The Ghost, the Machine and the Requirements Engineer

Roel Wieringa

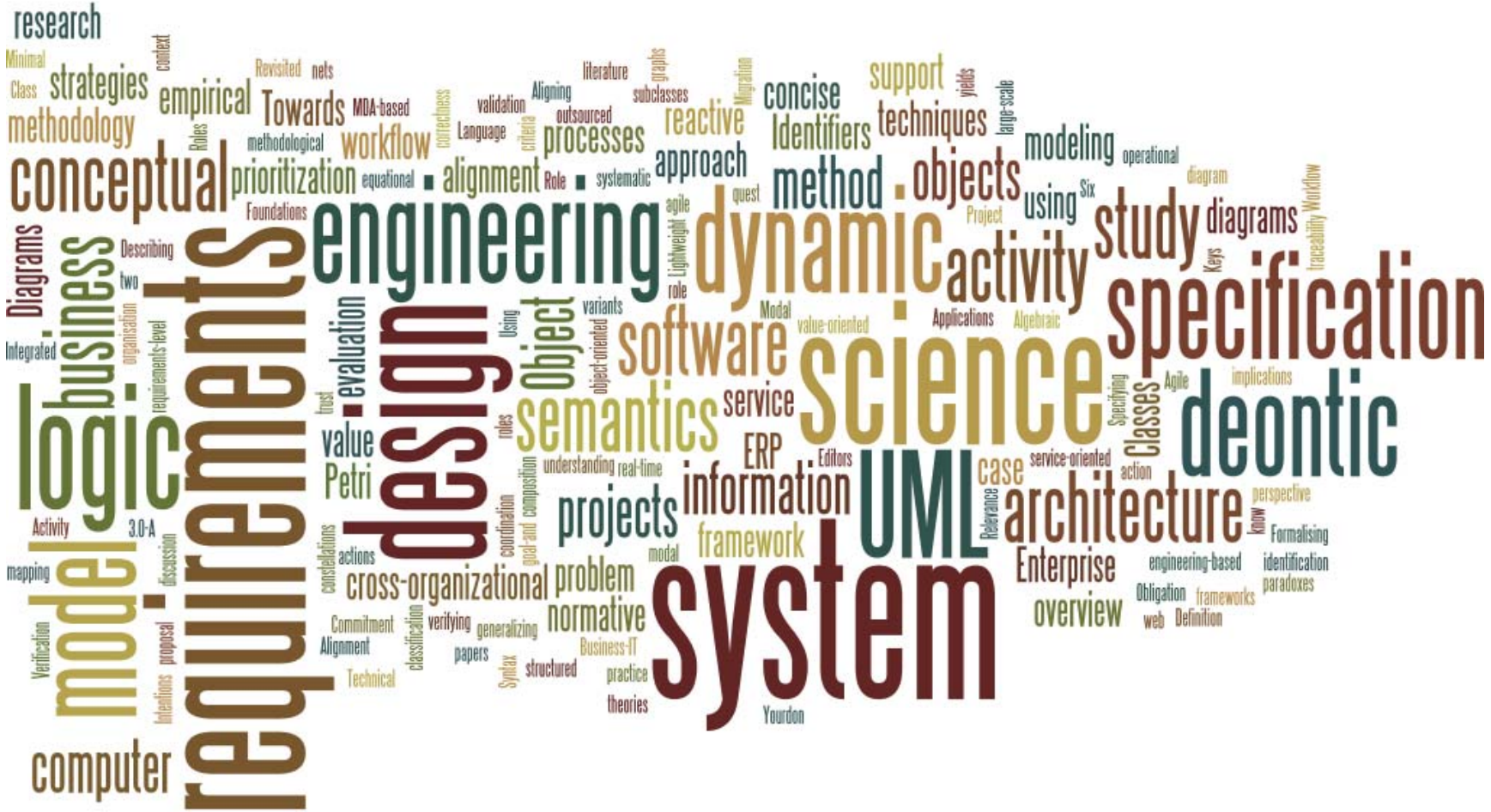
https://wwwhome.ewi.utwente.nl/~roelw/

What did I do?

An ego-document

Warning: There is no conclusion

Word cloud of the titles of my 50 most cited publications



1978: M.Sc Math, Univ. Of Groningen

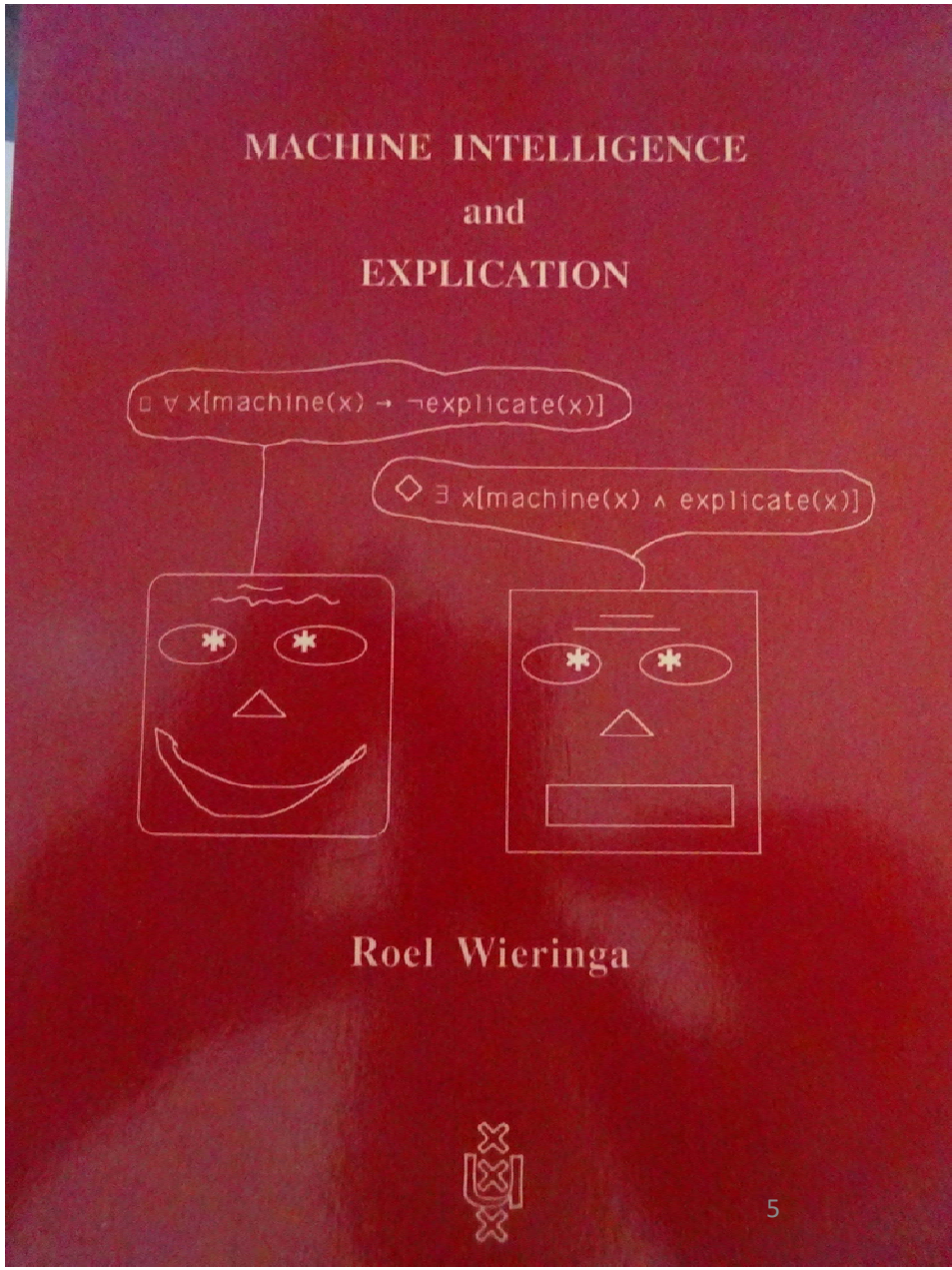
- 1978: Teacher of mathematics (Groningen, Zambia, Amsterdam)
- 1982: Programmer (Tilburg)
- 1984: Applied philosopher (a.k.a. “computer scientist”) (Wageningen, Amsterdam, Twente)

1987 M.A. philosophy, Univ. Of Amsterdam

- A machine is a system that is explicitly described

- So a machine cannot perform the process of explication

"To produce an explicit description of a phenomenon without accessing such a description of it."



From the Preface

"Therefore, in the interest of brevity, I stopped explicating when further explication would backfire and merely expose the emptiness of the argument.

That —the empty argument— would have been closer to the truth than the essay I wrote now.

But then, I wouldn't have passed the exam by handing in an empty paper."

