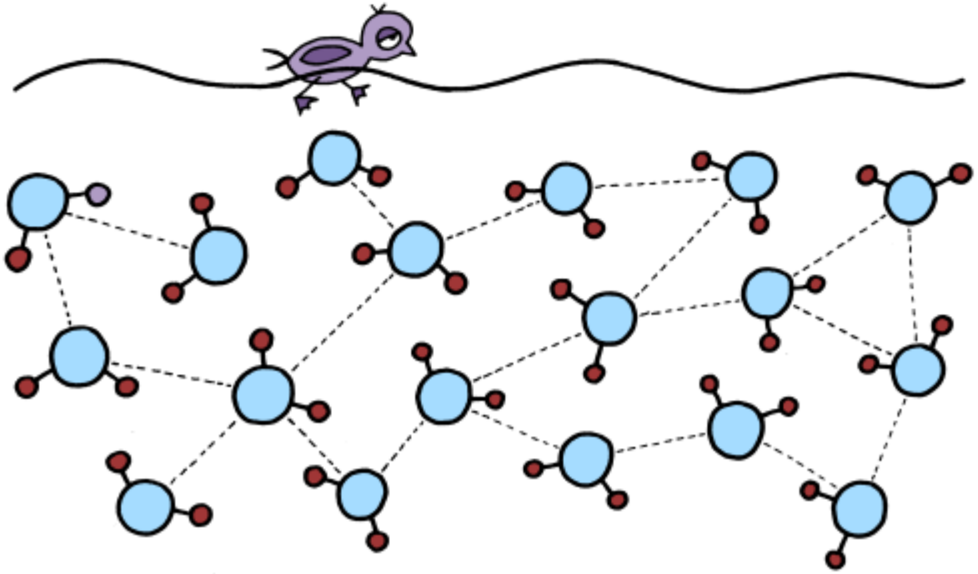
Complexity versus Lean

The Big Showdown

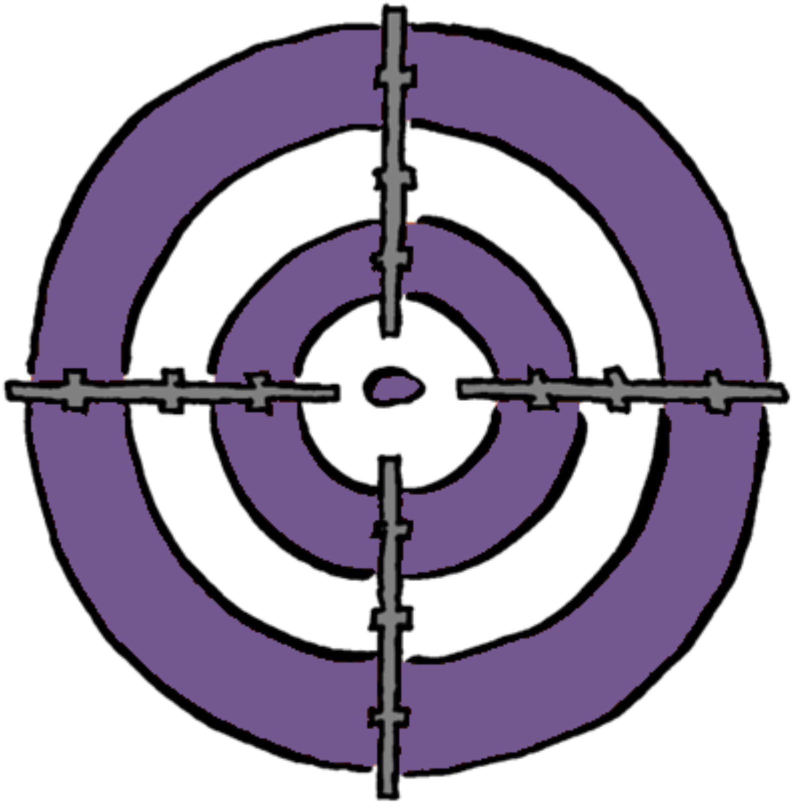


Jurgen Appelo
jurgen@noop.nl

version 1.ks

Goal

To further improve Lean software development by understanding and applying complexity thinking



Agenda

What is complex systems theory?

What is lean software development?

Can we define complexity thinking?

Can we apply complexity thinking?

A new management model

7 principles of Lean software development

5 core practices of Kanban

Various lean practices

Conclusion

Emergent, self-organizing, unpredictable

http://www.flickr.com/photos/judepics/

Complex Systems

“A **complex system** is a system composed of interconnected parts that as a whole exhibit one or more properties (behavior) not obvious from the properties of the individual parts.”

Sometimes called the sciences of complexity (plural)

http://cfpm.org/pub/users/bruce/thesis/chap4.pdf

General Systems Theory

Study of relationships between elements

Ludwig von Bertalanffy
(biologist)
1901-1972

Autopoiesis (how a system constructs itself)

Identity (how a system is identifiable)

Homeostatis (how a system remains stable)

Permeability (how a system interacts with its environment)

Cybernetics

Study of regulatory systems

Norbert Wiener
(mathematician)
1894-1964

Goals (the intention of achieving a desired state)

Acting (having an effect on the environment)

Sensing (checking the response of the environment)

Evaluating (comparing current state with system's goal)

Dynamical Systems Theory

Study of system behavior

Stability (stable states versus unstable states)

Attractors (systems getting sucked into stable states)

Game Theory

Study of co-adapting systems

John von Neumann
(mathematician)
1903-1957

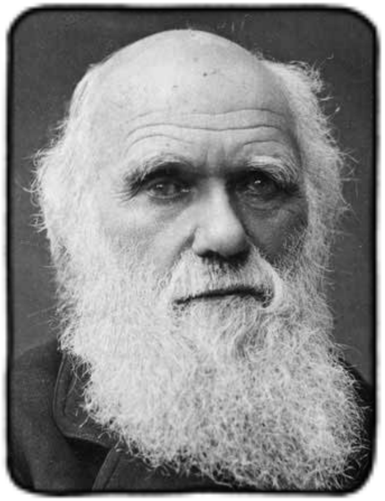
Competition versus cooperation

Zero sum games versus non-zero sum games

Strategies (including evolutionary stable strategies)

Evolutionary Theory

Study of evolving systems



Charles Darwin
(naturalist)
1809-1882

Population (more than one instance)

Replication (mechanism of making new instances)

Variation (differences between instances)

Heredity (differences copied from existing instances)

Selection (environment imposes selective pressure)

Chaos Theory

Study of unpredictable systems

Edward Lorenz
(meteorologist)
1917-2008

Strange attractors (chaotic behavior)

Sensitivity to initial conditions (butterfly effect)

Fractals (scale-invariance)

And more…

Study of all kinds of systems

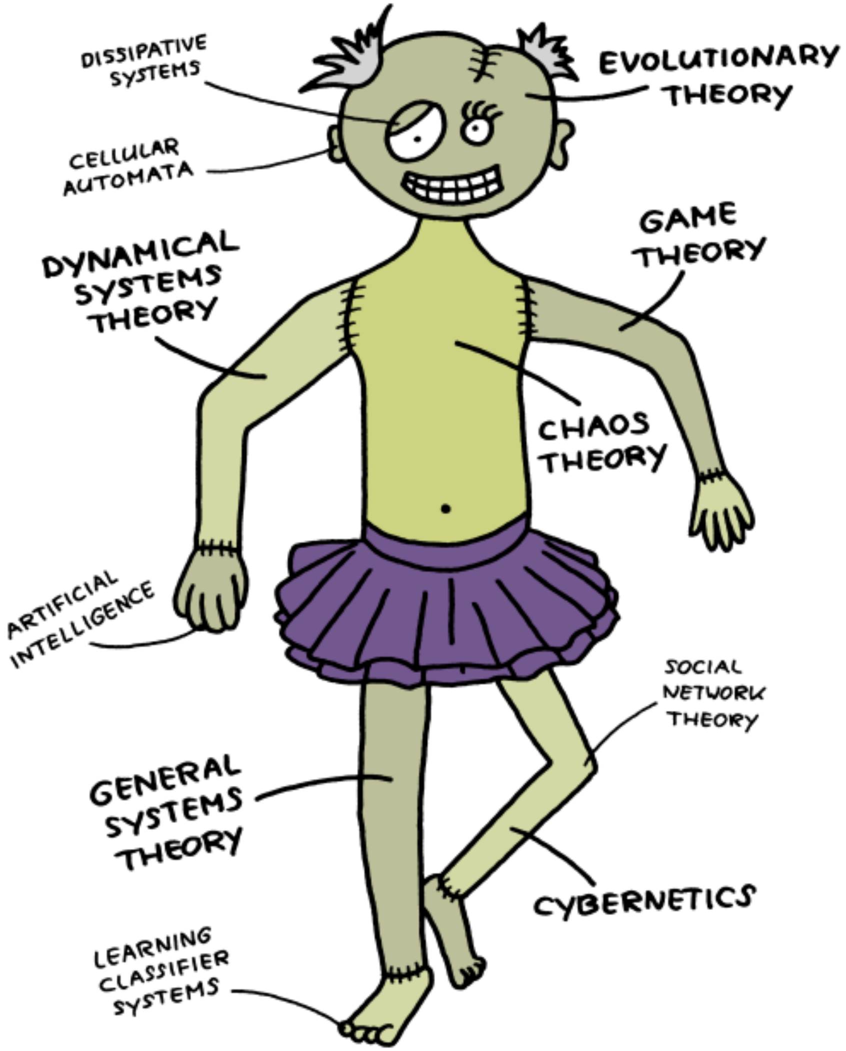
Dissipative systems (spontaneous pattern-forming)

Cellular automata (complex behavior from simple rules)

Genetic algorithms (adaptive learning)

Social network analysis (propagation of information)

The Body of Knowledge of Systems



Complex systems theory is the study of complex systems using multiple system theories

