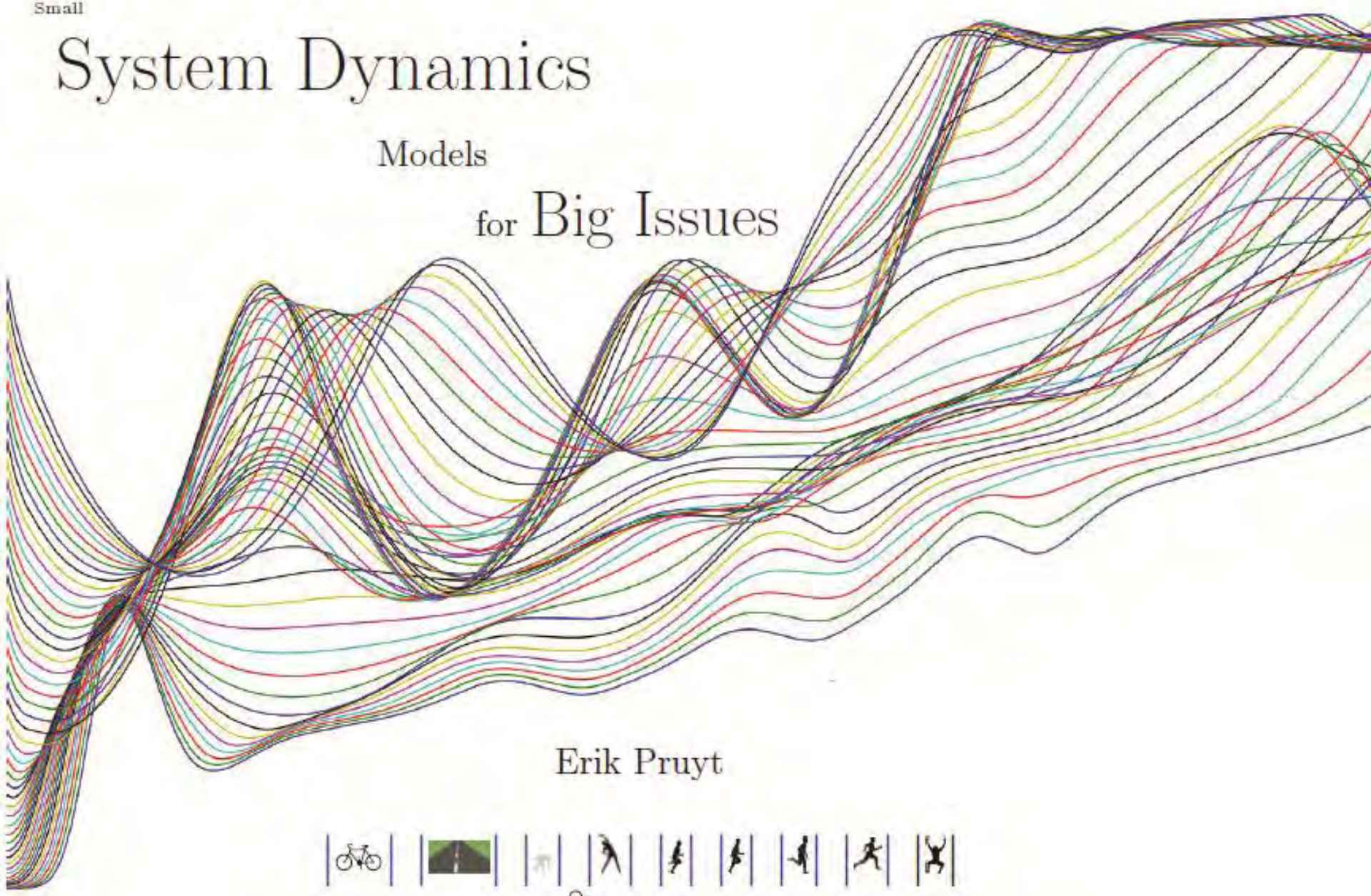
Small

System Dynamics

Models for Big Issues



Erik Pruyt

Triple Jump towards Real-World Dynamic Complexity

Overview

Why?	• History & Context: SD101 @ TU Delft • How to acquire SD modelling skills?
What?	• The E-Book
How?	• For professors • For self study • For the SD field

