Original

Toespraak gastspreker ter gelegenheid van de afscheidsrede van prof.dr.ir. P. A. Wieringa

3 maart 2023

Joost de Winter & Dimitra Dodou

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Uitgesproken tijdens de afscheidsrede van Prof.dr.ir. P. A. Wieringa:
Wieringa, P. A. (2023, March 3). Landschap van eigen aardigheden [video].
https://collegerama.tudelft.nl/mediasite/Showcase/public/Presentation/89d7501b88c14235852557d96ca58eec1d

Zo'n 20 jaar geleden was vrijdagmiddag rond deze tijd bijzonder voor mij, want dan was de wekelijkse meeting met Peter, mijn promotor. Aan de grote tafel, maar vaker nog staand voor het whiteboard, bood deze meeting volop stof tot nadenken. Ik sta hier vandaag deels namens mezelf en deels namens professor Joost de Winter, die vandaag helaas niet aanwezig kon zijn. We waren destijds twee van de laatste promovendi van Peter. In de komende vijf minuten zou ik graag drie voorbeelden willen schetsen van ideeën die hun oorsprong hadden in deze tijd.

Destijds heette de afdeling Man-Machine Systems. Dit is een screenshot van de website uit 2002. Peter gaf een vak met dezelfde naam, over onder meer fouten die kunnen optreden wanneer mensen interacteren met complexe machines. In één van zijn colleges werd een documentaire uit 1992 getoond, met daarin de psycholoog James Reason die sprak over de ramp met de olietanker Torrey Canyon in 1967 — ooit de ergste olieramp qua aantal tonnen olie die verloren gingen; tegenwoordig staat het op plaats 15. De tanker was gebotst met een rif, en een van de oorzaken was dat de autopiloot van het schip in een verkeerde 'modus' stond. Wat opvallend is, is dat fragmenten uit deze video nog altijd worden getoond op de faculteit, namelijk in het vak Human Robot Interaction. Er worden in dit vak klassieke voorbeelden van automatiserings-ongevallen besproken, iets dat relevant is vanwege de opkomst van robots en andere automatische systemen. Het noemenswaardige hier is dat een schijnbaar eenvoudige actie — Peter's beslissing om een video te betrekken in een college — 20 jaar later nog steeds invloed heeft, en zelfs aan relevantie heeft gewonnen.

Hier zijn nog vier dia's van Peter's colleges. In dit college maakte Peter een link tussen het Nyquist-Shannon sampling theorema uit de jaren vijftig — van de beroemde wiskundige Claude Shannon — en hoe mensen informatie samplen. Bijvoorbeeld: in complexe systemen, zoals cockpits van vliegtuigen, is de vraag hoe mensen optimaal hun aandacht moeten verdelen over verschillende informatiebronnen. Deze ideeën waren door onderzoeker John Senders in de jaren zestig ooit nader uitgewerkt: In zijn werk gaf Senders een klein aantal deelnemers de opdracht om meerdere wijzerplaten tegelijkertijd in de gaten te houden, en hij ontdekte dat de kijkfrequentie toenam met de frequentieinhoud van het signaal, overeenkomend met de informatietheorie van Shannon. Jaren later besloten Joost de Winter en Yke Bauke Eisma — inmiddels staflid bij de afdeling Cognitive Robotics — dit werk te

repliceren, hierbij gebruikmakend van moderne computers en eye-tracking-camera's, met bijna 100 deelnemers. Zij lieten zien dat het resultaat van Senders sterk repliceerde; en dit experiment leverde bovendien vele nieuwe inzichten op. Tegenwoordig werken zij aan een productieve onderzoekslijn, waarbij diverse promovendi en studenten zich bezighouden met hoe mensen visueel interacteren met robots en andere complexe systemen. Het interessante is dat het oplaten van een enkele ballonnetjes door Peter — hooguit enkele slides — voldoende is gebleken om een blijvend effect te sorteren.