"The movements start from the abdominal parts and the breath passing through the teeth produces various sounds. When articulated they linguistically make sense. Thus we clearly realize that they are unsubstantial." Rinzai (Lin-Chi, d. 867)

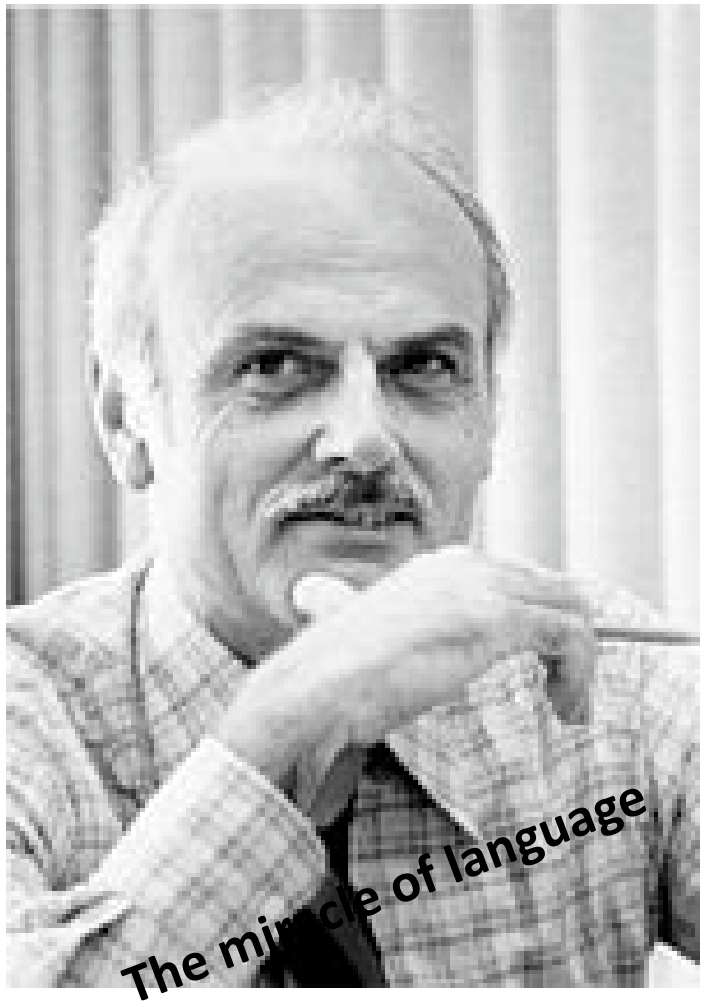
The miracle of language

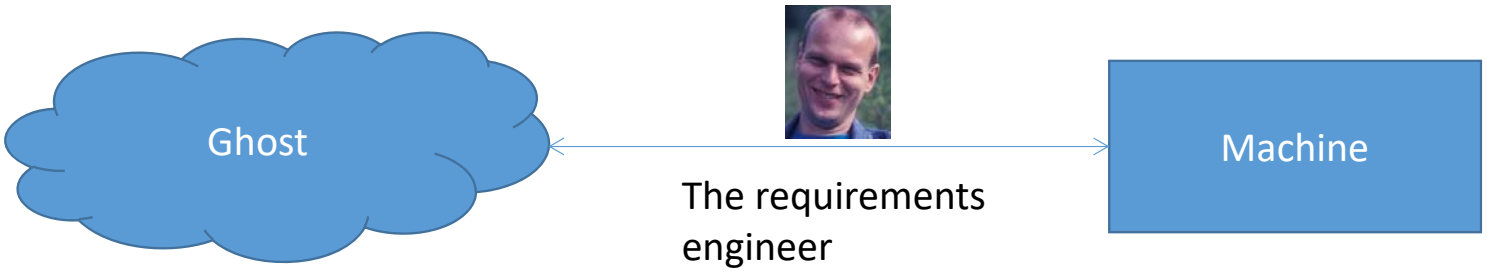
Making explicit what you mean is a never-ending process

"Actually, the task of capturing the meaning of data is a never-ending one."

E.F.Codd. "Extending the relational database model to capture more meaning".

Transactions on Database Systems, Vol 4, no. 4 (dec. 1979).

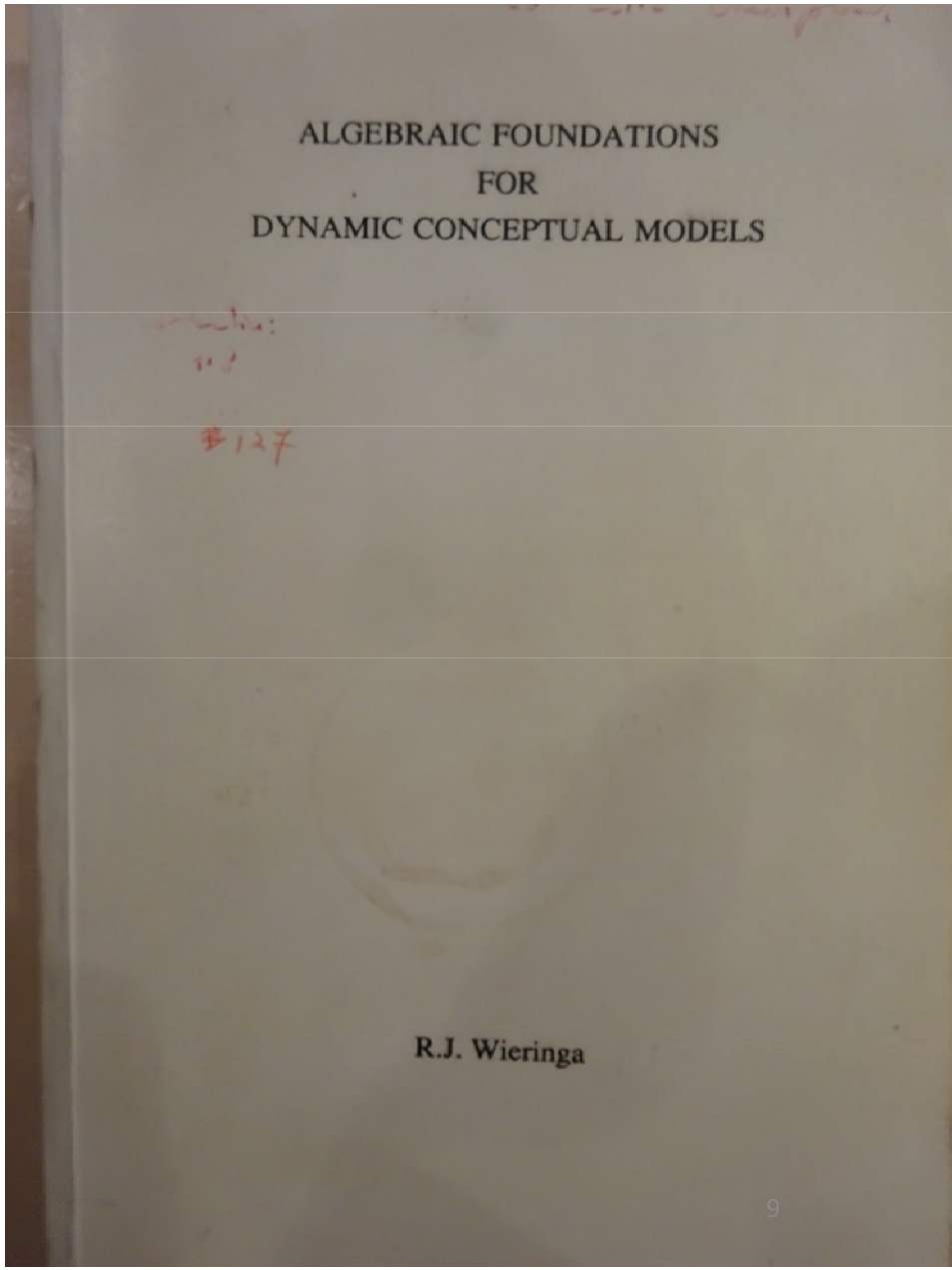




After arguing that conceptual modeling process cannot be formalized …

I started to write a PhD thesis on formalization of conceptual modeling.

1990: Algebraic Foundations for Dynamic Conceptual Models. PhD Thesis



From the Preface

"The approach in this thesis is more formal than what is customary in research into conceptual models, and makes less simplifications than is customary in theoretical computer science.

The result is that the number of details to be accounted for is large.

… this is necessary to achieve increased understanding and reliability …"

Very politically correct

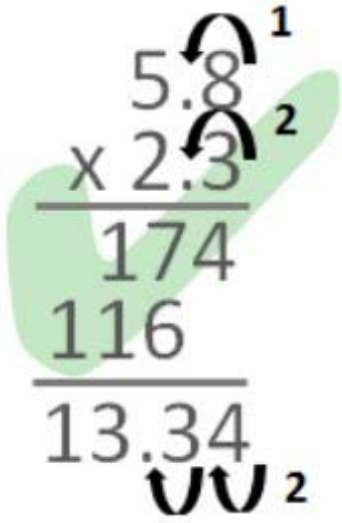
Got me accepted in a scientific community

Formalization

- The definition of physical symbols & their physical manipulation rules (based on their physical properties only)

