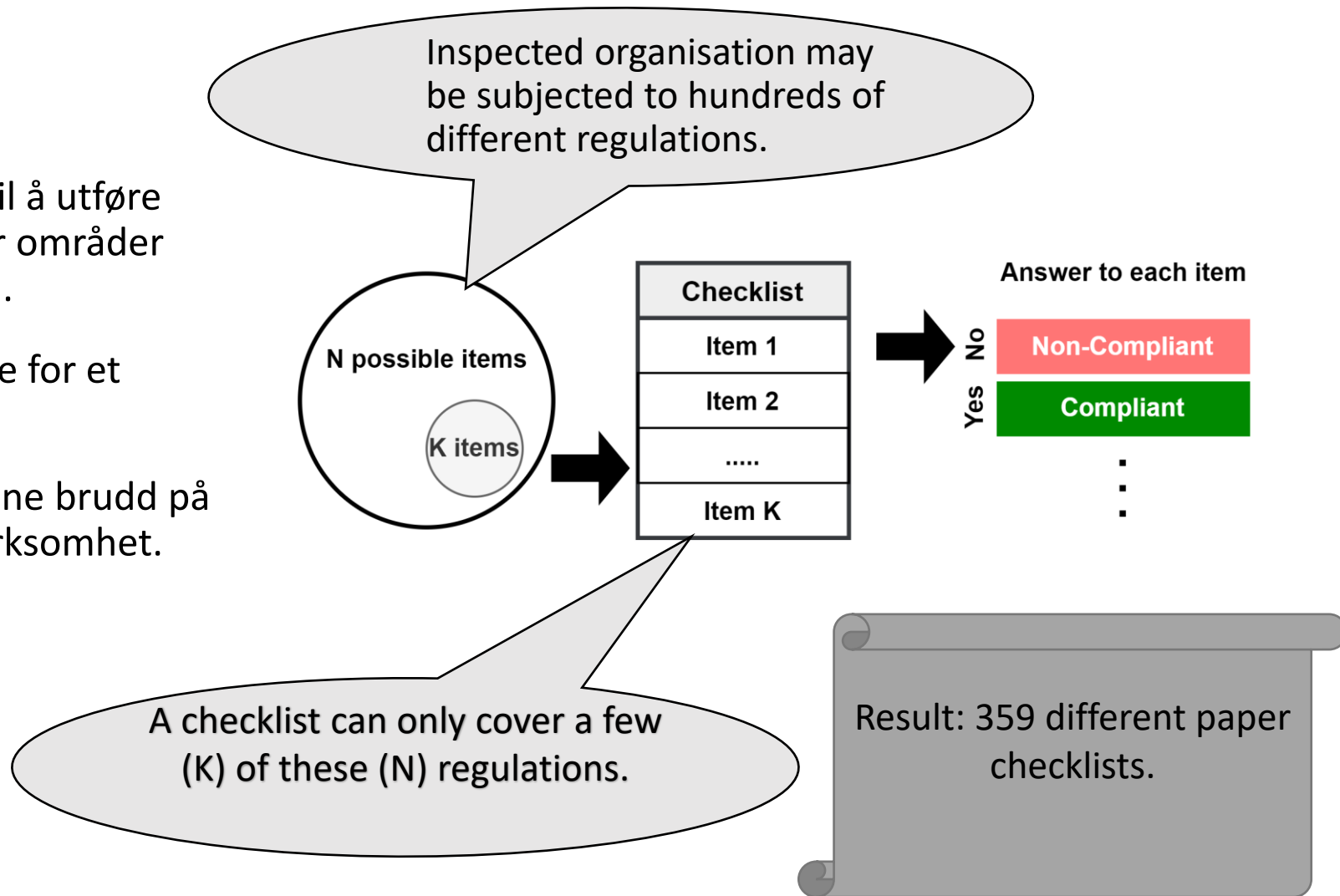


Bruk av kunstig intelligens for dynamiske sjekklister i tilsyn

Eirik Lund Flogard,
Seniorrådgiver i Arbeidstilsynet

Bakgrunn

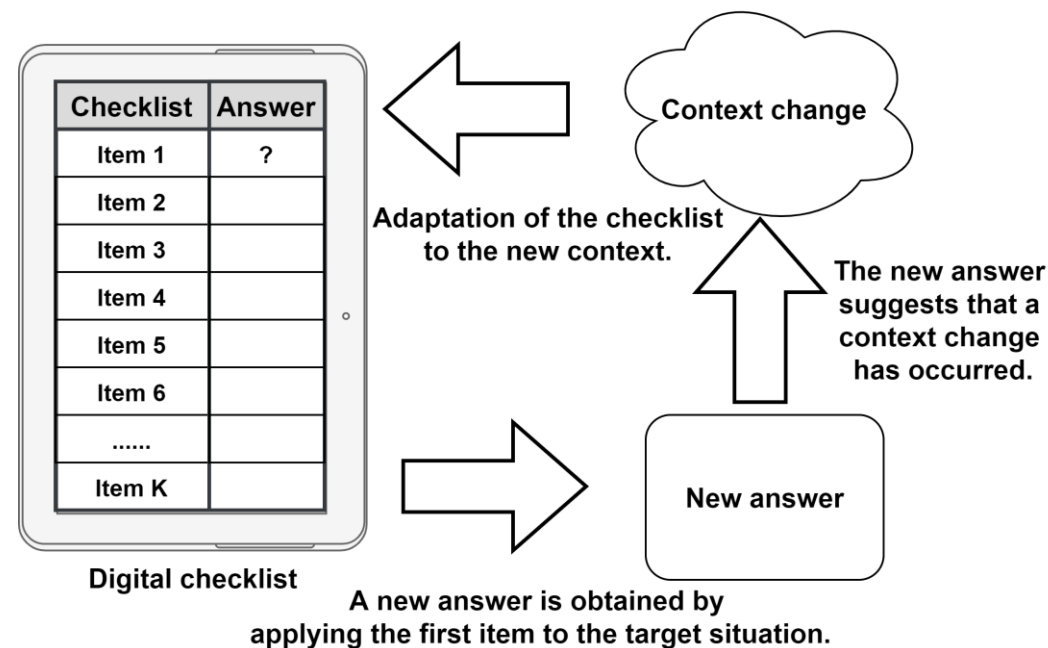
- Sjekklister brukes som hjelpemiddel til å utføre sikkerhetsrelaterte oppgaver innenfor områder som luftfart , kirurgi, romfart og tilsyn.
- Arbeidstilsyn gjennomføres for å sørge for et sikkert arbeidsmiljø.
- Inspektører bruker sjekklister for å finne brudd på Arbeidsmiljøloven hos den enkelte virksomhet.



Kan vi finne et bedre alternativ til de nåværende sjekklisterne?

Motivasjon – Dynamiske Sjekklister

- Et av formålene ved tilsyn er å innhente opplysninger (muntlig/skriftlig).
 - Opplysningene danner grunnlaget for å avdekke brudd på arbeidsmiljøloven.
- Nåværende sjekklister er statiske og ikke lett å tilpasse etter de er opprettet.
- Digitale smarte dynamiske sjekklister kan derimot tilpasses og endres automatisk under bruk [1].



[1] Eirik Lund Flogard, Ole Jakob Mengshoel and Kerstin Bach: *Creating Dynamic Checklists via Bayesian Case-Based Reasoning: Towards Decent Working Conditions for All*. International Joint Conference on Artificial Intelligence (IJCAI), 2022.



Prototype

Input er en dagligvarebutikk i Trondheim

Checklist Generator
Checklist length Save Excel

Input (inspection)

Municipality Municipality number County Industry subgroup code Industry main area code

Checklist

Organisational working conditions

Does the employer ensure that the employees work within the framework in Chapter 10 of the Working Environment Act? (Non-compliance)

Does the employer have a routine for discussing, evaluating and informing about control measures? (Yes)

Does the employer ensure that the employees have a daily work-free period between two main work periods, of at least 11 hours, possibly agreed down to 8 hours? (Yes)

Systematic work environment

Has the employer carried out a risk assessment on the basis of a survey of factors that may affect the employees physical and mental health and safety?