Terug naar mijn eigen vrijdagmiddagen. Mijn promotieonderwerp ging over het ontwikkelen van een robot die zich kon voortbewegen in het menselijk lichaam. We waren op zoek naar de 'perfecte vorm' voor het creëren van maximale grip op zachte menselijke weefsels. Grote overzichtstabellen met verschillende vormen, zoals deze, hingen op Peter's whiteboard. Terwijl we probeerden een wiskundig model te formuleren voor het voorspellen van de hoeveelheid grip, kwam Joost met het idee om factoranalyse toe te passen, een statistische methode die zijn origine heeft in de gedragswetenschappen. Aangezien 'vorm' een complex begrip is — net zoals menselijke eigenschappen — zou factoranalyse wel eens effectief kunnen zijn… En, de methode bleek effectief, waarbij verschillende vormen geclusterd werden op onderliggende dimensies, welke voorspellende waarde hadden voor de hoeveelheid grip. Sommige mensen vroegen zich af waarom Peter's promovendi een schijnbaar nutteloze zijweg waren ingeslagen, maar Peter ondersteunde de ongebruikelijke combinatie van vakgebieden. Hij glunderde bij de voortgang, gaf niet teveel expliciete sturing, en liet ruimte voor het proces. Dit leidde tot een artikel gepubliceerd in *Multivariate Behavioral Research*— de eerste keer dat een ingenieursgroep daar publiceerde, en het werk is inmiddels meer dan 1,000 keer geciteerd. Vandaag spelen vergelijkbare analysemethoden een belangrijke rol binnen mens-gerelateerd onderzoek op de faculteit.

Uit wat ik heb gepresenteerd zijn, volgens ons, belangrijke lessen te trekken. Dit betreft het belang van:

(1) het creëren van een <u>voedingsbodem</u> (geef ruimte, tijd, en belast de promovendus niet met zaken die creativiteit tegenhouden, zoals politiek of financiën),
(2) <u>zaaien</u>: het af en toe loslaten van een idee of het bieden van een mogelijkheid, en
(3) het vervolgens laten <u>groeien</u>.

Dit zijn belangrijke ingrediënten gebleken voor een blijvend effect en stimulans, en is iets waar wij Peter Wieringa oneindig dankbaar voor zijn.

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Bijlage

Tabel. Top 15 grootste olierampincidenten op zee (zowel tankers als platforms).

	Tanker/Platform	Datum	Verloren tonnen[1]
1	Deepwater Horizon	20 April 2010–15 July 2010	559500
2	Ixtoc I	3 June 1979–23 March 1980	467000
3	SS Atlantic Empress	19 July 1979	287000
4	MV ABT Summer	28 May 1991	260000
5	MT Castillo de Bellver	6 August 1983	252000
6	Taylor Energy	16 September 2004–present	245485
7	VLCC Amoco Cadiz	16 March 1978	225000
8	MT Haven	11 April 1991	144000
9	Sanchi	6 January 2018	138000
10	Odyssey	10 November 1988	132000
11	MV Sea Star	19 December 1972	115000
12	T/V Texaco Denmark	7 December 1971	107000
13	Irenes Serenade	23 February 1980	100000
14	Urquiola	12 May 1976	100000
15	Torrey Canyon	18 March 1967	99500

Peildatum: 1 maart 2023.

[1]Bron: Wikipedia (2023). List of oil spills. https://en.wikipedia.org/wiki/List_of_oil_spills. In het geval een bereik is gegeven is de middenwaarde ((min+max)/2) genomen. Opzettelijke olielozingen (bijv. aanslagen) zijn uitgesloten.