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Lean Software Development

Lean development is a prescriptive approach to work in social systems

Lean manufacturing

14 principles of The Toyota Way

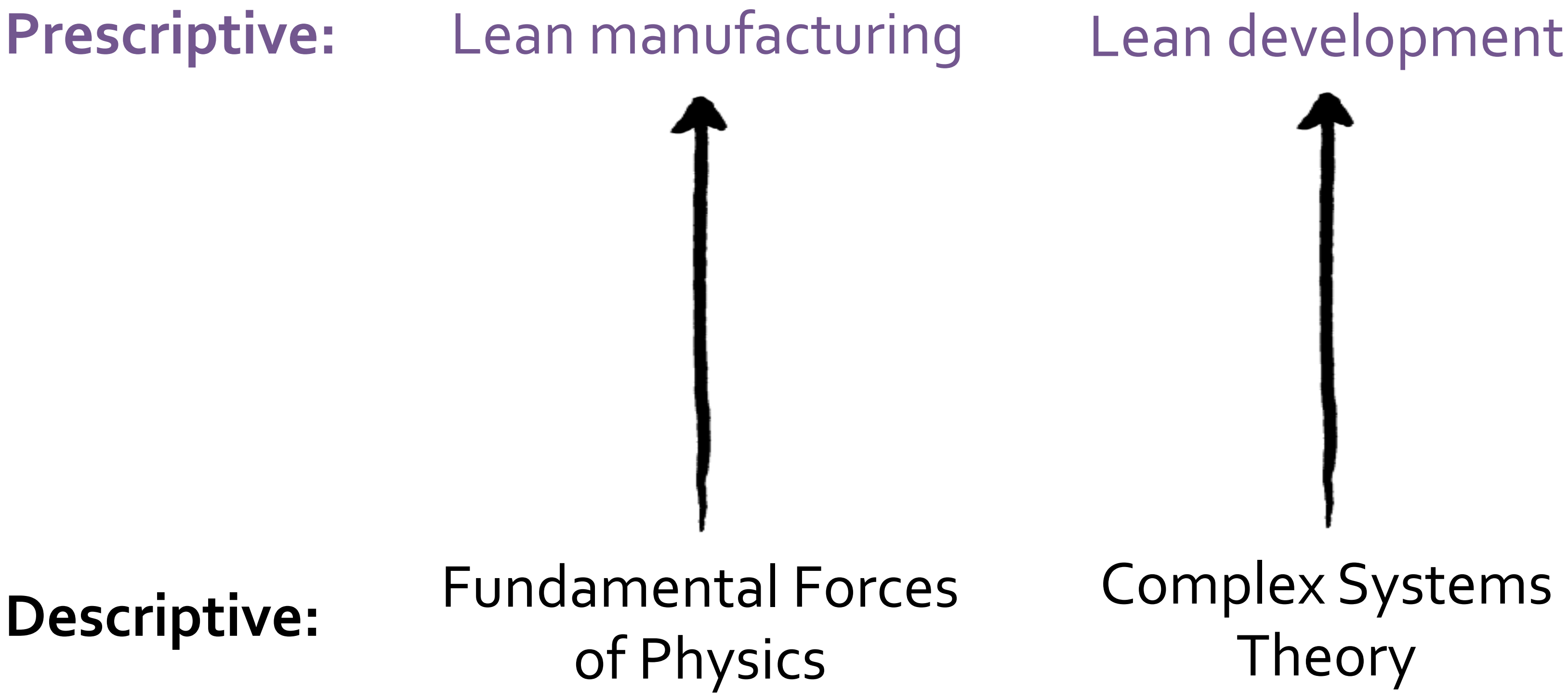
Respect for People & Continuous Improvement

Toyota Production System (TPS)

14 Points for Management (Deming)

Just In Time Production

http://www.complexification.net/gallery/machines/treeGarden/



Prescriptive: Lean manufacturing Lean development

Descriptive: Fundamental Forces of Physics Complex Systems Theory

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Complexity

“Complexity is that property of a system which makes it difficult to predict its overall behavior, even when given reasonably complete information about its components and their relations.”

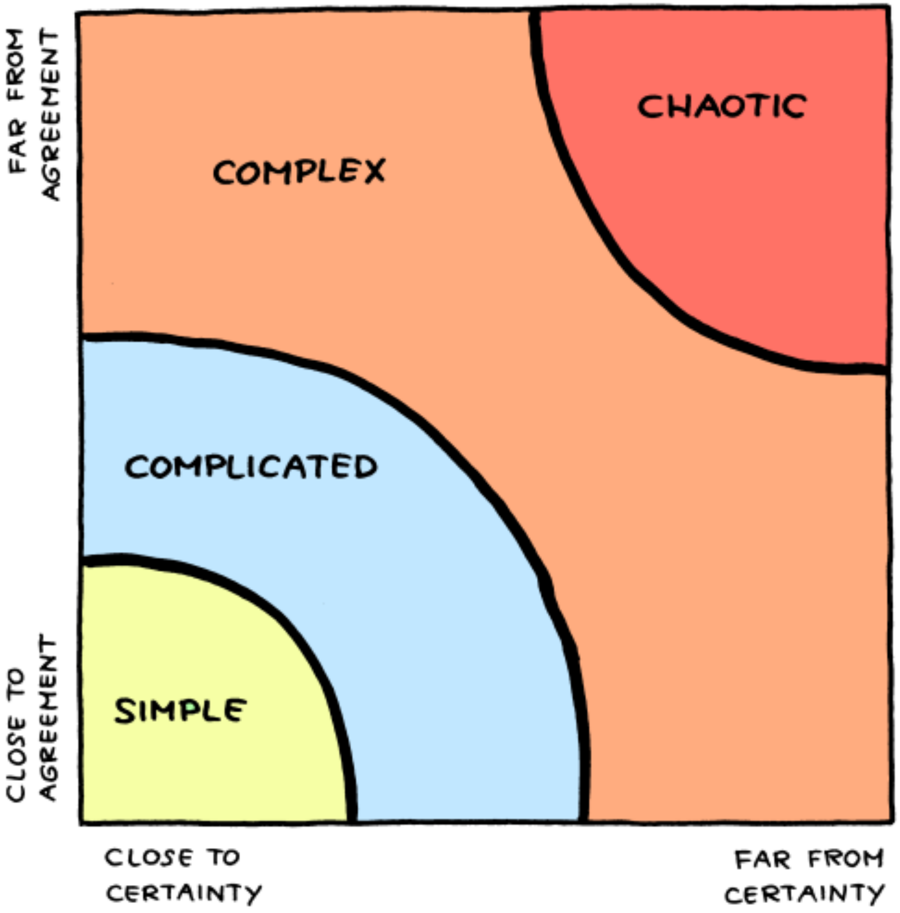
“edge of chaos”

“chaordic processes”

http://cfpm.org/pub/users/bruce/thesis/chap4.pdf

The Agreement & Certainty Model

Complex and complicated seen as different *domains*

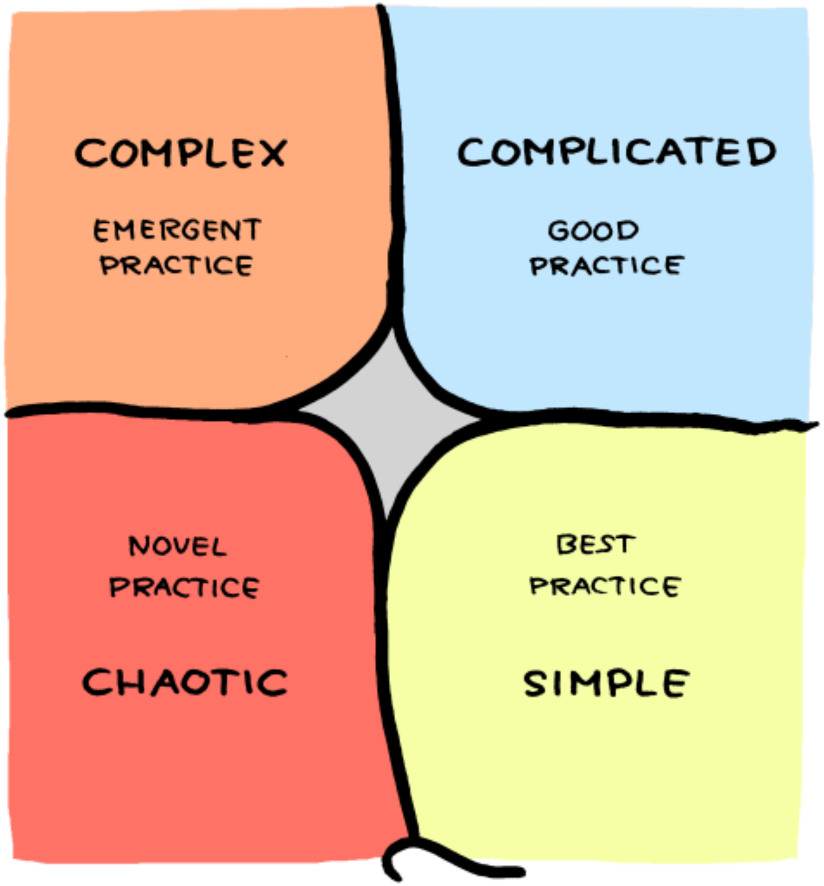


Simple + Complicated = Ordered;
Complex is between
ordered and chaotic

Stacey, Ralph D., *Strategic Management and Organisational Dynamics: The Challenge of Complexity,* ©2000 Pearson Education, Inc.