Has the company chosen a safety representative?

Has the customer of cleaning services in the contract with the cleaning company been informed that the cleaning companys employees must have at least the pay and working conditions that follow from the

Do customers of cleaning services have systems and routines to ensure that the pay and working conditions of the cleaning company from which they purchase services are in accordance with the current gen

Has the employer implemented the necessary measures and / or prepared a plan describing measures to remove or reduce hazards and problems at work?

Has the employer mapped the dangers and problems the employees may be exposed to in the company and on this basis assessed the risk of injury to or danger to the employees health and safety?

Does the employer ensure that the safety representative receives the necessary training?

tk

Given the current state of the inspection, you will likely find non-compliance to the following items:

- Does the company pay at least a 40 per cent supplement to the salary for overtime work?

Where your answer on the following items: Does the employer ensure that the employees work within the framework in Chapter 10 of the Working Environment Act? had the greatest impact.

Do you want to add these to the current checklist?

Generert sjekkliste med K=10 elementer

Anbefalt element og forklaring

Forklaringer peker tilbake til de besvarte punktene

Sjekkliste i Excel-format

The screenshot shows the Microsoft Excel interface with a checklist table. The ribbon is set to 'Hjem' (Home). The table has three columns: 'Probability for non-compliance', 'Answer', and 'Comment'. The rows contain various organizational and systematic work environment questions, each with a corresponding percentage in the 'Probability for non-compliance' column and a 'Yes' or 'Non-compliance' answer in the 'Answer' column.

	A	B	C	
		Probability for non-compliance	Answer	Comment
1	Checklist			
2	Organisational working conditions			
3	Does the employer ensure that the employees work within the framework in Chapter 10 of the Working Environment Act?	48%	Non-compliance	
4	Does the employer have a routine for discussing, evaluating and informing about control measures?	41%	Yes	
5	Does the employer ensure that the employees have a daily work-free period between two main work periods, of at least 11 hours, possibly agreed down to 8 hours?	46%	Yes	
6	Systematic work environment			
7	Has the employer carried out a risk assessment on the basis of a survey of factors that may affect the employees physical and mental health and safety?	52%		
8	Has the company chosen a safety representative?	40%		
9	Has the customer of cleaning services in the contract with the cleaning company been informed that the cleaning companys employees must have at least the pay and working conditions that follow from the general regulations for cleaning services?	62%		
10	Do customers of cleaning services have systems and routines to ensure that the pay and working conditions of the cleaning company from which they purchase services are in accordance with the current general regulations for cleaning services?	73%		
11	Has the employer implemented the necessary measures and / or prepared a plan describing measures to remove or reduce hazards and problems at work?	37%		
12	Has the employer mapped the dangers and problems the employees may be exposed to in the company and on this basis assessed the risk of injury to or danger to the employees health and safety?	40%		
13	Does the employer ensure that the safety representative receives the necessary training?	26%		
14	Added items			
15	Does the company pay at least a 40 per cent supplement to the salary for overtime work?	46%		
16				
17				

Side ved side sammenligning - ML- basert dynamisk kontra tradisjonell sjekkliste

ML- basert sjekkliste for et hotell i Oslo

Organisational working conditions

Has the employer ensured that the employment agreements are in line with the minimum requirements in the Working Environment Act § 14-6? (Non-compliance)

Does the employer ensure that the employees work within the framework in Chapter 10 of the Working Environment Act? (Non-compliance)

Does the company have a routine for detecting, correcting and preventing violations of the Working Environment Acts provisions on working hours? (Not relevant)

Does the employer ensure that the employees have a daily work-free period between two main work periods, of at least 11 hours, possibly agreed down to 8 hours? (Yes)

Systematic work environment

Has the employer mapped the dangers and problems the employees may be exposed to in the company and on this basis assessed the risk of injury to or danger to the employees health and safety?

ML-basert sjekkliste dekker de samme emnene som den tradisjonelle...
Og mer.

Den ML-baserte sjekklisten er også kortere.

Tradisjonell sjekkliste for hoteller og restauranter.