Translation

Guest speaker speech on the occasion of the valedictory lecture by prof. dr. ir. P. A. Wieringa

3 March 2023

Joost de Winter & Dimitra Dodou

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Delivered during the valedictory lecture of Prof. Dr. Ir. P. A. Wieringa:
Wieringa, P. A. (2023, March 3). Landschap van eigen aardigheden [Landscape of peculiarities] [video].
https://collegerama.tudelft.nl/mediasite/Showcase/public/Presentation/89d7501b88c14235852557d96ca58eec1d

About 20 years ago, Friday afternoon around this time was special to me, because then there was the weekly meeting with Peter, my supervisor. At the large table, but more often standing in front of the whiteboard, this meeting provided plenty of food for thought. I stand here today partly on my own behalf and partly on behalf of Professor Joost de Winter, who unfortunately could not be present today. We were then two of Peter's last doctoral candidates. In the next five minutes, I would like to sketch three examples of ideas that originated during this time.

At that time, the department was called Man-Machine Systems. This is a screenshot of the website from 2002. Peter taught a course with the same name, about errors that can occur when people interact with complex machines. In one of his lectures, a 1992 documentary was shown featuring the psychologist James Reason talking about the Torrey Canyon oil tanker disaster in 1967 — once the worst oil spill in terms of tons of oil lost; nowadays it ranks 15th. The tanker collided with a reef, and one of the causes was that the ship's autopilot was in the wrong 'mode'. What is remarkable is that clips from this video are still shown at the faculty, namely in the course Human Robot Interaction. This course discusses classic examples of automation accidents, something that is relevant because of the rise of robots and other automatic systems. The notable thing here is that a seemingly simple action — Peter's decision to incorporate a video into a lecture — still has an impact 20 years later, and has even gained relevance.

Here are four more slides from Peter's lectures. In this lecture, Peter made a link between the Nyquist-Shannon sampling theorem from the 1950s — by the famous mathematician Claude Shannon — and how people sample information. For example: in complex systems, such as airplane cockpits, the question is how people should optimally distribute their attention among different sources of information. These ideas were further developed by researcher John Senders in the 1960s: In his work, Senders assigned a small number of participants to monitor multiple dials at once, and he discovered that the viewing frequency increased with the signal's frequency content, consistent with Shannon's information theory. Years later, Joost de Winter and Yke Bauke Eisma — now a staff member at the Cognitive Robotics department — decided to replicate this work, using modern computers and eye-tracking cameras, with almost 100 participants. They showed that Sender's result strongly replicated; and this experiment also

provided many new insights. Today, they are working on a productive research line, with various PhD students and students investigating how people visually interact with robots and other complex systems. The interesting thing is that Peter's launching of a single balloon — at most a few slides — turned out to be enough to have a lasting effect.

Back to my own Friday afternoons. My dissertation topic was about developing a robot that could move in the human body. We were looking for the 'perfect shape' for creating maximum grip on soft human tissues. Large overview tables with different shapes, like this one, hung on Peter's whiteboard. As we tried to formulate a mathematical model to predict the amount of grip, Joost came up with the idea of applying factor analysis, a statistical method that originated in the behavioral sciences. Since 'shape' is a complex concept — just like human traits — factor analysis could be effective... And indeed, the method proved effective, with different shapes being clustered on underlying dimensions, which had predictive value for the amount of grip. Some people wondered why Peter's doctoral candidates had taken what seemed to be a pointless detour, but Peter supported the unusual combination of disciplines. He was gleeful at the progress, didn't provide too much explicit guidance, and left room for the process. This led to an article published in Multivariate Behavioral Research — the first time that an engineering group had published there, and the work has since been cited more than 1,000 times. Today, similar analysis methods play an important role in human-related research at the faculty.

From what I have presented, we believe there are important lessons to be learned. These concern the importance of:

(1) creating a fertile ground (provide space, time, and do not burden the PhD candidate with matters that inhibit creativity, such as politics or finances),
(2) sowing: occasionally letting go of an idea or providing an opportunity, and
(3) then letting it grow.

These have turned out to be important ingredients for a lasting effect and stimulus, and for this, we are infinitely grateful to Peter Wieringa.

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Appendix

Table. Top 15 largest marine oil spill incidents (both tankers and platforms).