The Cynefin Framework

Complex and complicated seen as different *domains*



There's a fifth domain "disorder" in the middle; and a "cliff" between simple and chaotic

http://en.wikipedia.org/wiki/Cynefin

Simplicity: A New Model

Simple = structure is easily understandable

Complicated = structure is very hard to understand

Ordered = behavior is fully predictable

Complex = behavior is somewhat predictable

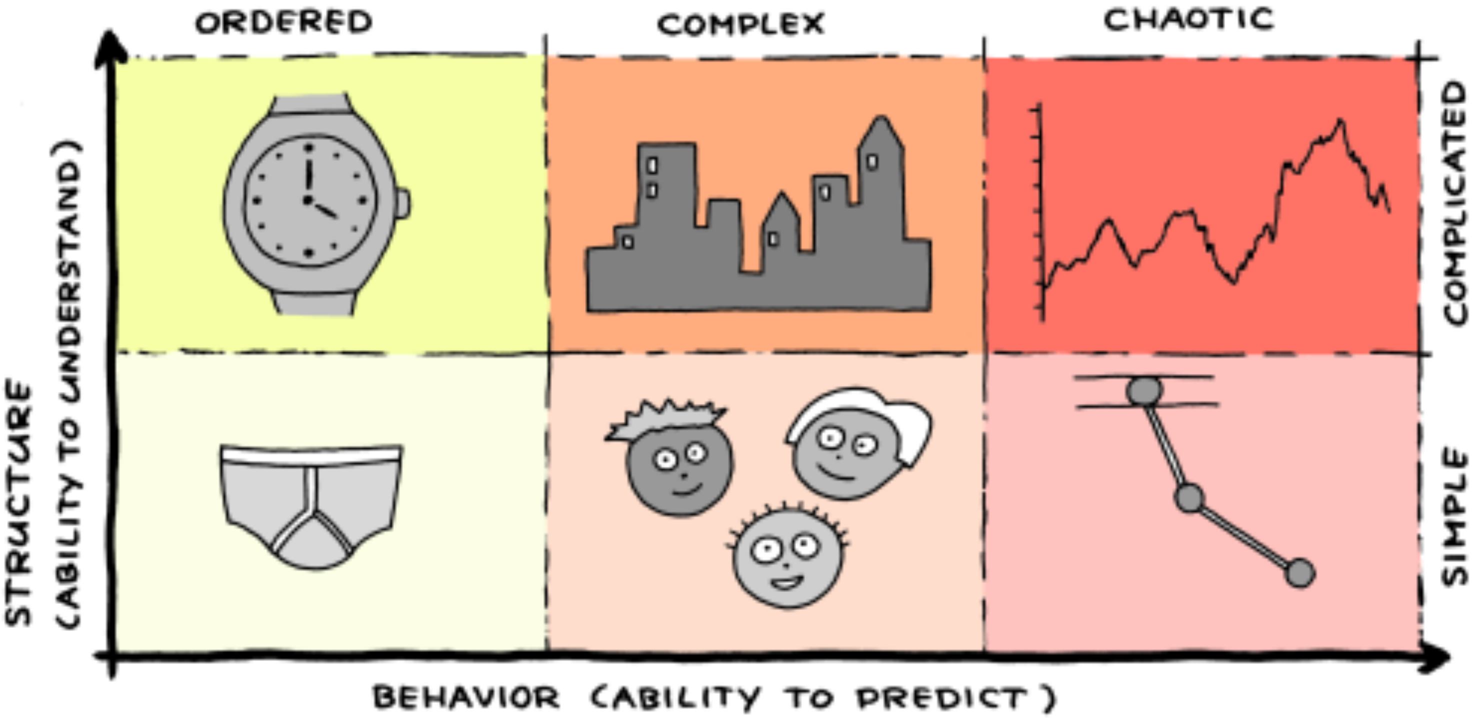
Chaotic = behavior is very unpredictable

Simplification = making something better understandable

Linearization = making something more predictable

Structure-Behavior Model

Complex and complicated
seen as different *dimensions*


ORDERED
COMPLEX
CHAOTIC
COMPLICATED
SIMPLE
STRUCTURE (ABILITY TO UNDERSTAND)
BEHAVIOR (ABILITY TO PREDICT)

http://www.noop.nl/2010/09/simplicity-a-new-model.html

Unhappy accident: tiger “eats” performer

“Black Swans”: unpredicted big events

Complex system is often predictable, sometimes not

Impact of “unknown unknowns” higher than all else

Risk management deals only with “known unknowns”

- Mirage Casino lost $100 million due to show cancellations
- Airline industry lost billions because of ash cloud from Iceland
- 9/11

http://www.amazon.com/Black-Swan-Improbable-Robustness-Fragility/dp/081297381X/

Happy accident: inkjet printer invention

Serendipity

Accidental discovery while looking for something else

Again: high impact, not predicted

- Inkjet printer invented when putting soldering iron on pen
- Viagra invented by accident (by Pfizer)
- America discovered by accident

http://www.amazon.com/Black-Swan-Improbable-Robustness-Fragility/dp/081297381X/

Distinguishing Cause and Effect

Non-Linear Behavior

Sometimes hard to distinguish cause and effect

Sometimes many causes for one effect

- Low quality from high pressure,
  or high pressure from low quality?
- Bad atmosphere because colleagues are cranky,
  or colleagues are cranky because of bad atmosphere?

http://www.amazon.com/Black-Swan-Improbable-Robustness-Fragility/dp/081297381X/

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System Dynamics

Study of non-linear behavior of systems

Jay Wright Forrester
(computer engineer)
1918-

Circular feedback loops and time-delayed relationships

Analysis through simulations and calculations

Systems Thinking

Approach to problem solving

Peter Michael Senge
(social scientist)
1947-

"Problems" are part of a system

View systems in a holistic manner

Not a science, but a "frame of mind"

Some Criticism

“The strength of systems thinking is its recognition that human systems are messy, they frequently need focus and alignment; its weakness is that it assumes that the design of that focus and alignment is a top down objective based process. […] The ambiguity of human systems is recognized, but the basic concept of central control or planning remains at the heart.”

Multi-ontology sense-making - David Snowden (2005)

http://kwork.org/stars/snowden/Snowden.pdf

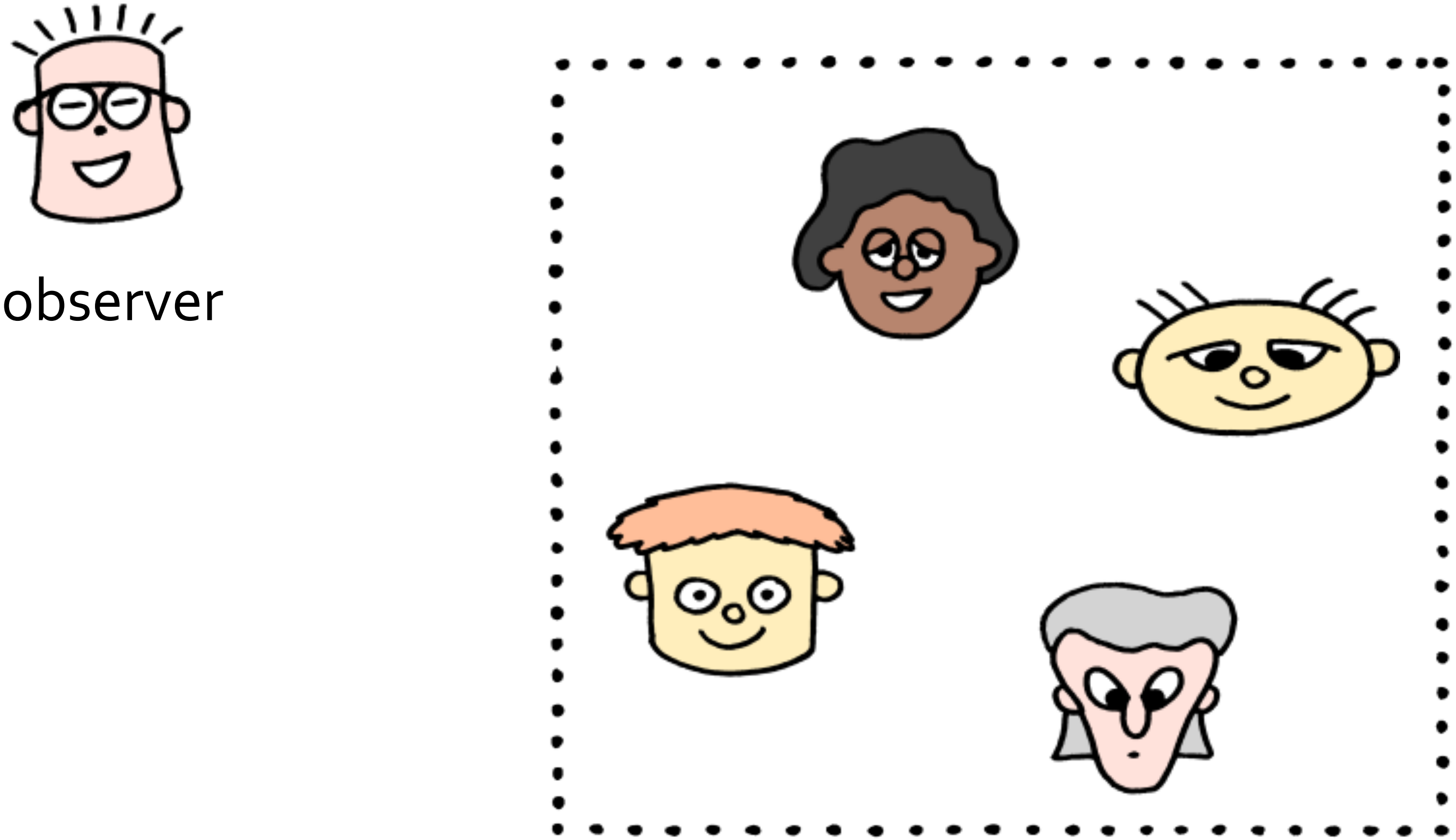
Some Criticism

“Systems thinking contains a fundamental difficulty right at its roots. This is to regard human interaction as a system. This assumption leads to thinking about that interaction as something about which another human standing outside it makes choices.”