HISTORY & CONTEXT: SD101 @ TU DELFT

SD @ Delft University of Technology

- SD101 (two parts): BSc (200+) & MSc (40+)
- Systems Engineering, Policy Analysis, Mgt
- Policy Analysis, ABM, SD… => Systems Thinking
- Advanced SD, simulation master classes,…
- BSc thesis in SD, MSc thesis in SD

SD101 @ Delft University of Technology

- Mandatory: no drop-outs… no eroding goals…
- Part I – 8 weeks -> 5 weeks
  - **(Virtual) computer labs (4h+/wk):** cases, cases,…
  - Laptop lectures (2h/wk): feedback & feed forward
  - Exam: 15 MCQs + 1 case (make, use model & answer)
- Part II – 5 weeks **SD project** (70h)
  - Pairs of students with weekly supervision / coaching
  - Open project <-> pre-specified project

Focus & skills focused on

- Focus: Quant. SD modeling & policy analysis
- Skills Part I: How to make & use models
  - **Basic & intermediate model building & specification**
  - Debugging & model testing
  - **Basic model analysis**
  - Different uses, focus on model-based policy analysis
  - Diagramming for understanding & communication
- Skills Part II: modeling process in practice
- Part I&II: systems thinking & SD philosophy

HOW TO ACQUIRE PRACTICAL SD MODELLING SKILLS?

…CASES, CASES, CASES, CASES…

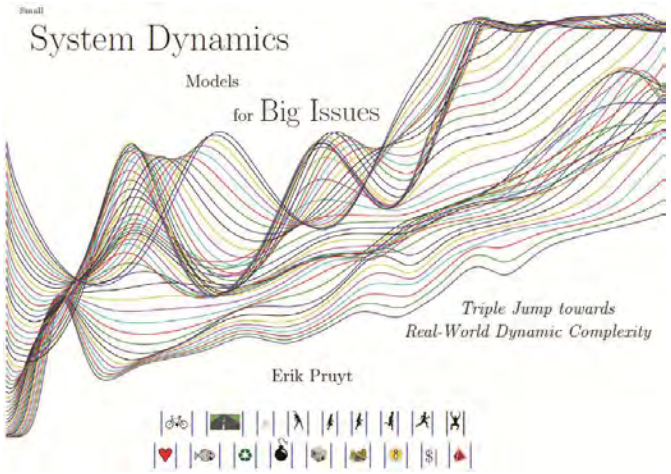
Case-Based Approach to Learning SD

- Comfort seekers beware: hard work ahead!
- *Real* learning = from doing and …
  - … (nearly) failing + feedback & sharing of experience
  - … succeeding => "wow, I did it!" Where do others fail?
- *'I learned more from cases than from the lectures'*
- Not just cases: explanations, hints, models, fdbck, context, embedding, experience & reflection

$\Rightarrow$ Hands-on learning by doing + FF & FDBCK

Type of Cases Used

- Harvard Business cases?
- Cases in the SD repository?
- Small model -> 1-2p descr. + 10 guiding questions
- Big issues, as actual as possible:
  - Pandemics, bank runs, metal scarcity, transitions,…
  - Motivating, usefulness, potential areas of application
  - Highly aggregated & rather simplistic models
- Problems: variable speed, delayed feedback, too many cases and too high a workload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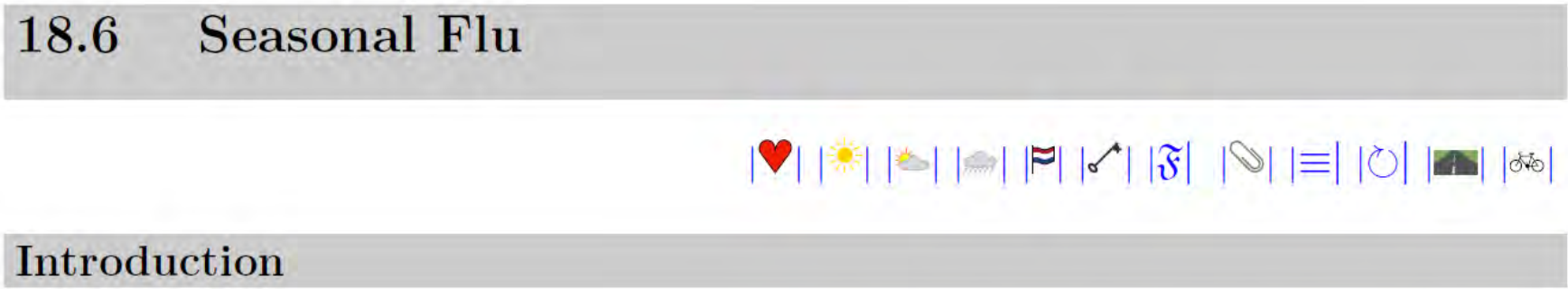
THE E-BOOK