	Tanker/Platform	Date	Lost tons[1]
1	Deepwater Horizon	20 April 2010–15 July 2010	559500
2	Ixtoc I	3 June 1979–23 March 1980	467000
3	SS Atlantic Empress	19 July 1979	287000
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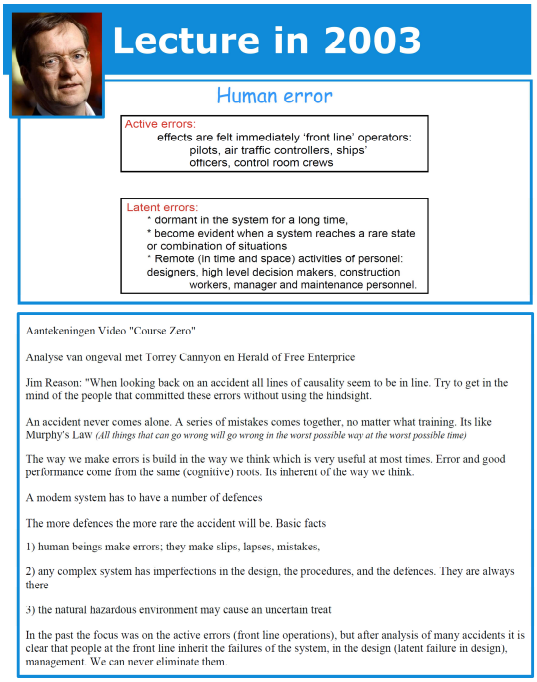
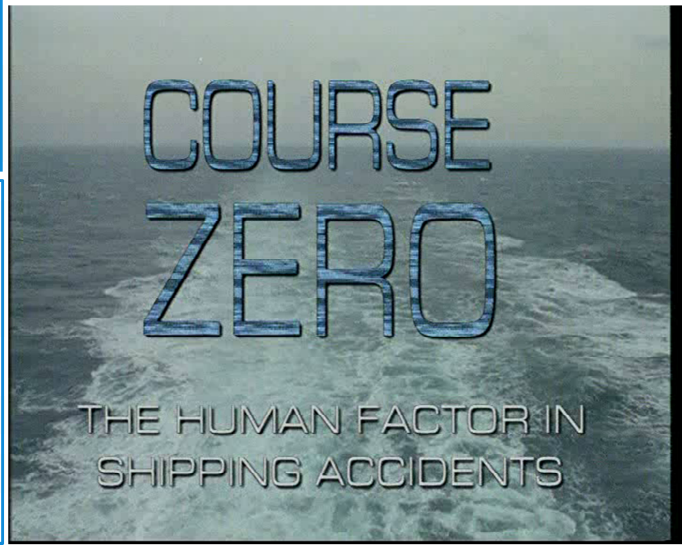
13	Irenes Serenade	23 February 1980	100000
14	Urquiola	12 May 1976	100000
15	Torrey Canyon	18 March 1967	99500

As of: 1 Maart 2023.

[1]Source: Wikipedia (2023). List of oil spills. https://en.wikipedia.org/wiki/List_of_oil_spills. If a range is given, the midpoint ((min+max)/2) is taken. Intentional oil spills (e.g., attacks) are excluded.

Bijhorende slides
[Associated slides]





Lecture in 2003

Human error

Active errors:
effects are felt immediately 'front line' operators:
pilots, air traffic controllers, ships' officers, control room crews

Latent errors:
* dormant in the system for a long time,
* become evident when a system reaches a rare state or combination of situations
* Remote (in time and space) activities of personel: designers, high level decision makers, construction workers, manager and maintenance personnel.

Aantekeningen Video "Course Zero"

Analyse van ongeval met Torrey Cannyon en Herald of Free Enterprice

Jim Reason: "When looking back on an accident all lines of causality seem to be in line. Try to get in the mind of the people that committed these errors without using the hindsight.