Complexity and Management – Ralph Stacey (2000)

http://www.amazon.com/Complexity-Management-Inorganisations-Ralph-Stacey/dp/0415247616/

“Traditional” Systems Thinking

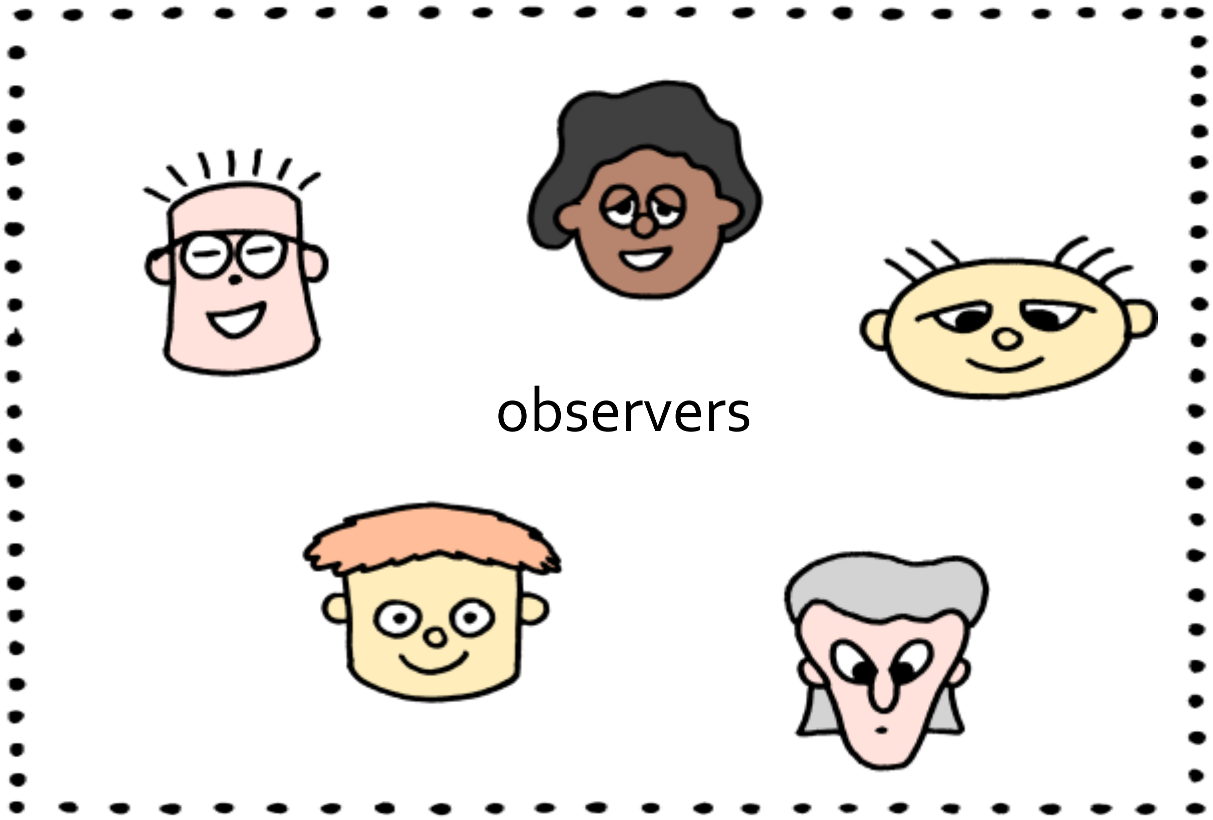


observer

system

http://www.amazon.com/Complexity-Management-Inorganisations-Ralph-Stacey/dp/0415247616/

Complexity Thinking



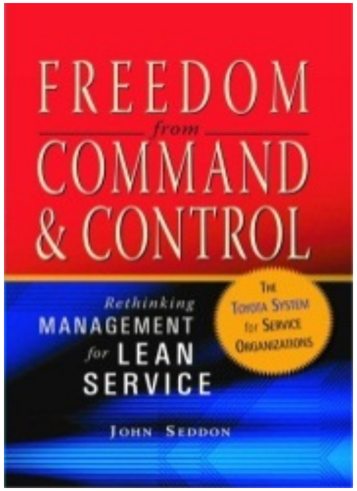
observers

system

http://www.amazon.com/Complexity-Management-Inorganisations-Ralph-Stacey/dp/0415247616/

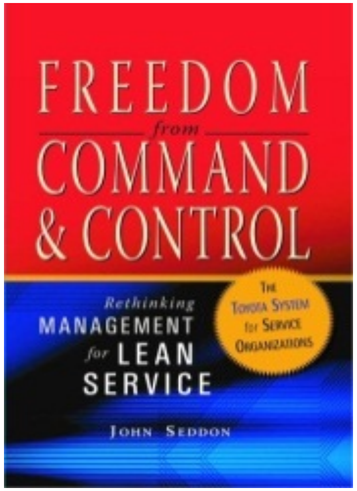
Example

“The purpose of a business is to find/satisfy customers (produce customer value).”



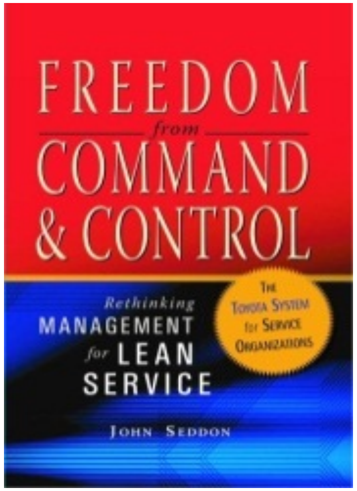
Example

~~“The purpose of a business is to find/satisfy customers (produce customer value).”~~

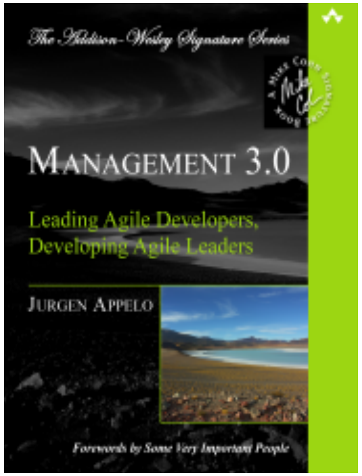

FREEDOM from COMMAND & CONTROL
Rethinking MANAGEMENT for LEAN SERVICE
The Toyota System for Service Organizations
JOHN SEDDON

Example

~~"The purpose of a business is to find/satisfy customers (produce customer value)."~~



"The purpose of a business is whatever emerges from the interaction of stakeholders."


The Addison-Wesley Signature Series
A Mike Cohn Signature Book
Management 3.0
Leading Agile Developers,
Developing Agile Leaders
Jurgen Appelo
Forewords by Some Very Important People

Complexity Thinking

Jurgen Appelo
(idea farmer)
1969-

Don't separate the designers from the system

Don't ignore the human part (social complexity)

Don't ignore the unknown unknowns

Don't rely (too much) on linear cause and effect

Complexity Thinking = Systems Thinking++

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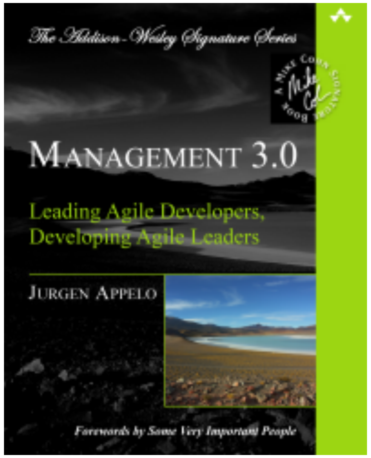
The Management 3.0 Model

Six organizational views based on complexity thinking



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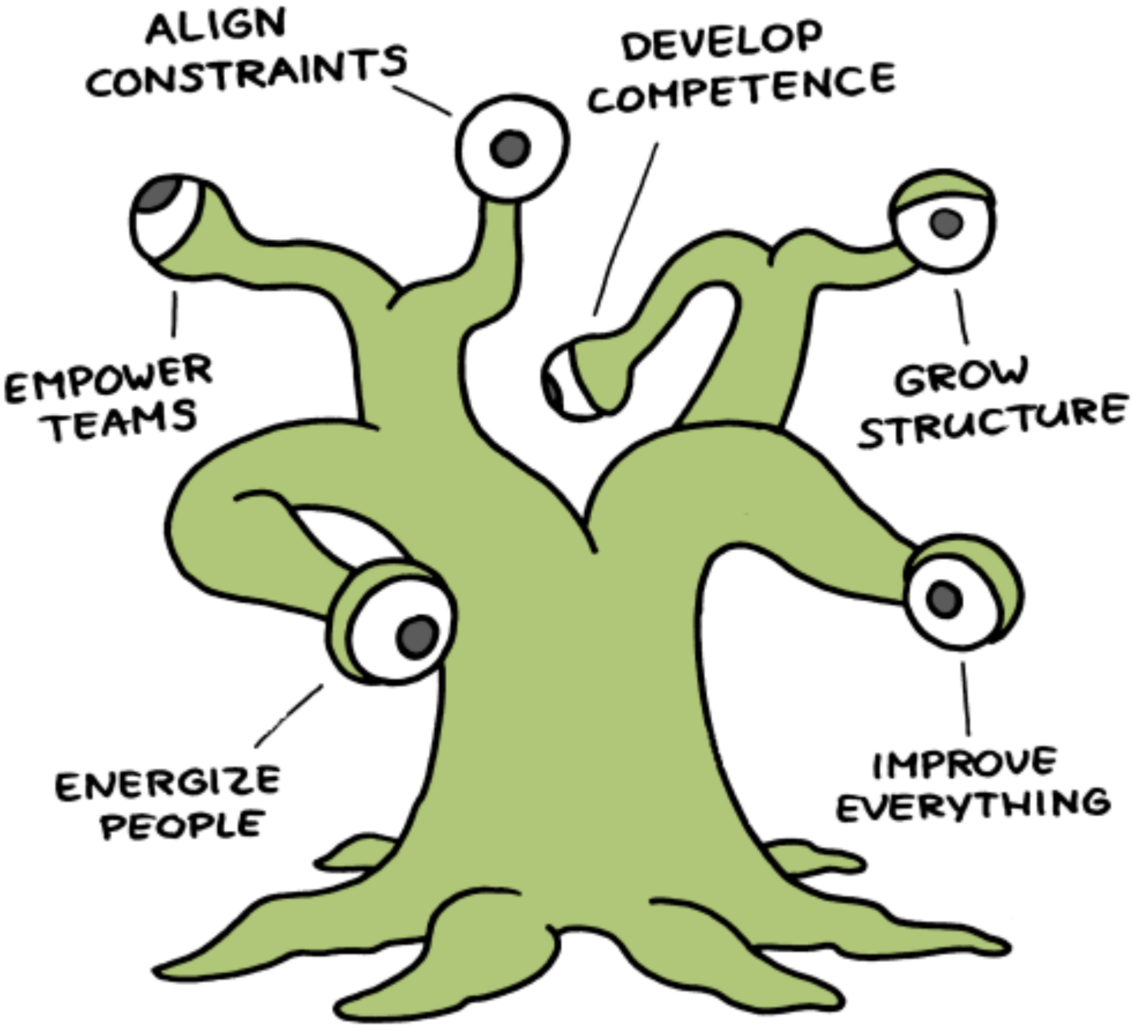
MANAGEMENT 3.0