Triple Jump towards RW Dyn. Complexity

- 6 parts: 
  - Warm-up: qualitative SD – 14 diagramming ex. + …
  - Run-up: quantitative SD – 11 small & simple ex. +…
  - **Hop: spec. functions & structures – 15 technical ex. +…**
  - **Step: introductory cases – 17 closed cases +…**
  - **Jump: intermediate cases – 22 closed cases +…**
  - Fly: project cases – 6 open cases
- 4 chapters per part: Theory^{+}, Ex. or Cases^{+}, MCQs^{+} (15 r/w + 20 MCQs +…), Feedback^{+}

Cases+

- Closed *build-this-model-and-use-it* T&T cases:
  - Case description: 4 levels per case
  - 8-10 guiding questions: (1) model, (2) test, (3) …
  - Hints sims models feedback



  - Linked to 1 or more of 9 themes

9 Themes

 Health Policy, Epidemiology & Drugs (p.17),

 Environmental & Ecosystems Management (p.18),

 Resource Dynamics & Energy Transitions (p.19),

 Safety, Security & Risk (p.20),

 Policing & Public Order (p.21),

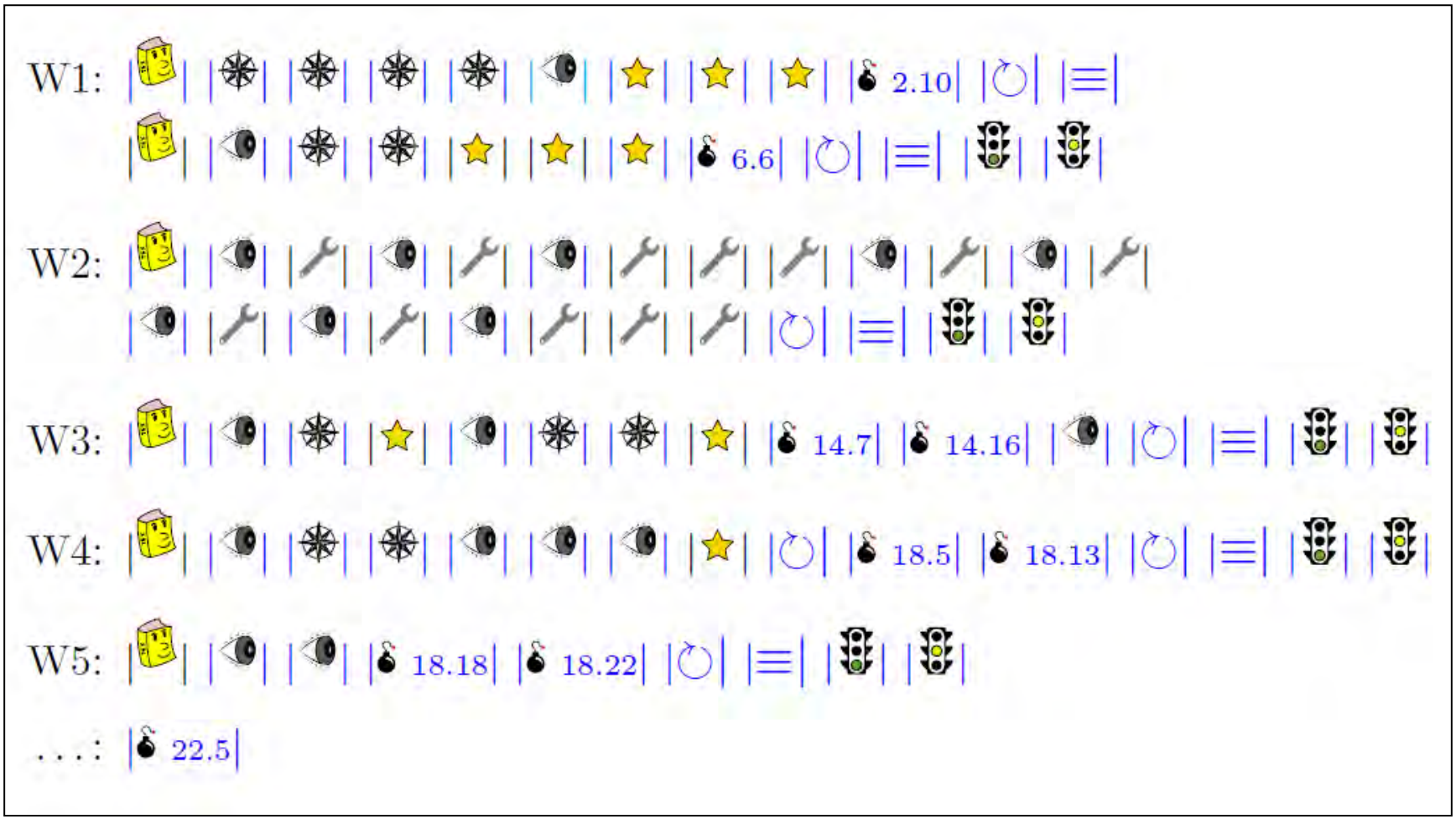
 Housing Policy & Urban Planning (p.22),