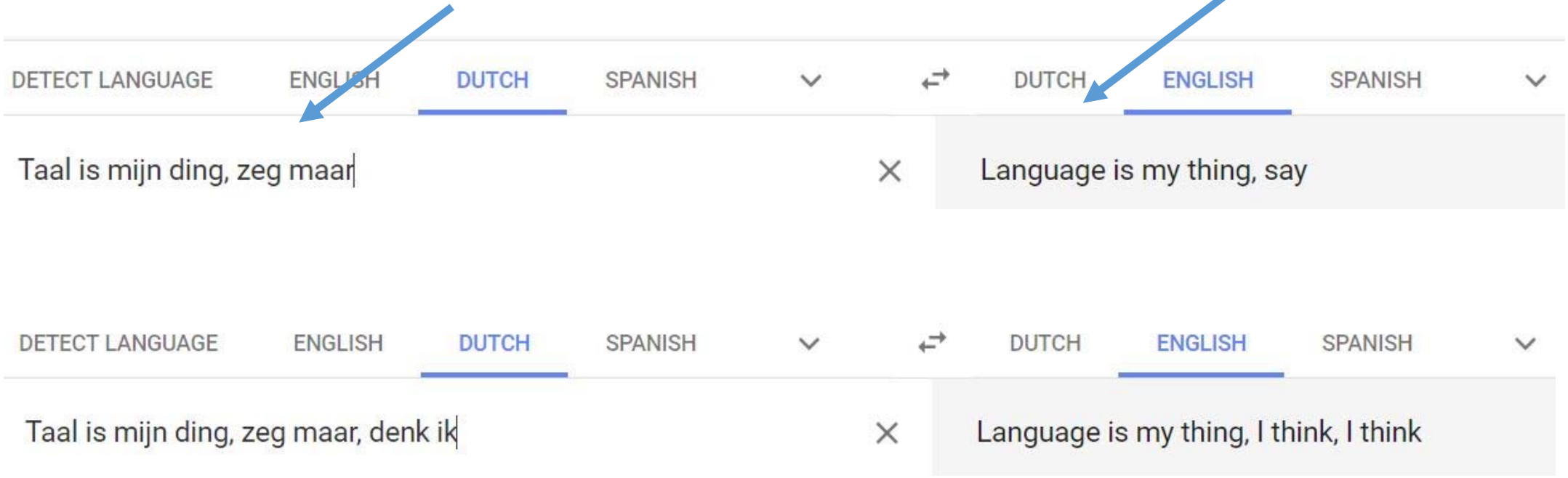
Form = a physical property

Formalization replaces meaning by physical symbol manipulation



Google translate: physical string matching

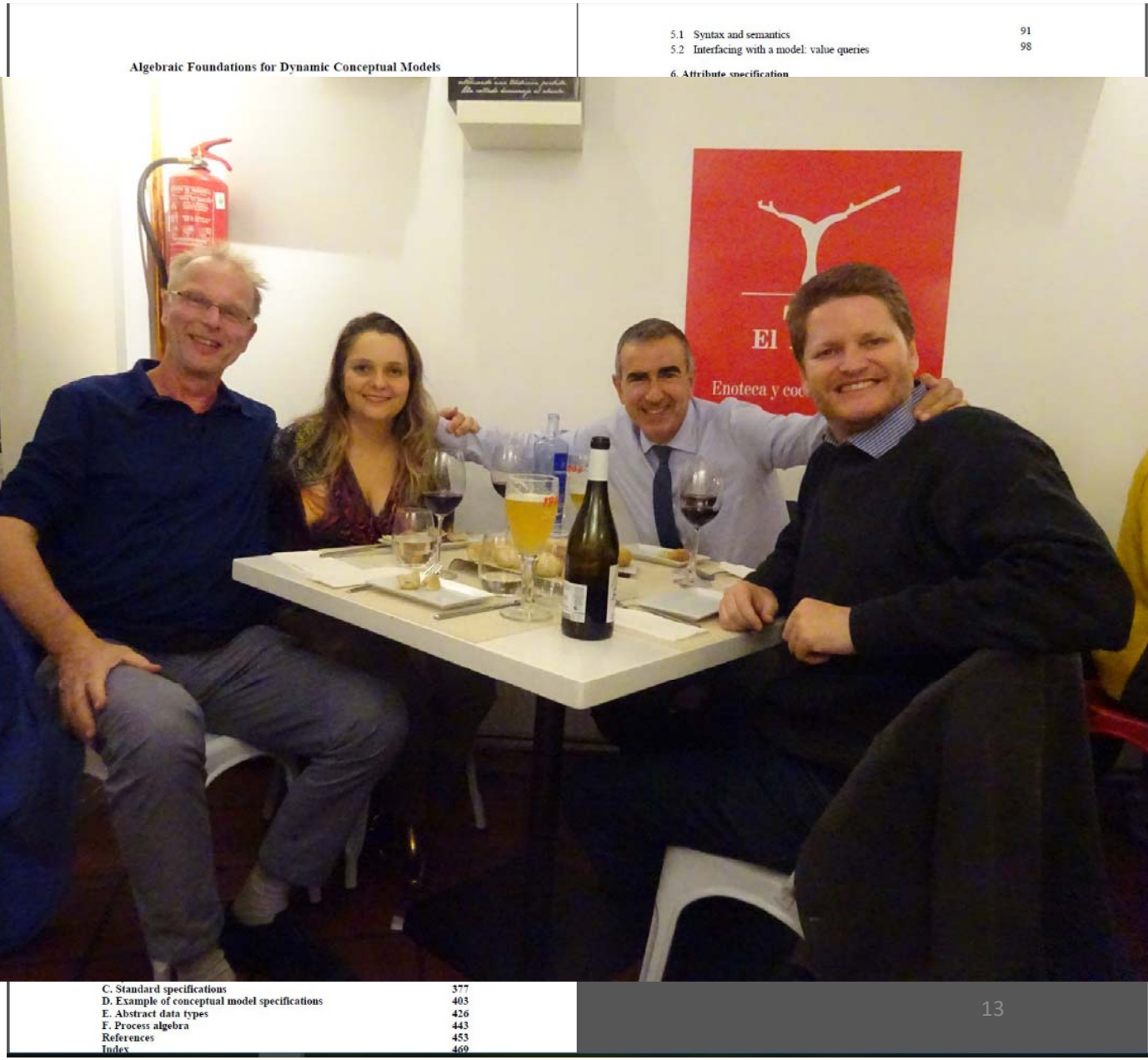
In a very large sample of written translations,
A string of words **like this** often translates into a string of words **like this**



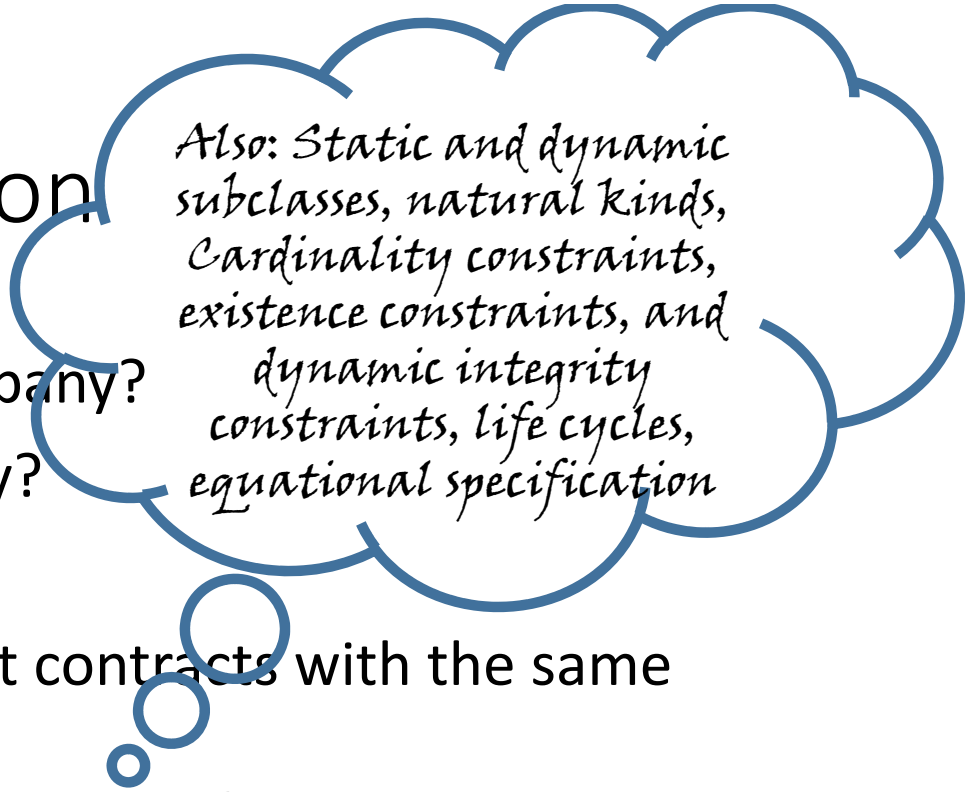
What formalizations did I create in my PhD thesis?

1. The world consists of communicating complex dynamic objects

2. Classification is identification



Classification is identification



- How many employees work in this company?
- How many people work in this company?

- One person can have three employment contracts with the same company
  - So *Employee* is not a subclass of *Person*; it is a *role* of person
  - When counting, we must know the class of things we are counting

- How many passengers, employees, products, services, immigrants?

What is the meaning of data?

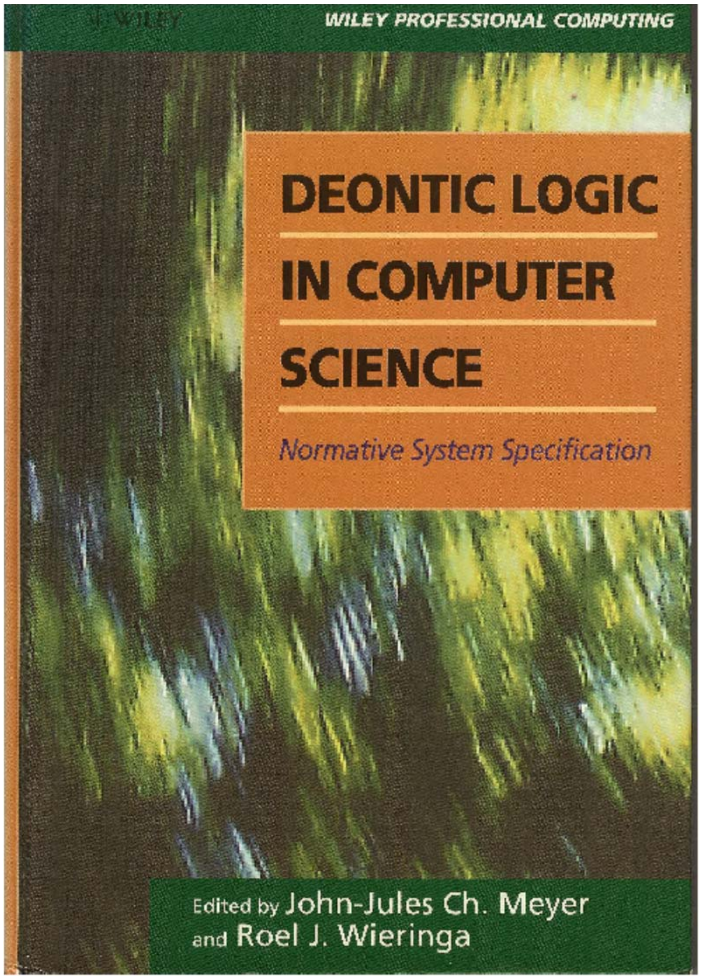
- The number of conditions that contribute to the meaning of data is infinite

- I really liked this.
  - Simple things are complex!