Leading Agile Developers, Developing Agile Leaders

JURGEN APPELO

Forewords by Some Very Important People

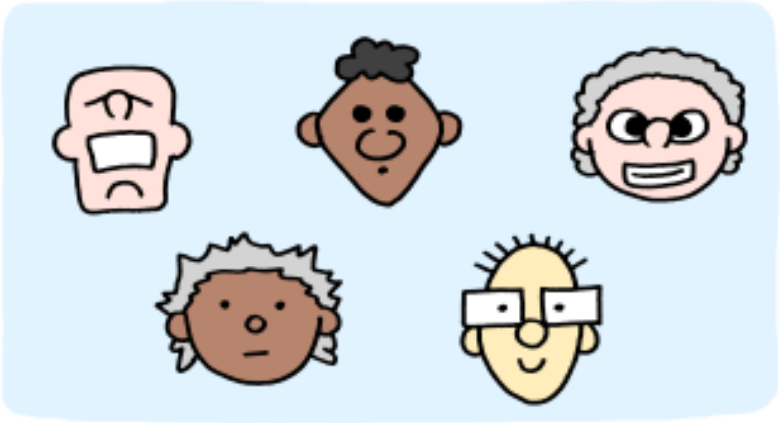


View #1: Energize People

People are the most important parts of an organization and managers must do all they can to keep people active, creative, and motivated.

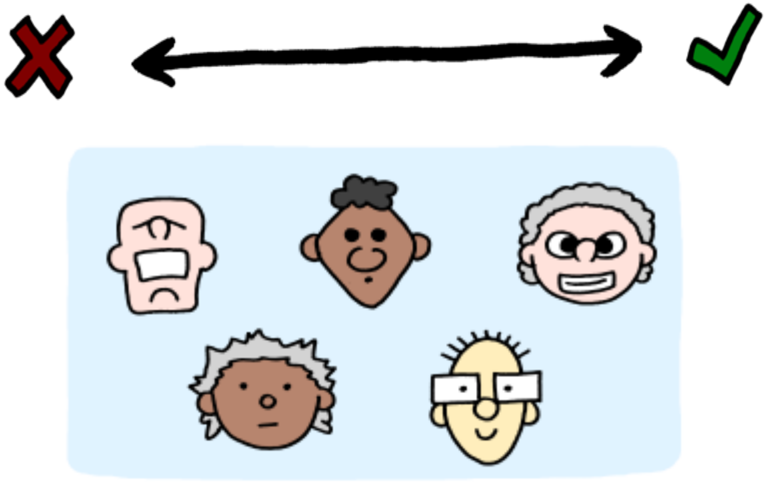
View #2: Empower Teams

Teams can self-organize, and this requires empowerment, authorization, and trust from management.



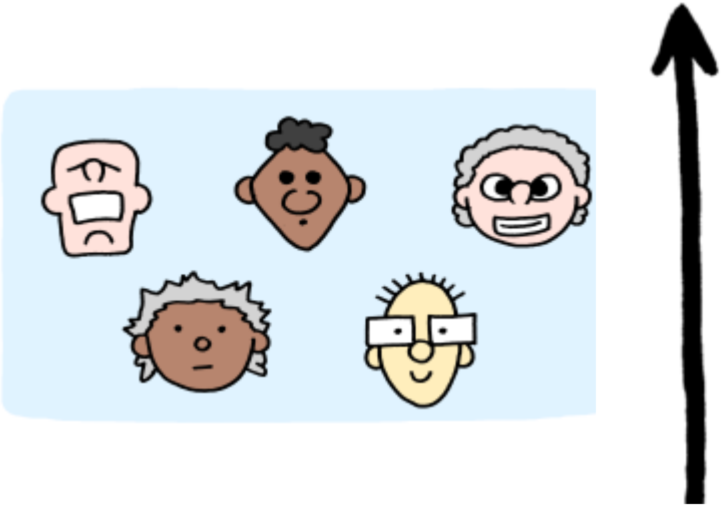
View #3: Align Constraints

Self-organization can lead to anything, and it’s therefore necessary to protect people and shared resources, and to give people a clear purpose and defined goals.



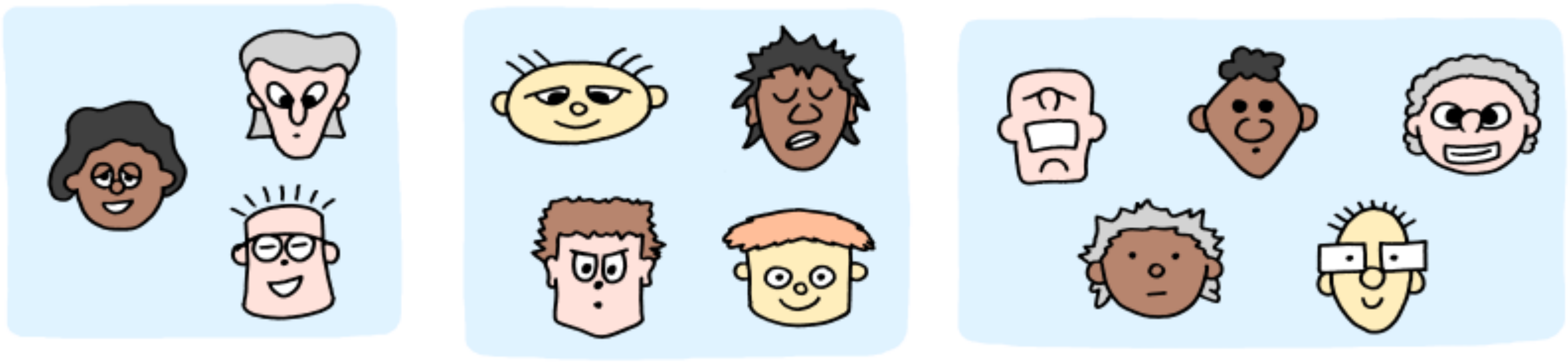
View #4: Develop Competence

Teams cannot achieve these goals if team members aren't capable enough, and managers must therefore contribute to the development of competence.



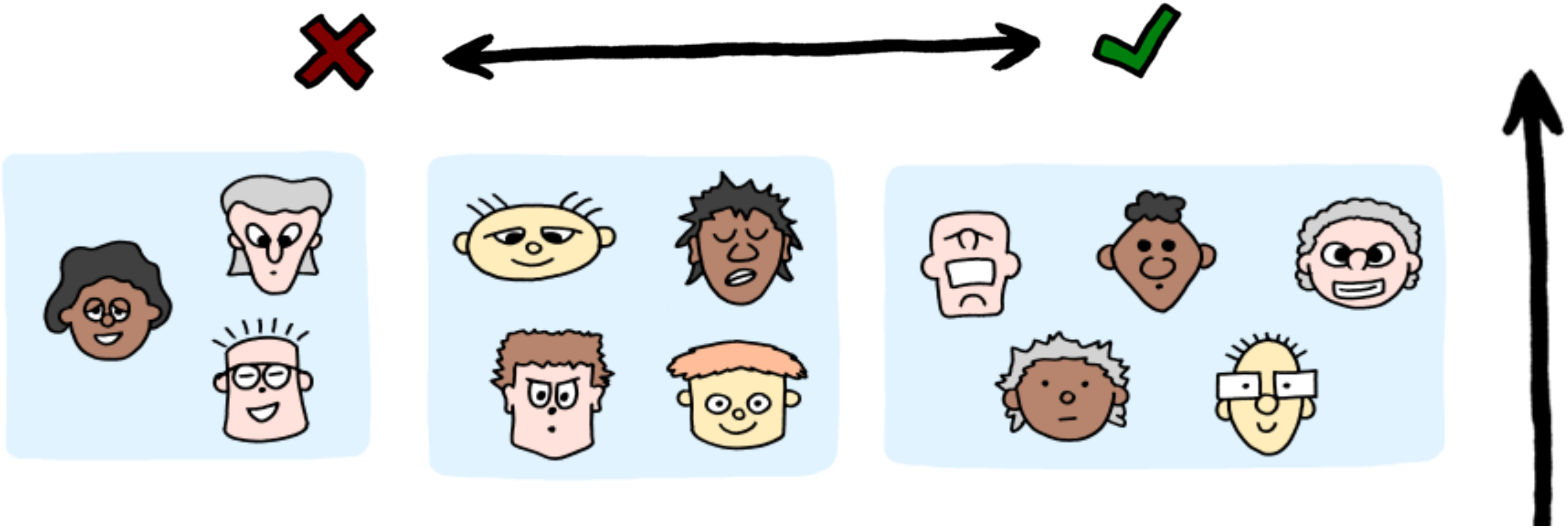
View #5: Grow Structure

Many teams operate within the context of a complex organization, and thus it is important to consider structures that enhance communication .



View #6: Improve Everything

People, teams, and organizations need to improve continuously to defer failure for as long as possible.



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Principle 1: Eleminate Waste

http://www.flickr.com/photos/braydawg/202403468/

Principle 1: Eleminate Waste

Yes, ~~but~~...