Does the employer ensure that a written working agreement is made with the employees?	Yes / No
Does the employer have a continuous overview of how much the individual employee works?	Yes / No
Has the employer ensured that the employee has received a written statement of the calculation method for salary, the calculation basis for holiday pay and deductions that have been made (payslip)?	Yes / No
Has the employer arranged to pay wages, including holiday pay and other compensation in cash, via bank to the employee's account?	Yes / No
Does the employer pay wages in accordance with regulations on generalization of collective agreements for accommodation, catering and catering businesses?	Yes / No
Has the employer paid wages and any other compensation in accordance with the current public policy decision?	Yes / No
Has the employer deducted the employee's wages for accommodation in the company in accordance with regulations on the generalization of collective agreements for accommodation, serving and catering businesses?	Yes / No

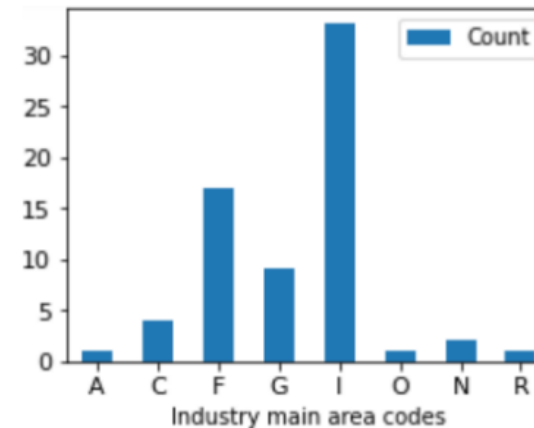
Data

- Bruker data fra nesten 60 000 tidligere tilsyn:
 - Mer enn 350 unike sjekklister
 - Nesten 2 000 unike sjekklisteelementer
- Features i datagrunnlaget– informasjon om tilsynsobjektet
 - Industri
 - Beliggenhet

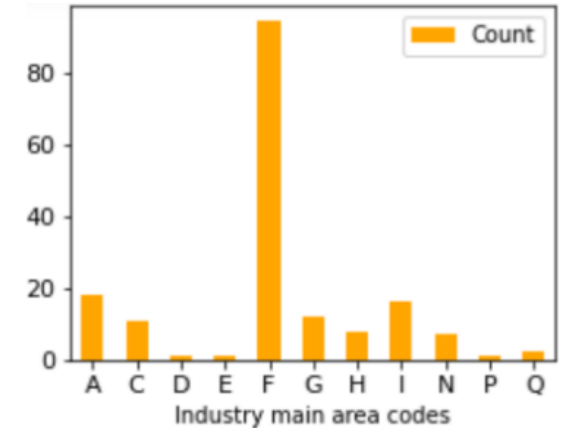


Feltstudie

- Syv inspektører fra Arbeidstilsynet deltok i et feltstudie [2].
- Testgruppe – 69 tilsyn.
 - Gjennomført med dynamiske sjekklister generert på prototypen .
- Kontrollgruppe – 171 tilsyn.
 - Gjennomført med tradisjonelle statiske sjekklister.
- Paret studie.



(a) Test group distribution of inspections using dynamic checklists.



(b) Control group distribution of inspections using paper-based checklists.

[2] Eirik Lund Flogard, Ole Jakob Mengshoel, Ole Magnus Theisen and Kerstin Bach: *Creating Explainable Dynamic Checklists via Machine Learning to Ensure Decent Working Environment for All*. European Conference on Artificial Intelligence (ECAI), 2023. Received a best paper award.



Resultater fra feltstudien

Quantitative results from the test and control group of inspections conducted in the study.