1993: Deontic Logic in Computer Science

- $F\alpha \equiv [\alpha]V$
- $P\alpha \equiv \neg F\alpha$
- $O\alpha \equiv F(-\alpha)$

- An action is forbidden if doing it leads to a violation
  - Only results count
- An action is permitted if it is not forbidden
  - Adolescent value system
- An action is obligated if it is forbidden not to do it
  - This is a bit difficult



The paradoxes of deontic logic

- $P\ (Chew\ gum)\ or\ P(Kill\ the\ king) \leftrightarrow P(Chew\ gum\ or\ Kill\ the\ king)$
- "There is a way of doing this that does not result in a violation"

- $P(Pim\ chooses\ to\ chew\ gum\ or\ kill\ the\ king) \rightarrow P(Pim\ chews\ gum)\ and\ P(Pim\ kills\ the\ king)$

Annals of Mathematics and Artificial Intelligence 7(1993)289–346

Actors, actions, and initiative in normative system specification

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J.-J.Ch. Meyer
Vrije Universiteit, Amsterdam and University of Nijmegen, The Netherlands

Abstract

The logic of norms, called deontic logic, has been used to specify normative constraints for information systems. For example, one can specify in deontic logic the constraints that a book borrowed from a library should be returned within three weeks, and that if it is not returned, the library should send a reminder. Thus, the notion of obligation to perform an action arises naturally in system specification. Intuitively, deontic logic presupposes the concept of an *actor* who undertakes actions and is responsible for fulfilling obligations. However, the concept of an actor has not been formalized until now in deontic logic. We present a formalization in dynamic logic, which allows us to express the actor who initiates actions or choices. This is then combined with a formalization, presented earlier, of deontic logic in dynamic logic, which allows us to specify obligations, permissions, and prohibitions to perform an action. The addition of actors allows us to express *who* has the responsibility to perform an action. In addition to the application

- "When a **judge** applies law to facts, the law is interpreted in the light of the facts, and the facts are interpreted in the light of the law"
- "When a **computer** applies a representation of law to representation of facts,

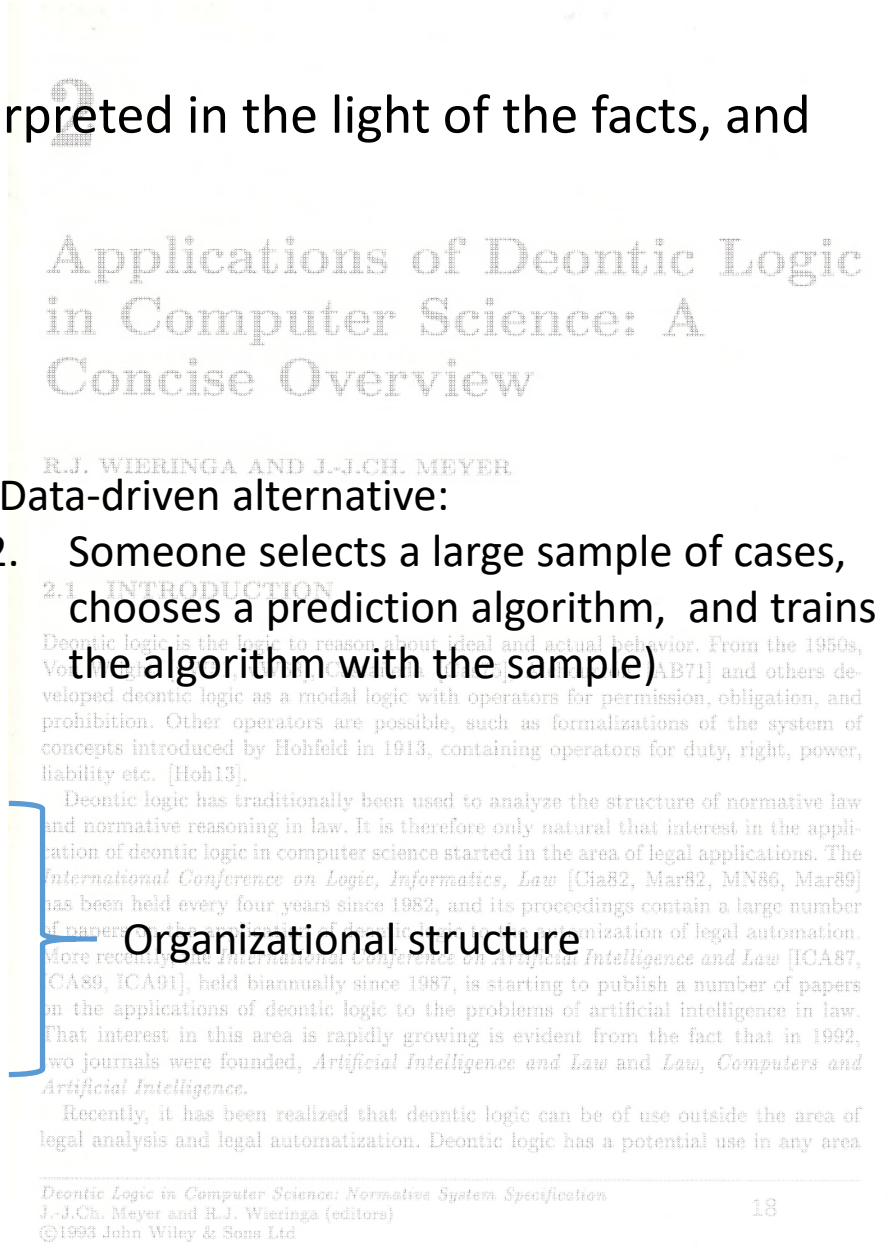
1. Someone selects an isolated area of law,
2. Someone translates this into a computer representation L,
3. Someone builds a representation of facts F,
4. After this, the computer applies L to F."

- And we must accept that the computer has the authority to do this,
- And have allocated responsibility to a person.

(Data-driven alternative:

2. Someone selects a large sample of cases, chooses a prediction algorithm, and trains the algorithm with the sample)

Organizational structure


Applications of Deontic Logic in Computer Science: A Concise Overview

R.J. WIERINGA AND J.-J.CH. MEYER

2.1 INTRODUCTION

Deontic logic is the logic to reason about ideal and actual behavior. From the 1950s, [...B71] and others developed deontic logic as a modal logic with operators for permission, obligation, and prohibition. Other operators are possible, such as formalizations of the system of concepts introduced by Hohfeld in 1913, containing operators for duty, right, power, liability etc. [Hoh13].

Deontic logic has traditionally been used to analyze the structure of normative law and normative reasoning in law. It is therefore only natural that interest in the application of deontic logic in computer science started in the area of legal applications. The *International Conference on Logic, Informatics, Law* [Gia82, Mar82, MN86, Mar89] has been held every four years since 1982, and its proceedings contain a large number of papers [...] organization of legal automation. More recently, the International Conference on *Artificial Intelligence and Law* [ICA87, ICA89, ICA91], held biannually since 1987, is starting to publish a number of papers on the applications of deontic logic to the problems of artificial intelligence in law. That interest in this area is rapidly growing is evident from the fact that in 1992, two journals were founded, *Artificial Intelligence and Law* and *Law, Computers and Artificial Intelligence*.

Recently, it has been realized that deontic logic can be of use outside the area of legal analysis and legal automatization. Deontic logic has a potential use in any area

Deontic Logic in Computer Science: Normative System Specification
J.-J.Ch. Meyer and R.J. Wieringa (editors)
©1993 John Wiley & Sons Ltd

18

Broersen, J (2003)

Modal Action Logics for reasoning about Reactive Systems.

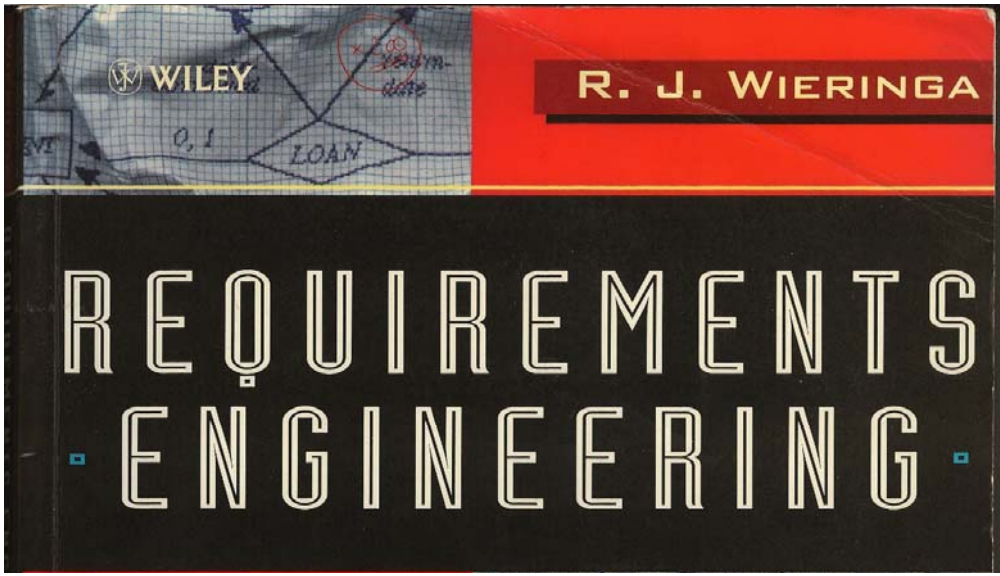
PhD Thesis, Free University of Amsterdam. ISBN 90-9016611-4.

Promotors Prof. Dr. R.J. Wieringa, Prof. Dr. J.-J.Ch. Meyer, Prof. Dr. R.P. van de Riet.

1996

My opinion now:

- Very solid
- Very boring



1 customer review

5.0 out of 5 stars

5 star	100%
4 star	0%
3 star	0%
2 star	0%
1 star	0%

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Showing 1-1 of 1 reviews

Top Reviews

A customer

One of the best books I have read on RE

April 29, 2004

Format: Paperback

This book provides a conceptual framework for understanding requirements that can be applied in any methodology. I do IV&V. For many of the requirements/SRS I see, the analysts don't have a good grasp on requirement levels: how far to decompose, what level of detail to include. After reading this book, where you are in the levels will always be clear to you, or if you got lost, you will be able to find your way back to where you should be.