Junk DNA (98%) enables innovation and resilience

You cannot measure the unexpected value of waste

And thus:

There can be value in having waste “lying around”

If the cost of waste is low, maybe you should keep it

Principle 2: Build Quality In

http://www.flickr.com/photos/extranoise/276297674/

Principle 2: Build Quality In

Yes, ~~but~~...

Preventing errors inhibits learning from errors

Limiting ways of usage limits innovation

You cannot predict the value of doing things “wrong”

And thus:

There can be value in being ambiguous & inexplicit

Principle 3: Create Knowledge

http://www.flickr.com/photos/butterflysha/135659489/

Principle 3: Create Knowledge

Yes, ~~but~~...

Develop Competence =

skill * discipline * knowledge * social connectivity

And connectivity has more effect than knowledge

Cross, Rob et.al. *The Hidden Power of Social Networks*. Boston: Harvard Business School Press, 2004

And thus:

Competence in the system is more than knowledge

Principle 4: Defer Commitment

http://www.flickr.com/photos/zoutedrop/2317065892/

Principle 4: Defer Commitment

Yes, ~~but~~…

Committing early can be **motivating**

Committing early changes risks and opportunities

You cannot predict the results of these changes

And thus:

There is (sometimes) value in making early choices

Principle 5: Deliver Fast

http://www.flickr.com/photos/curns/4237949343/

Principle 5: Deliver Fast

Yes, ~~but~~...

This assumes adaptation as a survival strategy

Humans are successful thanks to consciousness

Also called an “anticipation device” (Daniel Dennett)

Anticipation can (sometimes) outsmart adaptation

And thus:

Think (briefly), then deliver fast

Principle 6: Respect People

http://www.flickr.com/photos/fhashemi/44551132/

Principle 6: Respect People

Yes, ~~but~~...

Energize People =

trust * respect * motivation * diversity * creativity

Respect is insufficient to instill a “need” for work

And thus:

People in the system must be energized

Principle 7: Optimize the Whole

http://www.flickr.com/photos/flatbag74/2884704165/

Principle 7: Optimize the Whole

Yes, ~~but~~...

Cross-functional teams can be sub-optimizing too

“Optimize the whole” invites top-down control

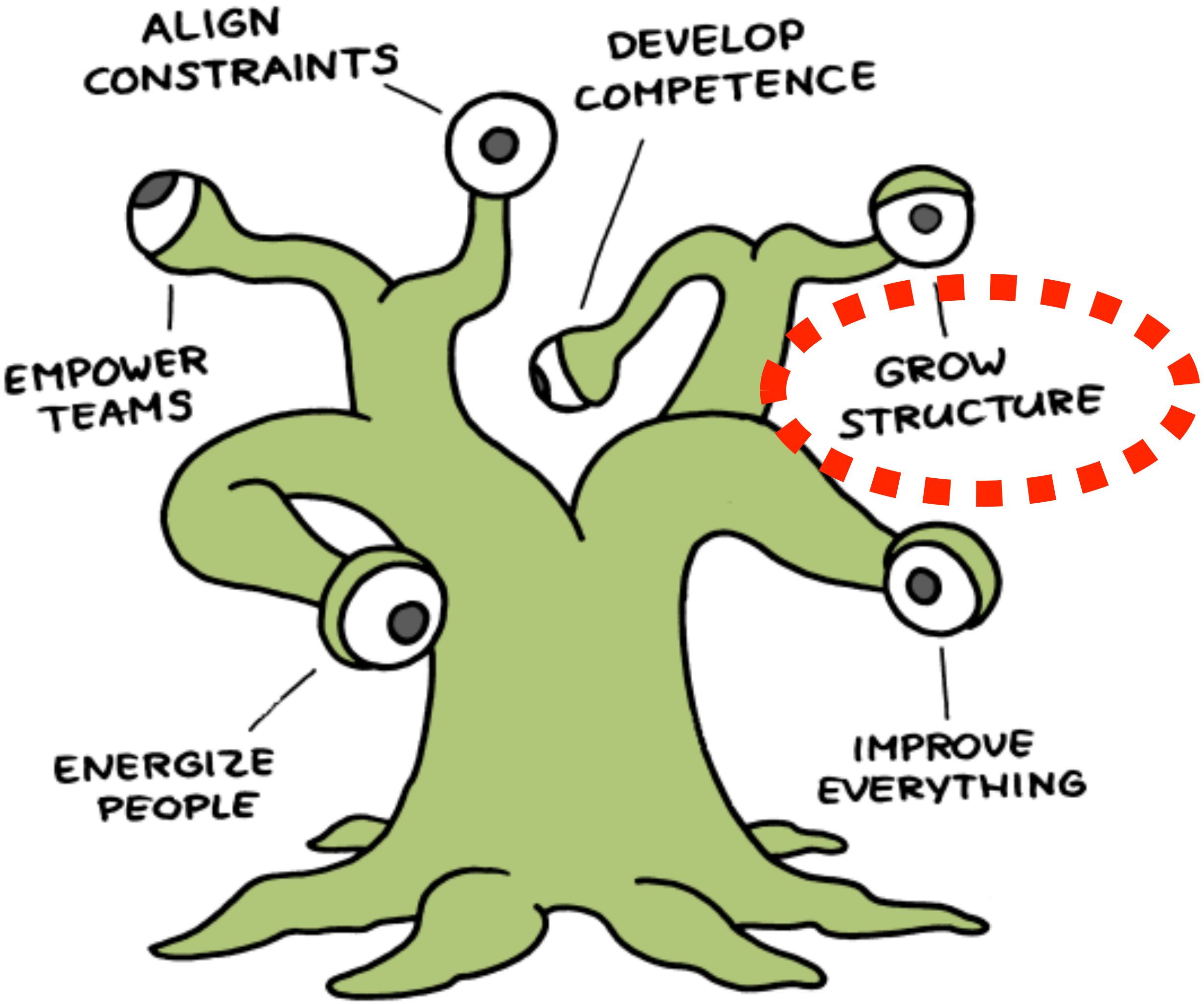
A complex system finds its own global optimum through local optimizations and global dependencies

And thus:

Create locally optimizing and interdependent teams

“~~Missing~~” in Lean Software Development

Not covered



“~~Missing~~” in Lean Software Development

Not covered

No guidance on structuring organizations

No explicit choice for value networks over hierarchies

That’s why Lean is abused in top-down “lean & mean”

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1: Visualize the workflow

http://www.flickr.com/photos/audreyjm529/235458062/

1: Visualize the workflow

Yes, ~~but~~…

“Value stream” and “value chains” suggest a linear flow of value

But an organization has **many stakeholders**, who all want to get value out of their collaboration

And thus…

Visualize multiple workflows

2: Limit work in progress (WIP)

http://www.flickr.com/photos/blumpy/325853852/

2: Limit work in progress (WIP)

Yes, ~~but~~...

A book author has an entire book in progress

Limited WIP is just one example of a constraint

And thus:

A system will self-organize around its constraints

Choose constraints to match the workflow

3: Measure and manage flow

http://www.flickr.com/photos/chefranden/390872656/

3: Measure and manage flow

Yes, ~~but~~...

Leads to sub-optimization when only flow to customers is considered

And thus:

Measure and manage flow to all stakeholders

(customers, suppliers, employees, shareholders, ...)

4: Make process policies explicit

http://www.flickr.com/photos/moonlightbulb/3323103034/

4: Make process policies explicit

Yes, ~~but~~...

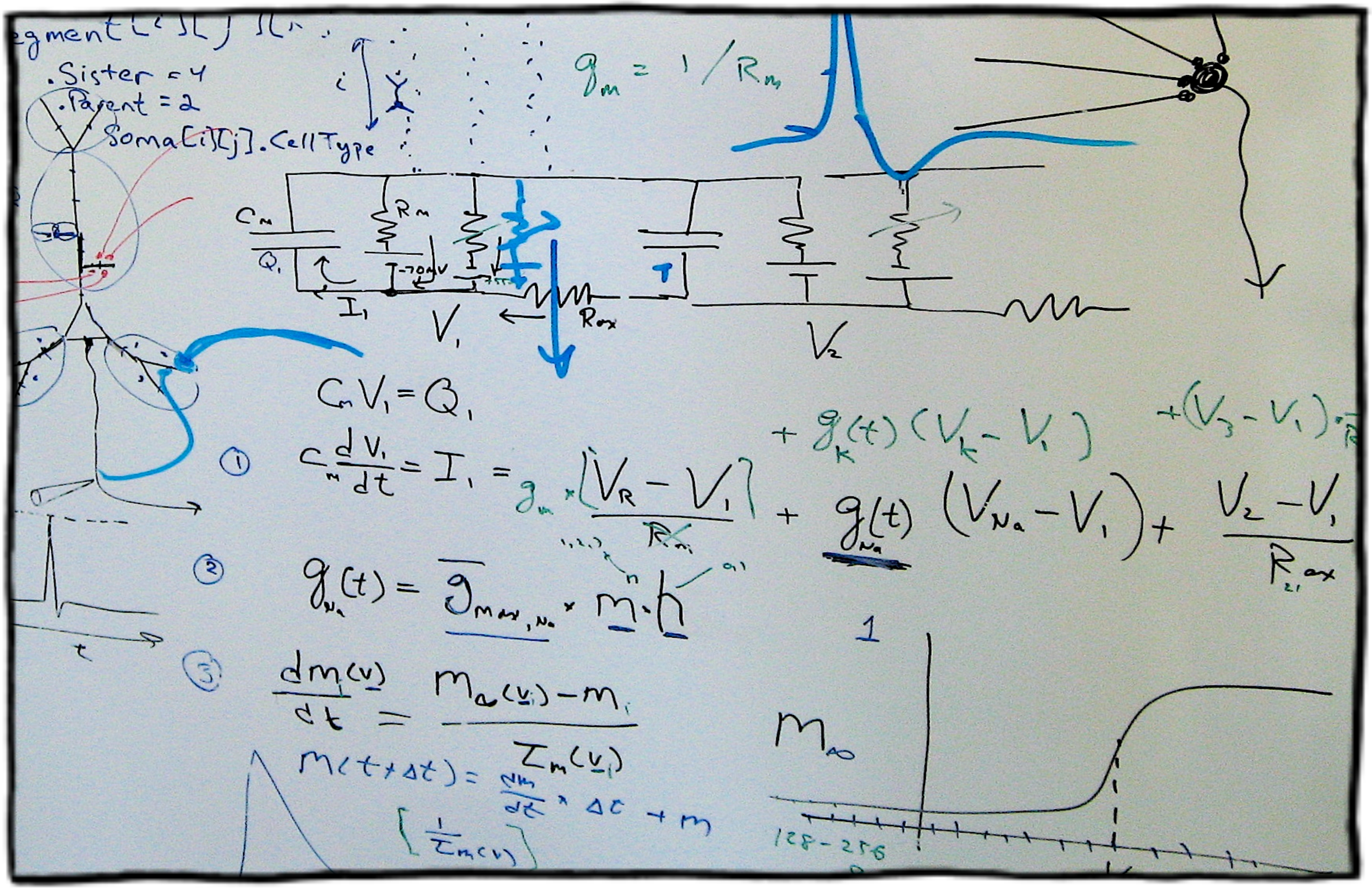
Genetic algorithms: a variety of conflicting rules