An accident never comes alone. A series of mistakes comes together, no matter what training. Its like Murphy's Law *(All things that can go wrong will go wrong in the worst possible way at the worst possible time)*

The way we make errors is build in the way we think which is very useful at most times. Error and good performance come from the same (cognitive) roots. Its inherent of the way we think.

A modern system has to have a number of defences

The more defences the more rare the accident will be. Basic facts

1) human beings make errors; they make slips, lapses, mistakes,

2) any complex system has imperfections in the design, the procedures, and the defences. They are always there

3) the natural hazardous environment may cause an uncertain treat

In the past the focus was on the active errors (front line operations), but after analysis of many accidents it is clear that people at the front line inherit the failures of the system, in the design (latent failure in design), management. We can never eliminate them.

Lecture in 2023

Remote factors

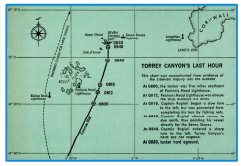
Proximal factors
- Persons in workplace
- Individual responsibility
- "Sharp end"
- Short history
- Active failures
- Human error causes accidents

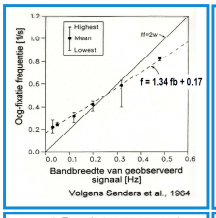
Remote factors
System, organization, society
- Collective responsibility
- "Blunt end"
- Long history
- Latent failures
- Human error is a consequence

*"In the **past**, the focus, the spotlight, was always upon the **active failures**; the failures of the people at the **sharp end**: the officers, the master ...*

*but since the Herald of Free Enterprise, since other accidents of that complexity, it is now clear that these people on the bridge or on the ship are often the **inheritors of long term failures in the system**. Failures that have been lying around for many years often without doing any harm and which arise from fallible decisions made in the higher regions of the organization, in the **organizational and managerial spheres**, and these are what we call **latent failures**."*

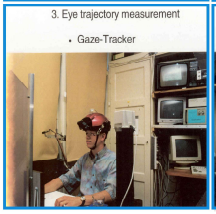
Torrey Canyon, 18 March 1967

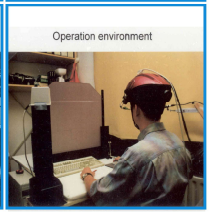




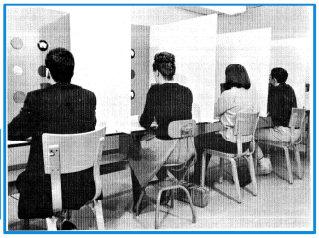
Senders (1984)
the nature of the eignale drivoe the monitoring behavior rather than the method of display.
=> *bandwidth, #events*

Moray (1986)
- *Practice* of subjects affects monitoring behavior; experienced subjects are more more sensitive to the dynamics and statistics of the obtained signals

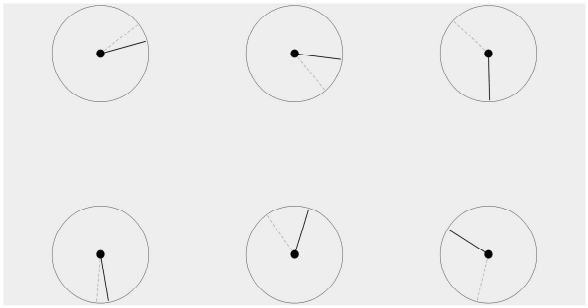


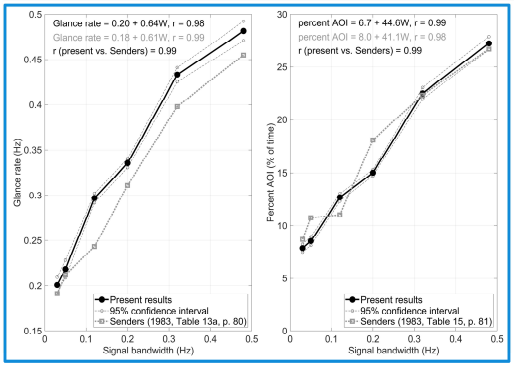


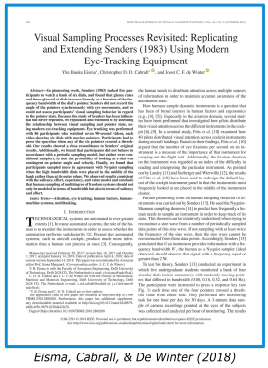
Claude Shannon (1916–2001)