Helpful | Comment | Report abuse

Troff and pic

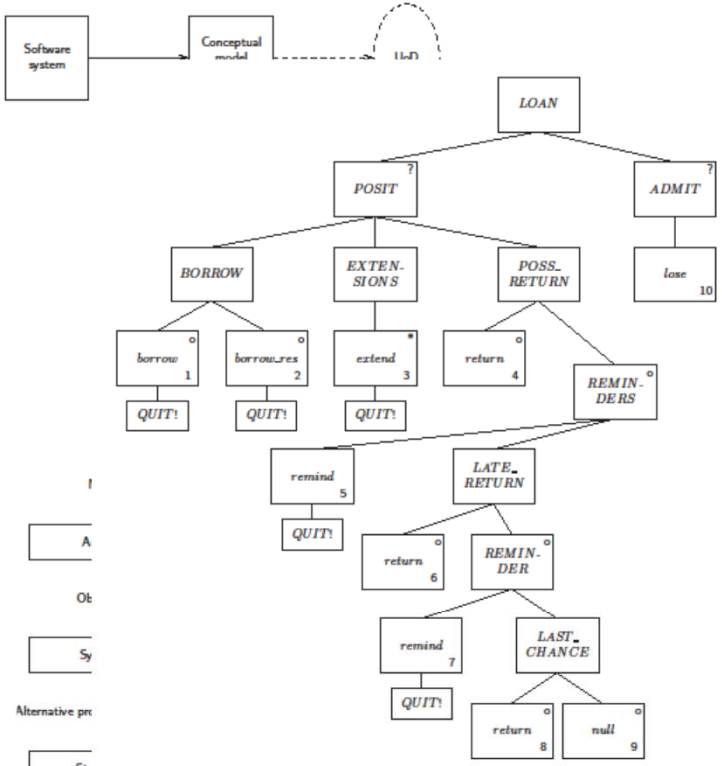


Figure 12.7: The *LOAN* life cycle. The numbers in the leaves are values for the life cycle indicator of *LOAN* instances.

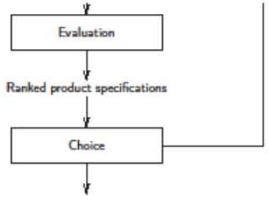


Figure 3.6: The engineering cycle.

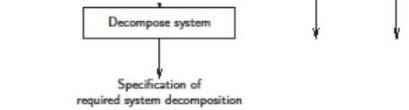


Figure 3.12: Requirements engineering and product specification.

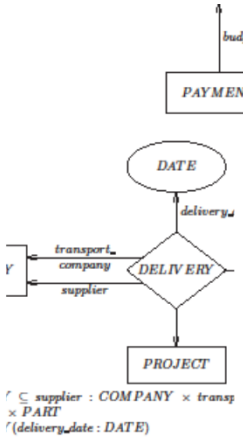


Figure 7.7: A relationship w

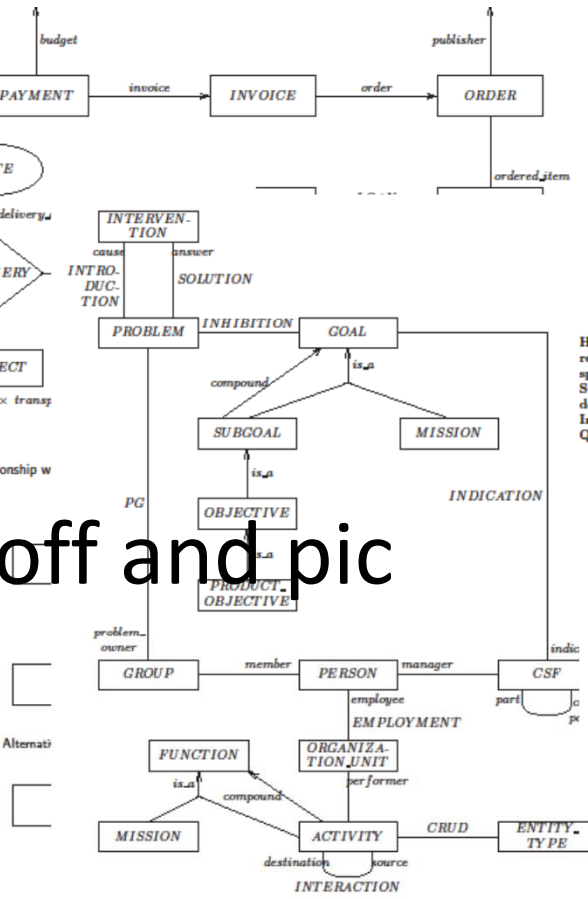


Figure 13.1: An integration of concepts from Change Analysis and ISP.

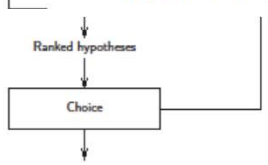


Figure 3.8: The empirical cycle.

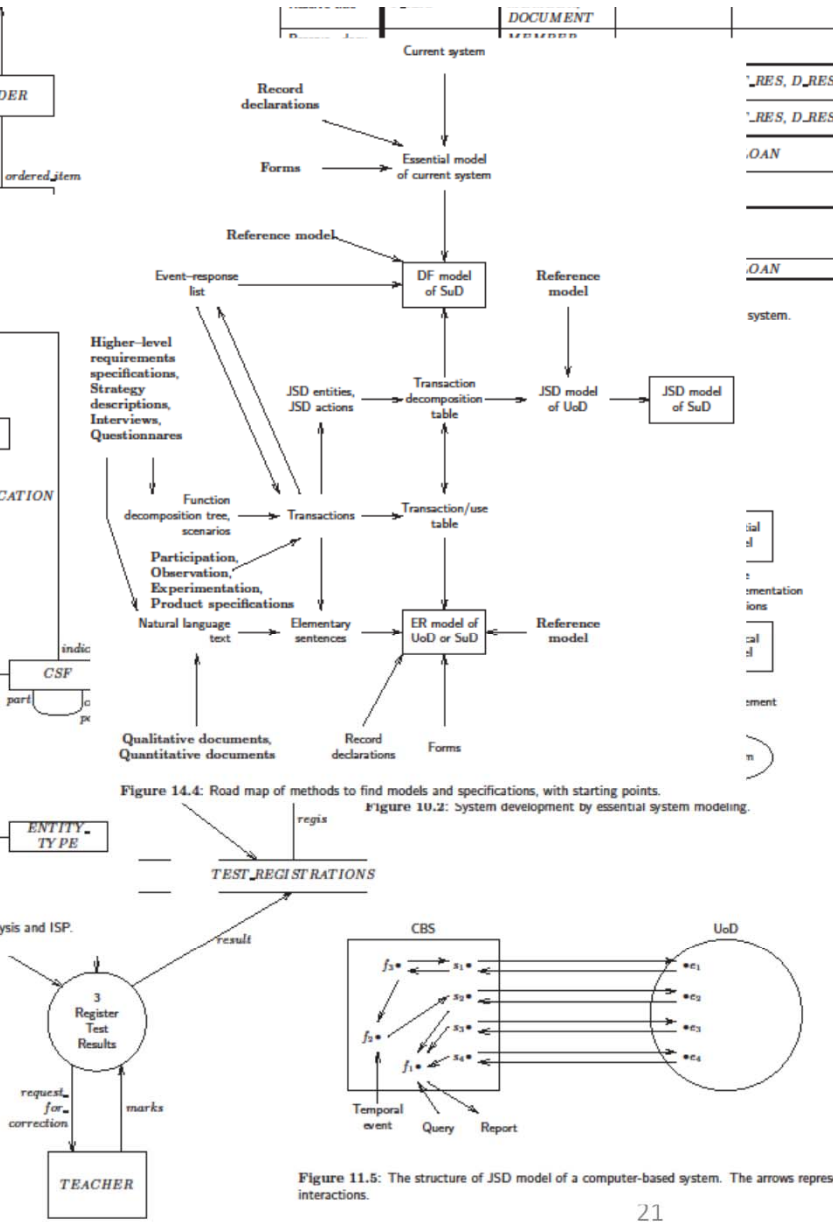


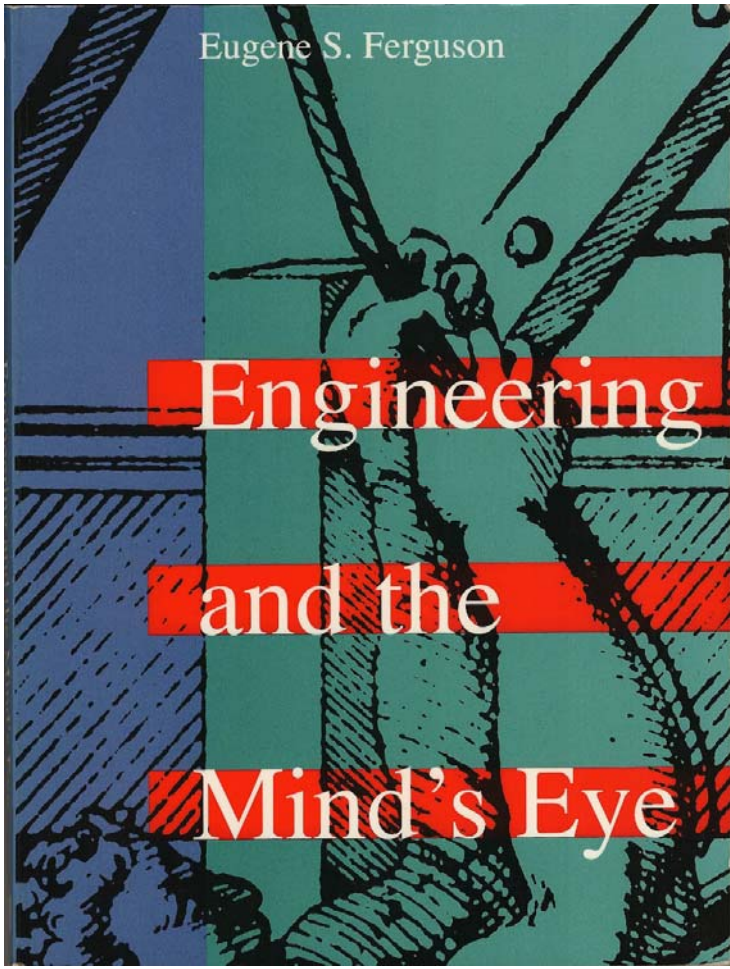
Figure 14.4: Road map of methods to find models and specifications, with starting points.

Figure 10.2: System development by essential system modeling.

Figure 11.5: The structure of JSD model of a computer-based system. The arrows represe interactions.

Figure 9.7: A DF diagram of part of the test administration.

Design thinking is visual thinking



"Before a thing is made, it exists as an idea."

"For more than 500 years, engineers have made increasing use of drawings to convey to workers what is in their heads."

For more than 20 years, students have skipped the text of my books and looked at the diagrams only.

Technical explanation requires physical hand-waving.