Learning made possible through “credit assignment”

And thus:

Experiment with rules

5: Use models to suggest improvements


egment[i][j][...
.Sister = 4
.Parent = 2
Soma[i][j].CellType
i
$g_m = 1/R_m$
C_m
Q_1
R_m
-70mV
I_1
V_1
R_{ax}
V_2
$C_m V_1 = Q_1$
① $C_m \frac{dV_1}{dt} = I_1 = g_m \times \frac{[V_R - V_1]}{\cancel{R_{m_i}}} + g_{Na}(t)(V_{Na} - V_1) + \frac{V_2 - V_1}{R_{ax_{2,1}}}$
$+ g_K(t)(V_K - V_1)$
$+ (V_3 - V_1)$
1,2,3
n
② $g_{Na}(t) = \bar{g}_{max,Na} \times m \cdot h$
③ $\frac{dm(v)}{dt} = \frac{m_\infty(v_i) - m_i}{\tau_m(v_i)}$
$m(t+\Delta t) = \frac{dm}{dt} \times \Delta t + m$
$\left[\frac{1}{\tau_m(v)}\right]$
1
m_∞
128-256
t

http://www.flickr.com/photos/jurvetson/447302275/

5: Use models to suggest improvements

Yes, ~~but~~…

All models are wrong, some are useful

Beware of “scientific approach” to workflows

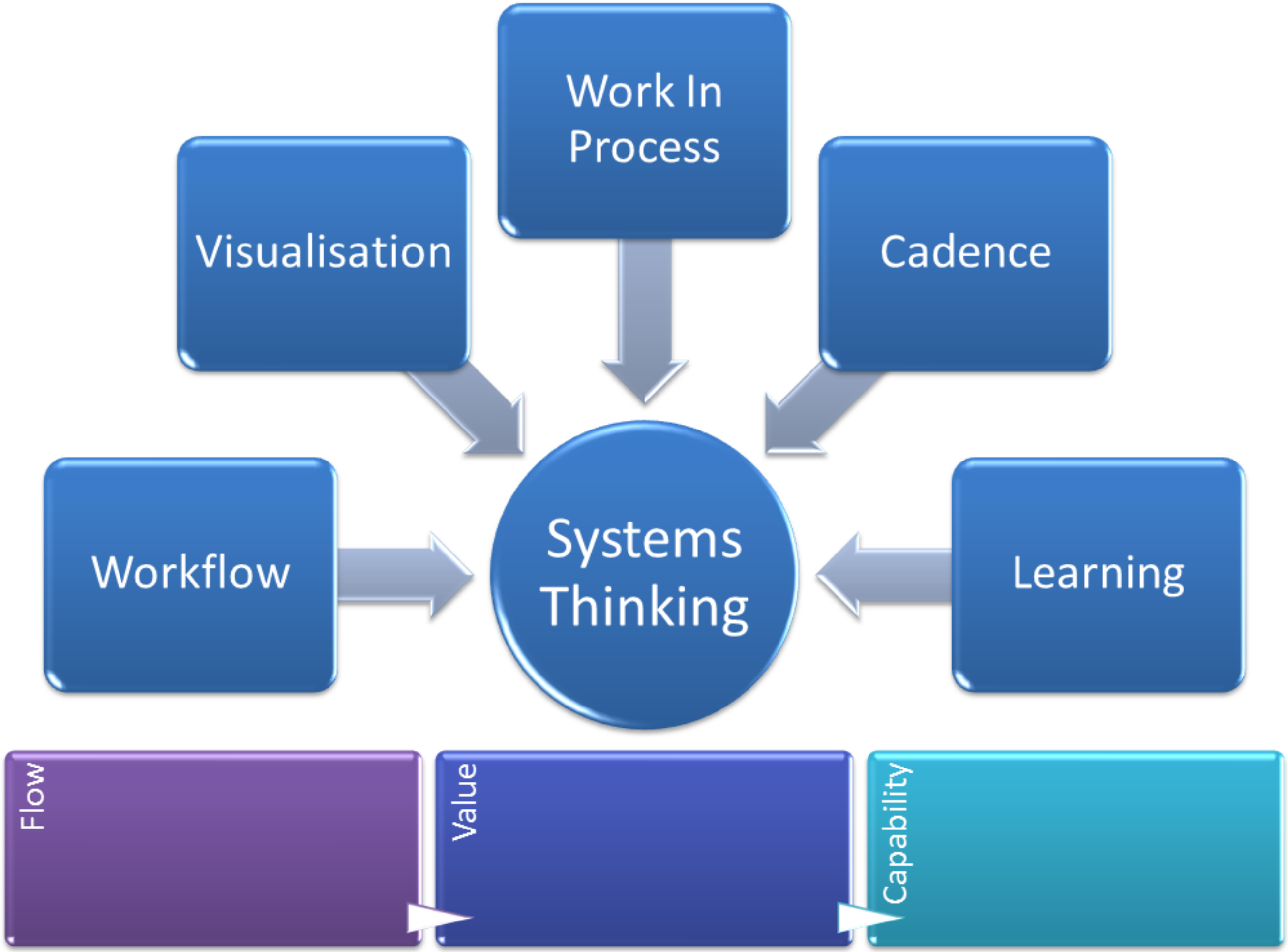
Banks and casinos also have “scientific approaches”

Yet, they have been unpleasantly surprised…

And thus:

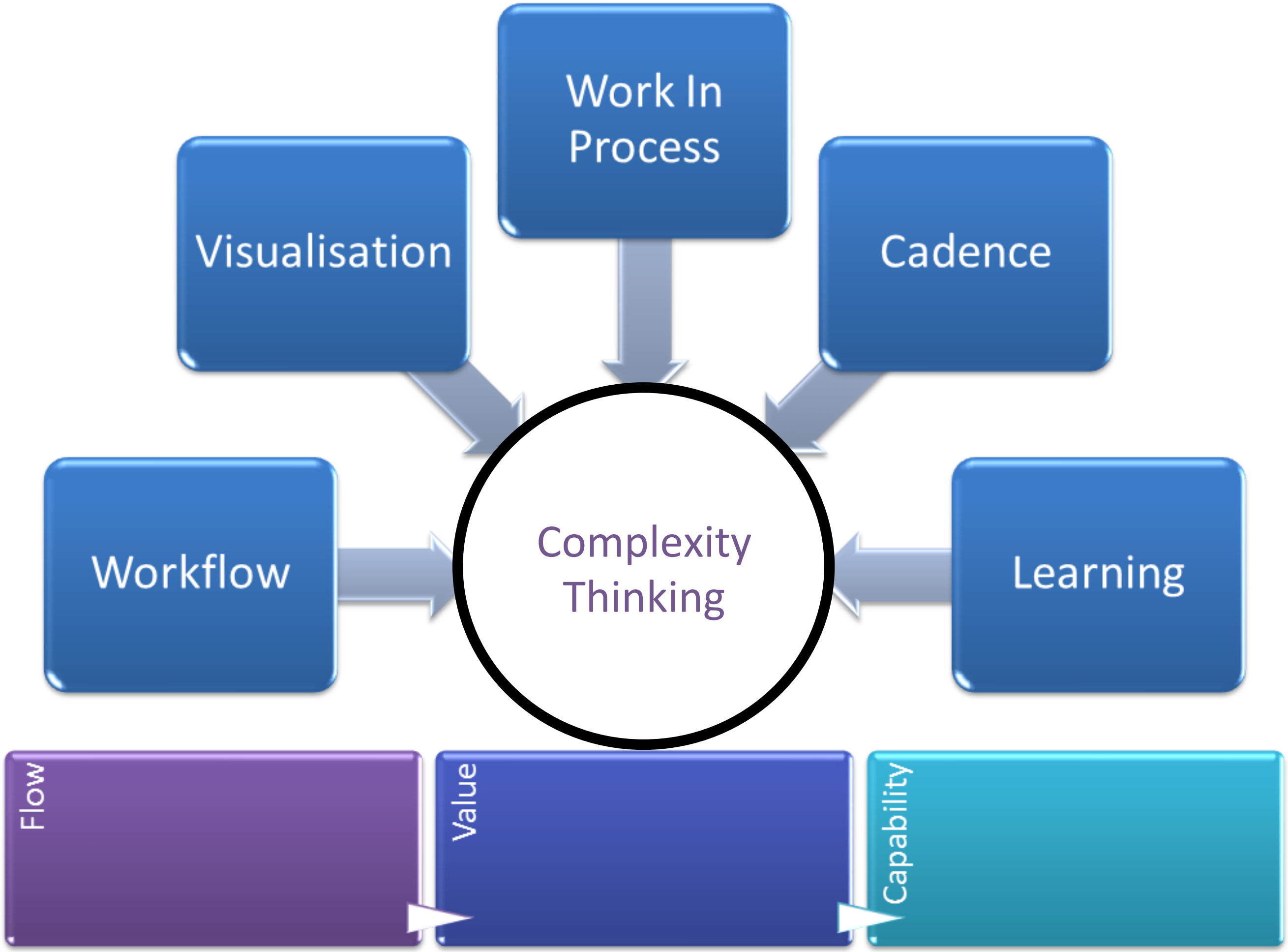
Use complexity thinking to suggest models