Test Group - Dynamic Checklists

	Acc&Food	Construction	Others	All
Avg. number of violations per inspection	9.03 ± 0.52	2.94 ± 0.76	3.53 ± 0.59	6.02 ± 0.54
Avg. precision	0.53 ± 0.02	0.17 ± 0.02	0.22 ± 0.02	0.35 ± 0.01
Avg. precision (dynamic items only)	0.71 ± 0.10	0.24 ± 0.09	0.12 ± 0.06	0.49 ± 0.08

Control Group - Traditional Checklists

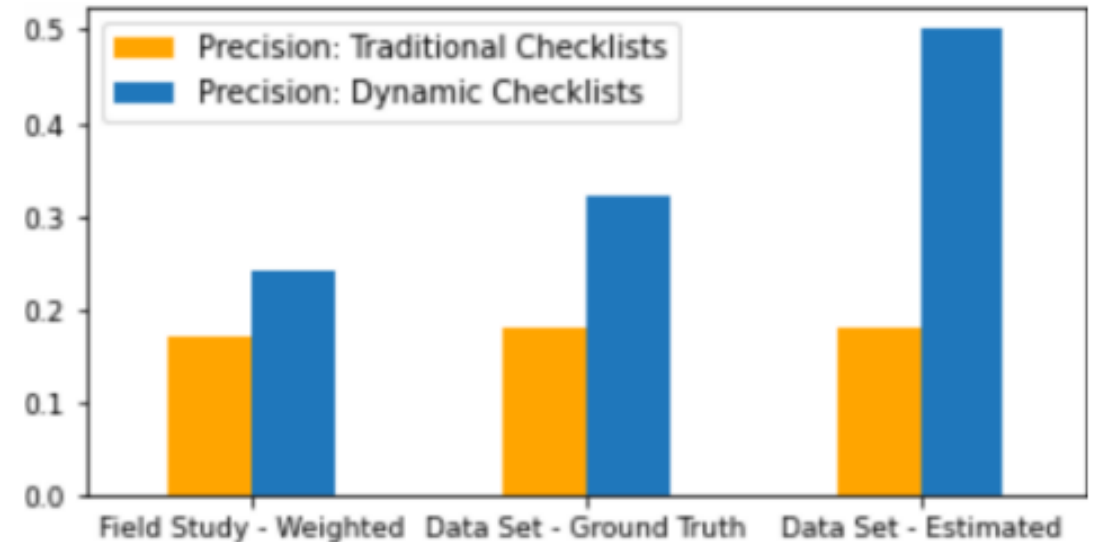
	Acc&Food	Construction	Others	All
Avg. number of violations	7.50 ± 0.86	2.88 ± 0.26	2.78 ± 0.38	3.70 ± 0.26
Avg. precision	0.42 ± 0.03	0.14 ± 0.01	0.15 ± 0.01	0.15 ± 0.01

Average relative frequency distribution of checklist answers per inspection from the test group in the field study.

	Acc&Food	Construction	Others	All
Non-compliance	0.53	0.17	0.22	0.35
Yes	0.42	0.52	0.59	0.49
Not controlled	0	0.06	0.04	0.03
Not relevant	0.04	0.25	0.15	0.13
Follow up later	0.01	0	0	0
Total	1.00	1.00	1.00	1.00

Oppsummert resultat fra feltstudien

- Resultater fra felt studie vs. prognose fra eksisterende data (kryssvalidering).
 - Skjevhetsskontrollert.
 - Antall brudd delt på sjekklstelengde.
 - Et høyere tall betyr at sjekklsten treffer bedre.
- Presisjon for tradisjonelle sjekklister :
 - Veldig lik for alle tilfeller.
- Presisjon for dynamiske sjekklister:
 - Prognosene er for optimistiske.



Konklusjon

Oppsummert:

- Utviklet en maskinlæringsmetode for å generere dynamiske smarte sjekklister.
- Gjennomført en feltstudie for å teste ML-baserte dynamiske sjekklister i tilsyn.
- Økt effektiviteten i tilsynene og gitt inspektørene bedre sjekklister.

Lærdom:

- Viktig å prøve ut nye konsepter før man tar dem i bruk.
- Brukerne bør involveres tidlig.
- Vurdere konseptet empirisk.

Implementere maskinlæringsmetoden/sjekklisene, samt videreutvikling.

Framtidig arbeid

- Hvordan skal sjekklisene integreres i virksomhetens arbeidsprosesser?
- Integrering av sjekklisene i saksbehandlingssystem og forbedring av grensesnittet.
- Flere muligheter for å forklare generert sjekklisestoff til inspektører .



Takk for at dere hørte på