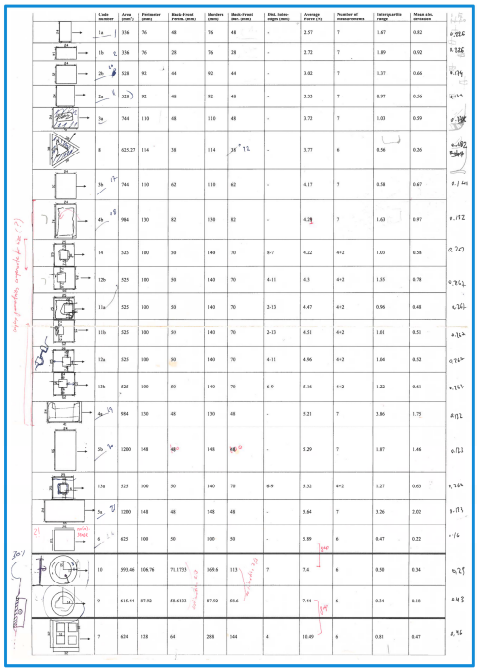
John Senders (1920–2019)



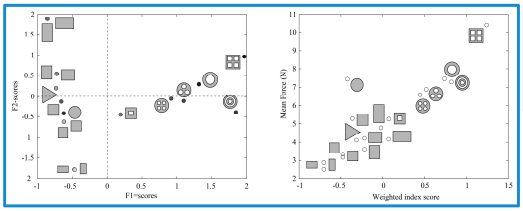



Visual Sampling Processes Revisited: Replicating and Extending Senders (1983) Using Modern Eye-Tracking Equipment

Eisma, Cabrall, & De Winter (2018)



Code number	Area (mm²)	Perimeter (mm)	Back-Front Points (mm)	Borders (mm)	Back-Front (ben. mm)	Dist. betw. edges (mm)	Average Force (N)	Number of measurements	Interquartile range	Mean abs. deviation
1a	336	76	48	76	48	-	2.57	7	1.67	0.82
1b	336	76	28	76	28	-	2.72	7	1.89	0.92
2b	528	92	44	92	44	-	3.02	7	1.37	0.66
2a	528	92	48	92	48	-	3.33	7	0.97	0.39
3a	744	110	68	110	48	-	3.72	7	1.03	0.59
8	625.27	114	38	114	38	-	3.77	6	0.56	0.26
3b	744	110	62	110	62	-	4.17	7	0.58	0.67
4b	984	130	82	130	82	-	4.38	7	1.63	0.97
14	343	100	30	100	30	3+7	4.42	4+2	1.03	0.28
12b	525	100	50	140	70	4-11	4.3	4+2	1.35	0.78
11a	525	100	50	140	70	2-13	4.47	4+2	0.96	0.48
11b	525	100	50	140	70	2-13	4.51	4+2	1.01	0.51
12a	525	100	50	140	70	4-11	4.96	4+2	1.04	0.52
13a	424	100	40	140	70	4-9	5.16	4+2	1.22	0.41
4a	984	130	48	130	48	-	5.21	7	3.86	1.75
5b	1280	148	68	148	68	-	5.29	7	1.87	1.46
13b	525	100	50	140	70	4-9	5.32	4+2	1.27	0.63
5a	1280	148	48	148	48	-	5.84	7	3.26	2.02
6	825	100	50	100	50	-	5.89	6	0.47	0.22
10	595.66	108.78	71.1735	169.6	113	7	7.4	8	0.58	0.34
9	418.44	87.92	48.4333	87.92	48.4		7.44	6	0.24	0.18
7	824	128	64	208	104	4	10.49	8	0.81	0.47