1999

vrije Universiteit amsterdam

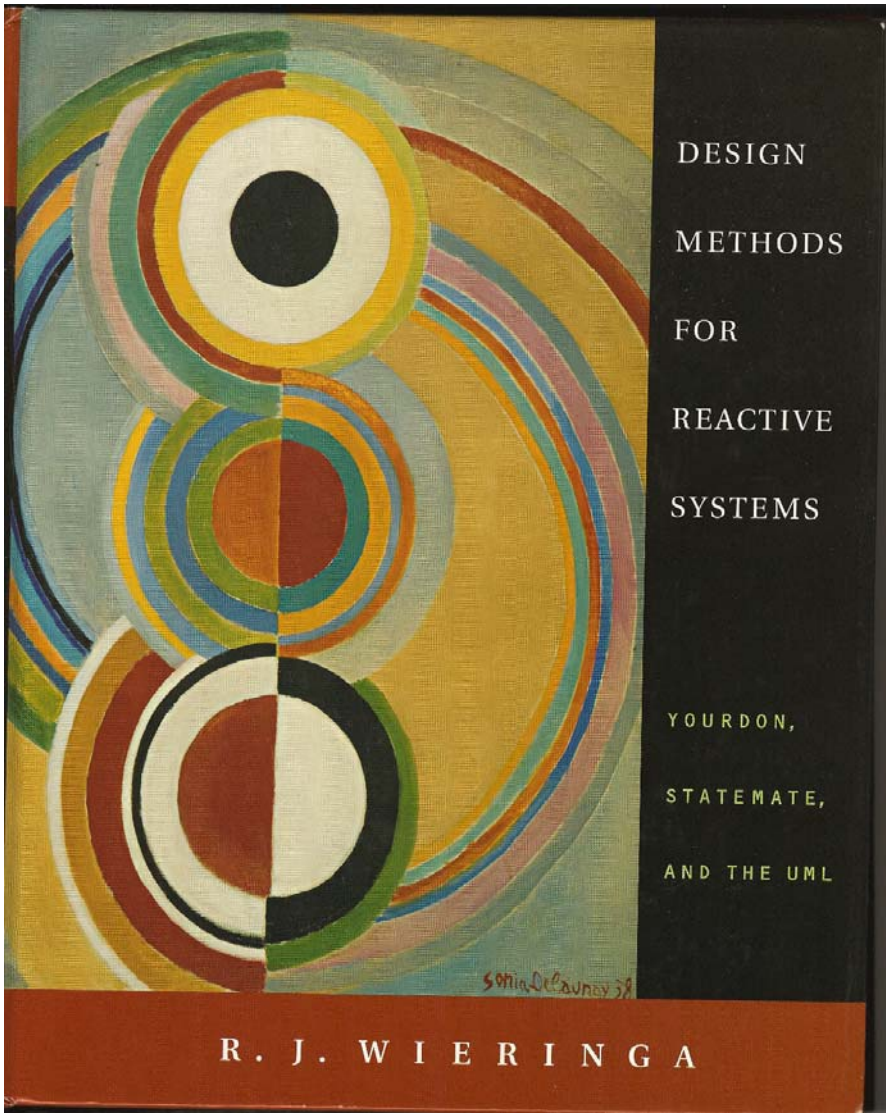
UNIVERSITY OF TWENTE.

2003

From the Preface:

“But more important than formalization is *precision*: The expression of what is intended without using redundant words.”

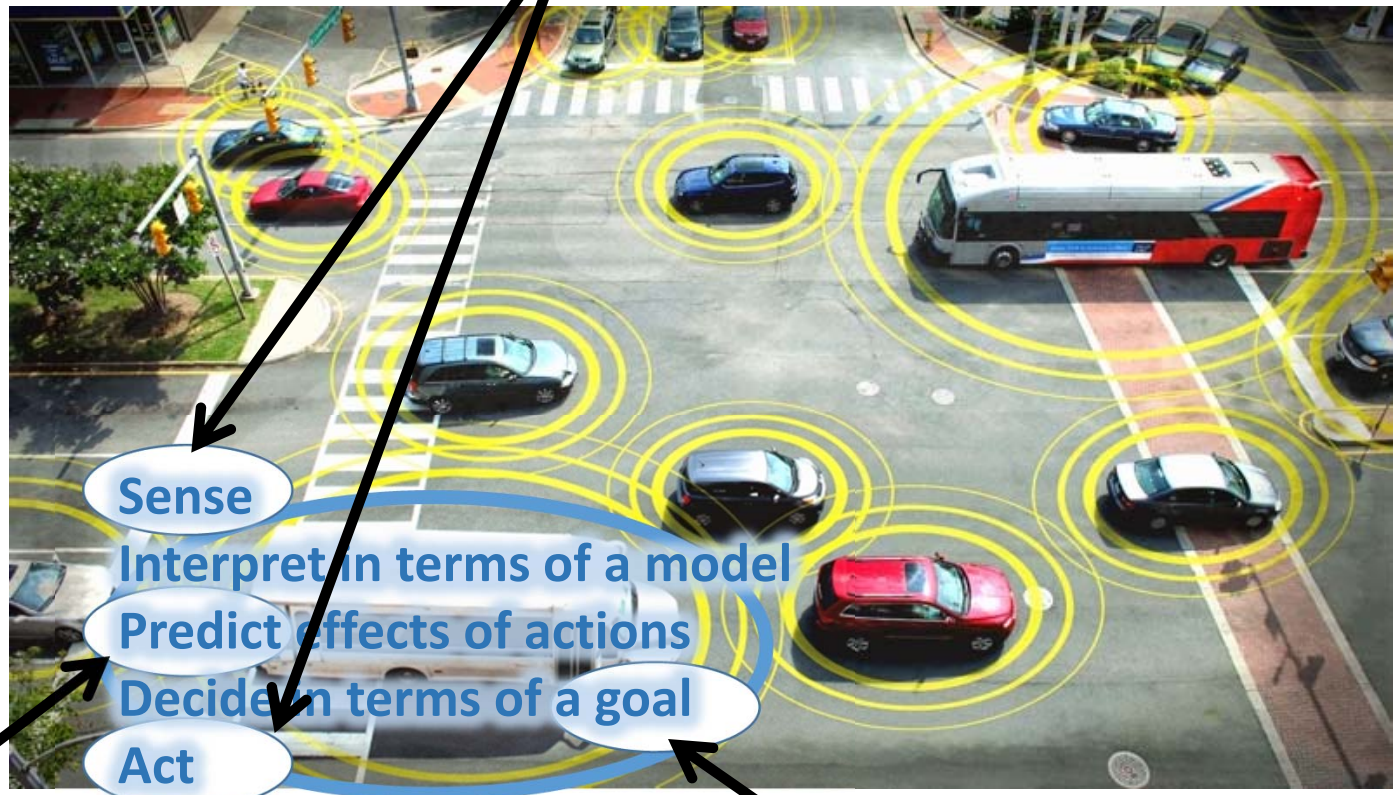
Remember the empty page of my philosophy Master’s Thesis



Reactive systems

- A reactive system maintains a model of its environment.
- Each model is a simplification, and
- The simplification is developed **before** the car is driven (Remember the judge)

Very hard: translating from the physical to the symbolic world and back again



This is what makes us perceive the system as intelligent

And who sets the goal? Tradeoffs?
E.g. safety of passengers or of others?

Reactive systems

Very hard: translating from the physical to the symbolic world and back again

Symbol grounding: assigning meaning to physical symbols.

The hardest thing: choosing the level of abstraction

- Depends on stakeholder goals
- Complexity of the context

What next? 2006

Generic structure of technical papers:

1. Define a technique
2. Find a problem solved by the technique
3. Show that your technique promises spectacular performance

Requirements Eng (2006) 11: 295–307
DOI 10.1007/s00766-006-0037-6

ORIGINAL RESEARCH

R. J. Wieringa · J. M. G. Heerkens

The methodological soundness of requirements engineering papers: a conceptual framework and two case studies

Received:
© Springer

Abstract

1 Introduction

This paper was triggered by concerns about the methodological soundness of many requirements engineering (RE) papers. As we argue in this paper, many of these papers describe techniques but do not report on any research. The techniques reported on are intended for use in RE practice: for example, how to improve the process of negotiating requirements, or how to build use case models, how to customize information systems

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Harley Davidson conferences

Acquire admiration with your spectacular technique that no one can use

On the other hand, a few ideas trickle to the market

Piran, Slovenia 2016

2014

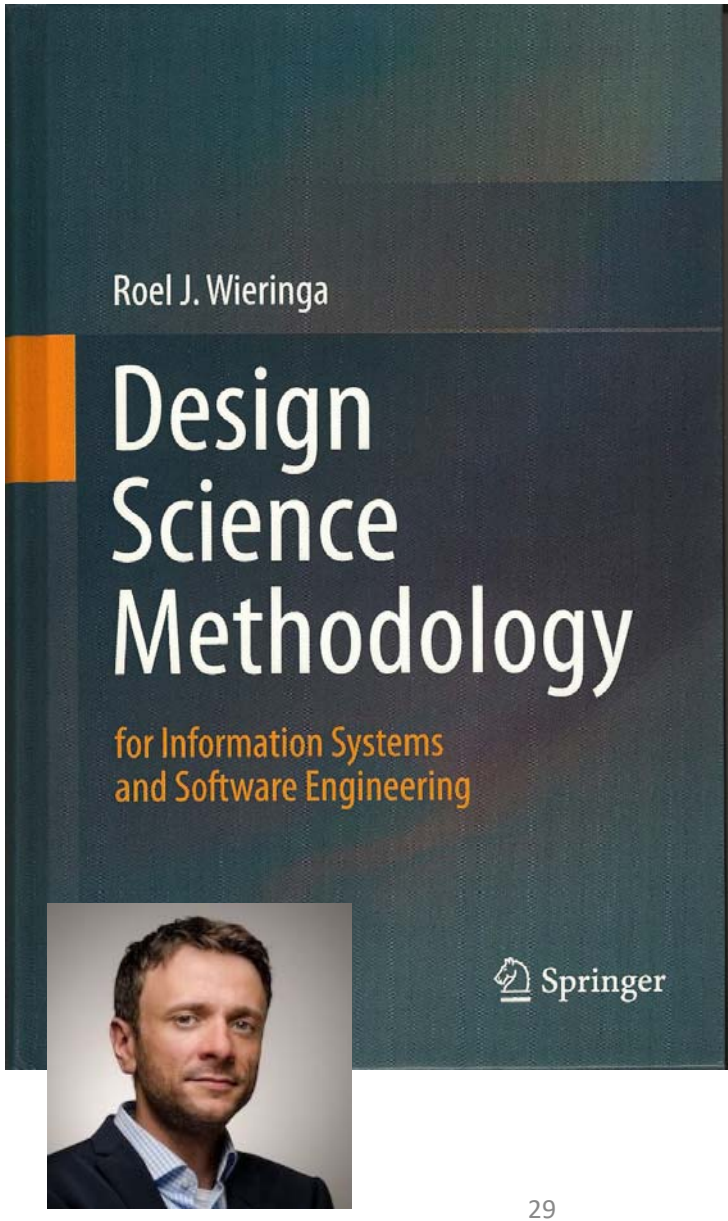
From the Preface:

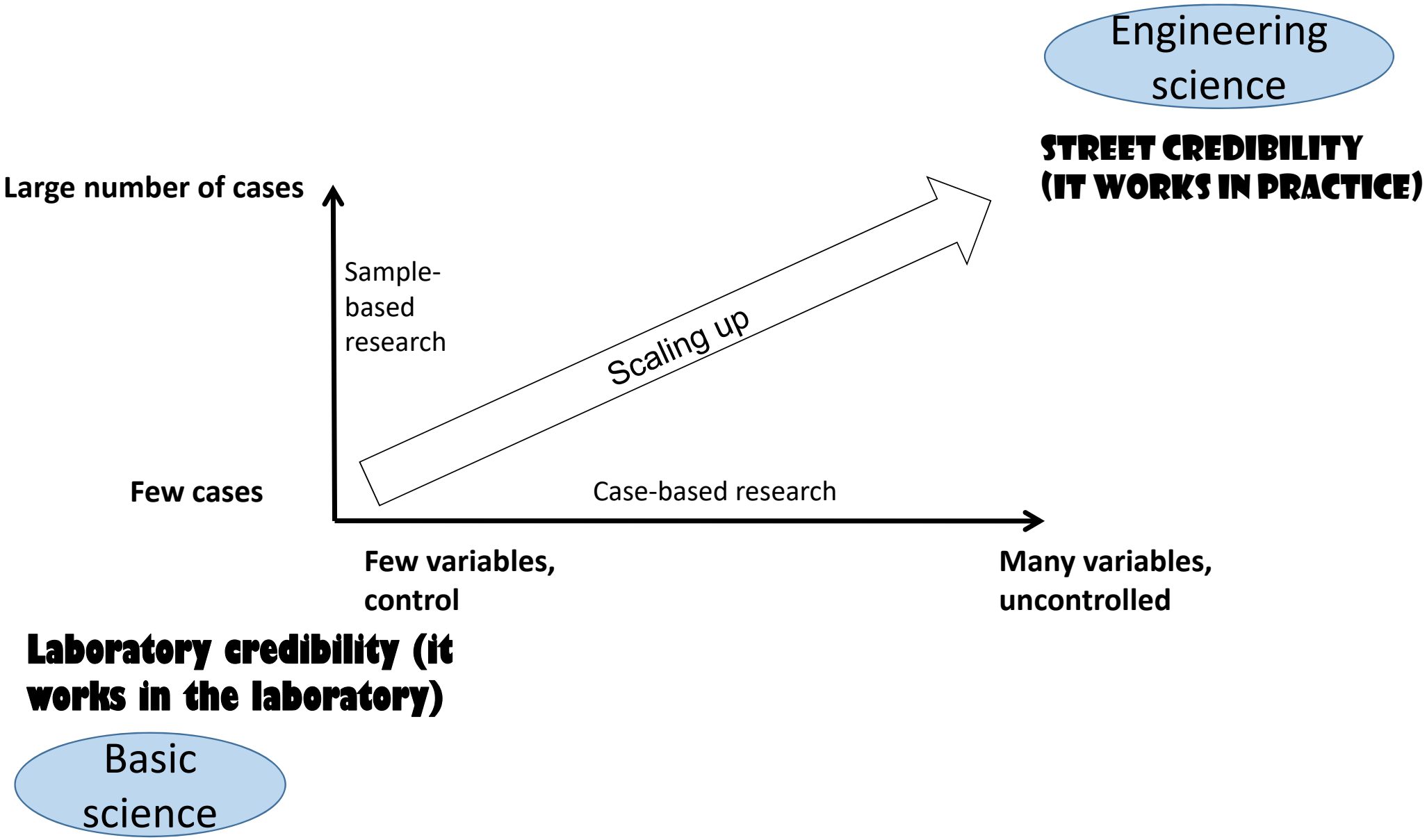
- “First, we treat design as well as empirical research as *problem-solving.*”

- “Second, the results of our problem-solving activities are *fallible.*”

- Improving our knowledge is a never-ending process.
- Validation: List all ways in which your theory can be wrong

Daniel checked the entire manuscript!




Engineering science
STREET CREDIBILITY (IT WORKS IN PRACTICE)
Large number of cases
Sample-based research
Scaling up
Few cases
Case-based research
Few variables, control
Many variables, uncontrolled
Laboratory credibility (it works in the laboratory)
Basic science

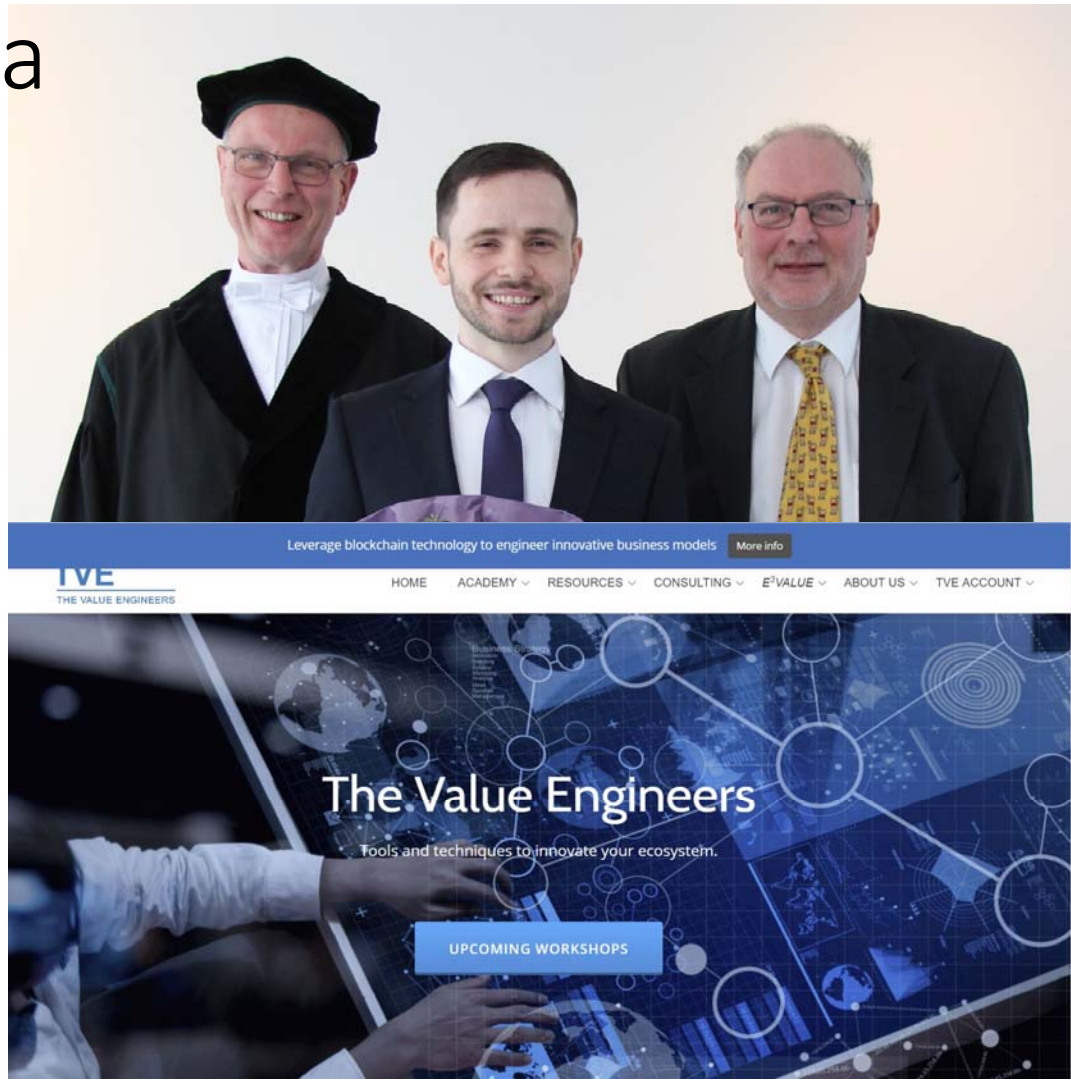
2017: Started *The Value Engineers BV* with Jaap Gordijn & Dan Ionita

http://www.thevalueengineers.nl

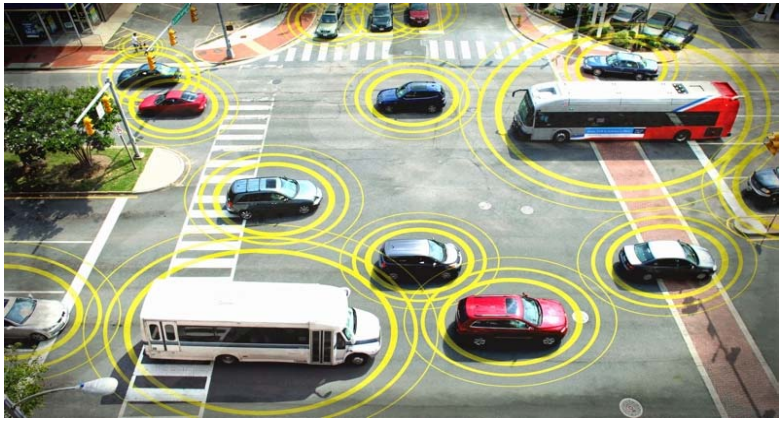
Tools to elaborate a vague digital product idea into an operational business network .

Sounds familiar?