 Education & Innovation (p.23),

$ Economics & Finance (p.24), and

 Management & Organization (p.25).

9 Theme Spec. Blended Learning Paths



+ Generic Blended Learning Path

– Quantitative SD modeling

Video: quantitative model building (settings, stocks, flows, auxiliaries, simulation)

Tutorials 5–6

Introductory quantitative SD exercises

∧ ex.6.1, ex.6.2, 1 from ex.6.3–6.11 (|❤| |♻| |📦| |🚢| |🐟| |⛵| |₿| |$| |💣|)

∨ other exercises from ex.6.3–6.11 (|❤| |♻| |📦| |🚢| |🐟| |⛵| |₿| |$| |💣|)

|⊕|: additional exercises |1| |2| |3| |4| |5| |6| |7| |8| |9| |10|

|↻| Video feedback across all introductory quantitative exercises

|≡| Written feedback across all introductory quantitative exercises

|🚦|

|🚦|

6.8 Pneumonic Plague (A)

|❤| |☀| |⛅| |🌧| |⚑| |📈| |ℱ| |📎| |≡| |↻| |🛣| |🚲|

Introduction

HOW?

For Professors/Teachers

- Blended online learning as pre-requisite for SD project
  $\Rightarrow$ Away from technical details: focus on *modeling / process*
- 175^{+} MCQs & 90^{+} cases for teaching / exams
  - **Note: particular type of cases! Other types: Colombia,…**
- +126 open slots => case repository?
  - Share your cases?
  - My new cases?
- Complementary to/not substitute for excellent books

For Self-Study / Students /…

- Actively getting started: acquire basic skills in 70h
- Blended hands-on learning at own level & pace
- Learning paths: more efficient for students
- Feedback across cases in same part: learning+++

- Additional cases to practice

- ‘Educate’ clients

For the SD Field

- Blended Collaborative Online Learning courses
- To open-up & organize global teaching materials
  - Please send me your cases, added under your name

  $\Rightarrow$ T&T case repository: webpages with cases+
- ***Free*** blended e-book(s) => MOOCs (**tomorrow lunch**!)
  - Two major issues: exams & massive project courses?

- Different diffusion model: few to 10(0)s -> all to all

CONCLUDING REMARKS

Offering

- Case-based blended learning approach:
  - Guided hand-on practicing at own pace with FF&FB
  - Backbone + lots of online materials
  - Future: more and more diverse cases
- Focus on basic/intermediate model building
- ST / SD philosophy along way & afterwards
- More time left for training on the job / project
- Or just cases…

Status?

- E-book version is ready: simulation.tbm.tudelft.nl
- Available from next week on
- If enough interest also publish paperback version
- Basic online materials on 1 Sept. 2013 (OCW)
- All online materials available on 1 Jan. 2014
- In meantime, extend to other contributors: Join?
- 2014: MOOC?
- Questions, suggestions, remarks, contributions: smallSDmodels@gmail.com

To download the e-book:
http://simulation.tbm.tudelft.nl

To be kept informed (twitter):
@smallSDmodels

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