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Exploratory Factor Analysis With Small Sample Sizes

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Exploratory factor analysis (EFA) is generally regarded as a technique for large sample sizes (N), with $N = 50$ as a reasonable absolute minimum. This study offers a comprehensive overview of the conditions in which EFA can yield good quality results for N below 50. Simulations were carried out to estimate the minimum required N for different levels of loadings (λ), number of factors (f), and number of variables (p) and to examine the extent to which a small N solution can sustain the presence of small distortions such as interfactor correlations, model error, secondary loadings, unequal loadings, and unequal p/f. Factor recovery was assessed in terms of pattern congruence coefficients, factor score correlations, Heywood cases, and the gap size between eigenvalues. A subsampling study was also conducted on a psychological dataset of individuals who filled in a Big Five Inventory via the Internet. Results showed that when data are well conditioned (i.e., high λ, low f, high p), EFA can yield reliable results for N well below 50, even in the presence of small distortions. Such conditions may be uncommon but should certainly not be ruled out in behavioral research data.

Exploratory factor analysis (EFA) is one of the most widely used statistical methods in psychological research (Fabrigar, Wegener, MacCallum, & Strahan, 1999), prompted by the need to go beyond the individual items of tests and questionnaires to reveal the latent structure that underlies them. Factor analyses

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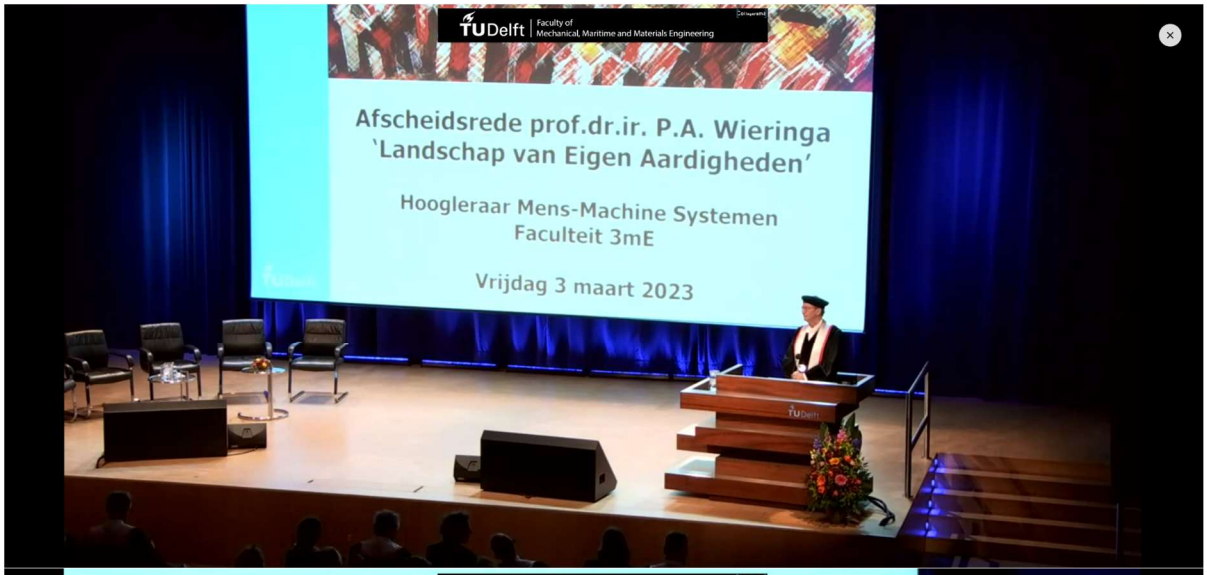

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