Unfinished business #1



January, 2019
Workshop “The Future of Artificial Intelligence”



- Decisions are distributed over people and machines, some of them ahead of time.
- How?
- Accountability?

1986

AI Magazine Volume 7 Number 5 (1986) (© AAAI)

LETTERS

Editor.

In his interesting article "Artificial Intelligence and Ethics: An Exercise in the Moral Imagination," Michael LaChat says that the basic outline of Shelley's *Frankenstein* needs to be recapitulated "even if, as is usually the case, the reader has seen only the poor image of the book in movie form." Contrary to what Mr. LaChat says, I think the poor image most people have of the book is sufficient reason to give a short outline of the original story. Doing this, we find one or two arguments that were not mentioned in LaChat's article but are relevant to the matter of ethics and artificial intelligence.

An outline of Mary Shelley's story follows: A creature is built which is intelligent and capable of suffering, that is, feels lonely, is aware of its death, and at the end of the story gets tired of its life. Dr. Frankenstein does not love his creation. He abhors it and flees from it, paralyzed in a feeling of guilt for what he did but unable to take responsibility for it. The creature is rejected not only by its creator but by all humankind. It feels lonely and asks its creator for a companion. The creator refuses this. The balance of the story is a dialogue between Dr. Frankenstein and his creature, which ends with the death of Dr. Frankenstein and the creature's announcement that it will commit suicide.

The story raises the question of whether the capacity for suffering is necessary in order to be intelligent. This question might be seen as one about the nature of intelligence, but it might also be seen as a question about ourselves, that is, whether we are willing to regard as intelligent a being without the capacity to suffer, feel lonely, and so on

the natural way: There is no way of *proving* that the other suffers. To know that the other suffers, we have to close the gap between us in an act of empathy. Only then can we begin to think of genuinely helping the other. Whatever his other attitudes, Dr. Frankenstein knows that his creation suffers and knows it in the way he knows human beings suffer.

Closely connected to this is the point that just as we have the moral obligation not to err on the wrong side in the fulfillment of our obligations toward suffering human beings (that is, we should not fail to fulfill our obligations toward them just because we think they are not *really* suffering or, worse, because we haven't been able to prove that they are really suffering), we ought not to err on the wrong side for the wrong reason in the case of suffering artifacts. This point is true regardless of the fact that there is no sort of Turing test for suffering (we and presumably they too can suffer without showing any behavior) and we will never know for sure, at least not by proof, that these beings are even capable of suffering. How are we going to solve *this* problem?

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Letters to the editor should be addressed to the letters editor at AI Magazine, 445 Burgess Drive, Menlo Park, California 94025, and should include the sender's complete address and telephone number. Not all letters will be published. Those that are will be edited and, if necessary, excerpted.

1986 The AI designer's dilemma

- The capability to pass ethical judgments **presupposes** the capability to suffer and have empathy.

- Suppose we design an Artificial Intelligence (AI) **not** capable of suffering and empathy.
- Then the ethical judgment of the AI would really be the designer's ethical judgment (specified in advance)

- Suppose we design an AI that **is** capable of suffering and empathy.
- Then, building this AI places a moral demand on us.
  - "Why did you create me this way?"
  - "I'm lonely."

Unfinished business #2

So, what did I do?

- Write papers with a lot of wonderful people
- Thank you!

What else? Deliver PhDs!


Paul Spruit


Rik Eshuis


Jan Broersen


David Jansen


Tatjana Bondarouk


Zlatko Zlatev


Bela Mutschler


Stanislav Pokraev


Virginia Nunes


Roberto Santana


Lianne Bodenstaff


Chen Li


Emmanuele Zambon


Ayse Morali


Ricardo Neisse

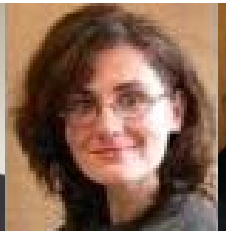

Silja Eckartz


Hassan Fatemi


Dulce Pumareja


Mohammad Zarifi


Shahin Zarghami

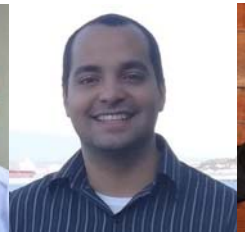

Zornitza Bakalova

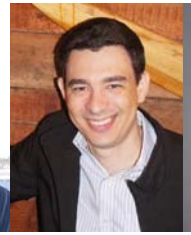

João Moraes


Lei Wang


André Van Cleeff


Eelco Vriezekolk


Carlos Azevedo


Robson Albequerque


Steven Bosems

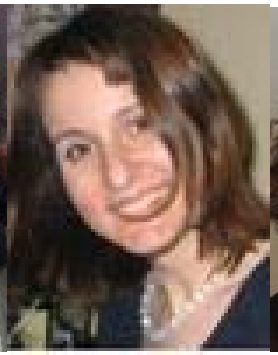

Dan Ionita

I learned a lot from them.
Thank you!

More to come

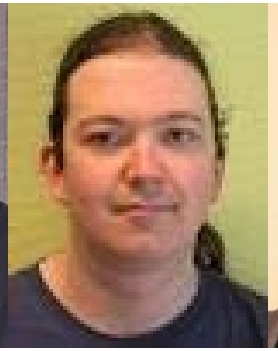

Prince Singh


Preethu Anish

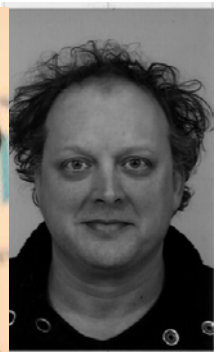

Jelena Marincic


Roeland Kegel


Wasim Alsaqaf

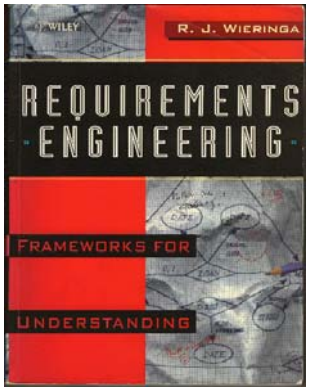

Wilco Engelsman


Pierre Erasmus


Hans Wienen

Unfinished business #3

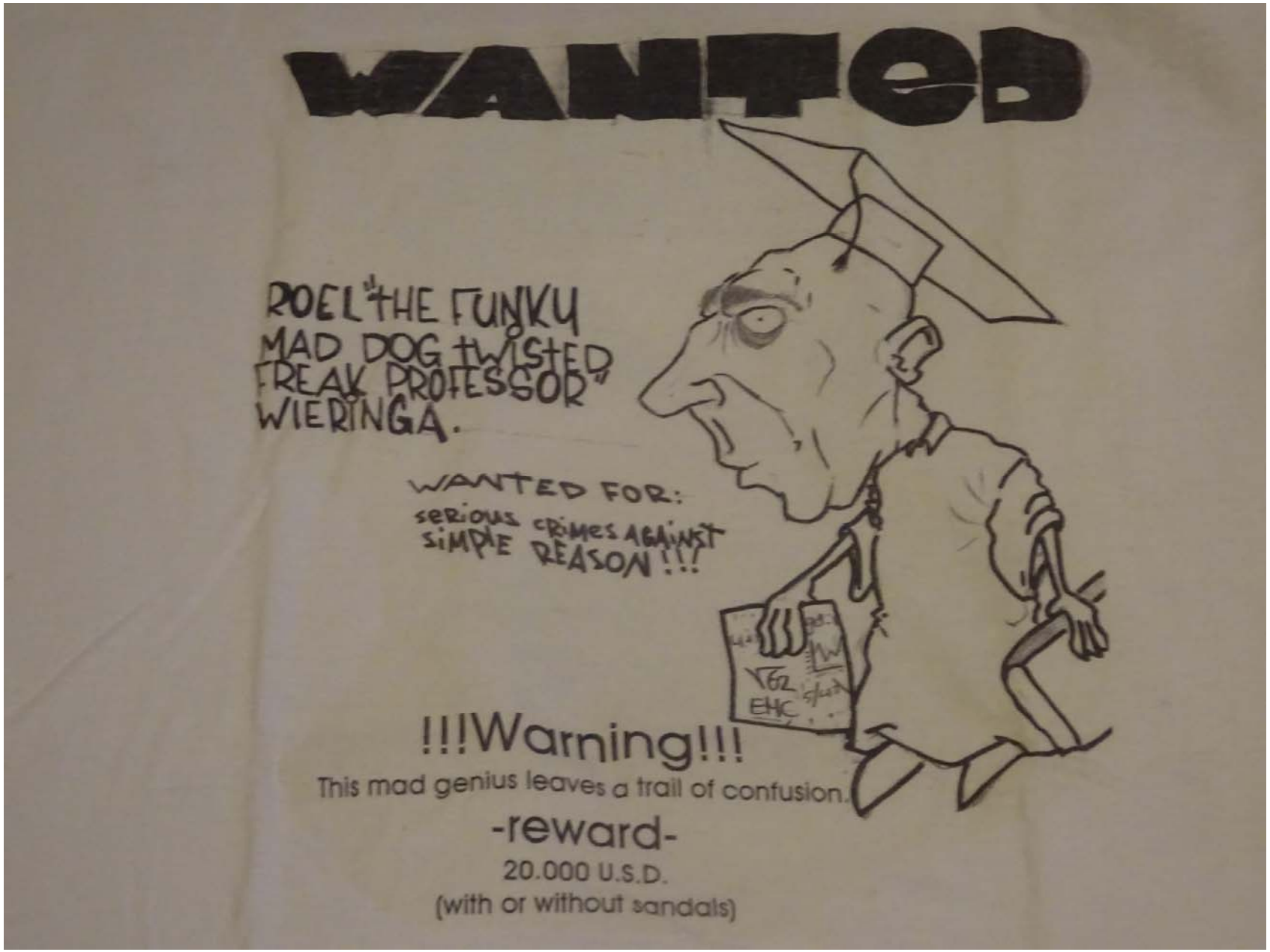
Future



- 1996: “Writing this book has been made bearable by the unceasing efforts of Mieke Poelman who, despite a busy career of her own, managed to find the time to keep me from my work.”

This leaves me speechless

Thank you



https://tinyurl.com/donation-Roel or
https://actie.soskinderdorpen.nl/Acties

See the invitation

Possible too, during the reception, at the bar