“A Model for Creating a Kanban System”



http://availagility.co.uk/2010/10/11/a-model-for-creating-a-kanban-system/

“A Model for Creating a Kanban System”



Work In Process

Visualisation

Cadence

Workflow

Complexity Thinking

Learning

Flow

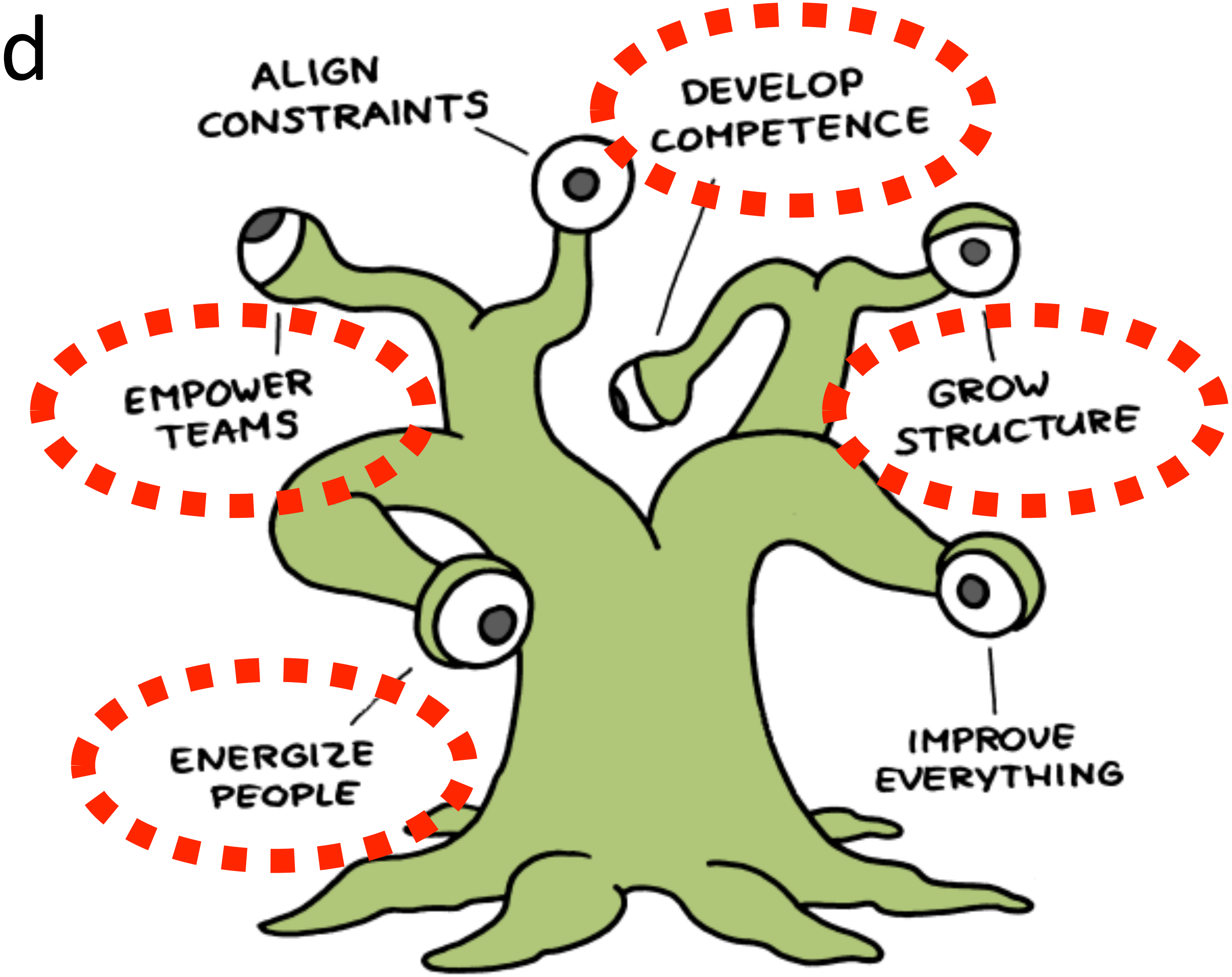
Value

Capability

http://availagility.co.uk/2010/10/11/a-model-for-creating-a-kanban-system/

“~~Missing~~” in Kanban

Not covered



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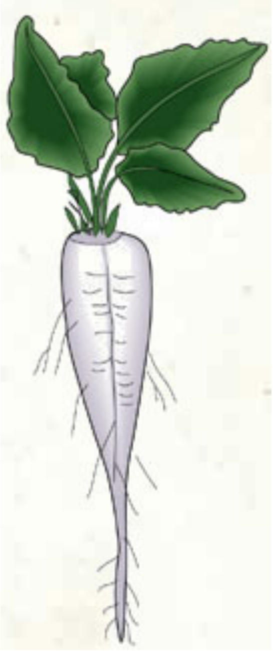
Root Cause Analysis

Suggests there *is* a root cause

But often there are non-linear relationships

Unclear what is cause and what is effect

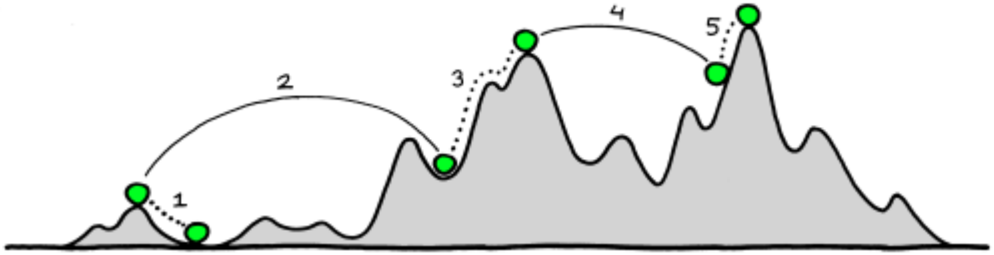


Kaizen

Suggests gradual linear process improvement

But systems can get stuck in a local optimum on the fitness landscape

Sometimes need for radical change (kaikaku)



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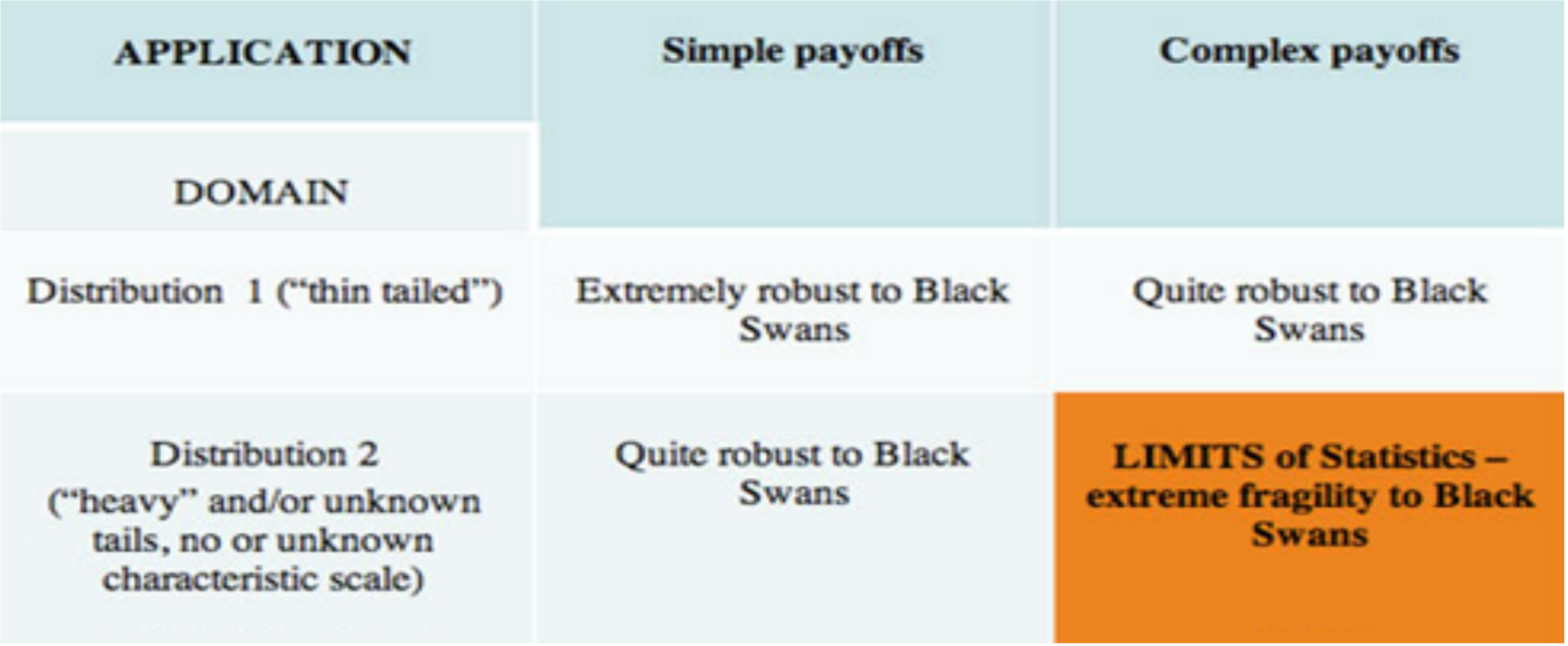
The 1nd “~~danger~~” of Lean misunderstanding

Relying on data, ignoring Black Swans

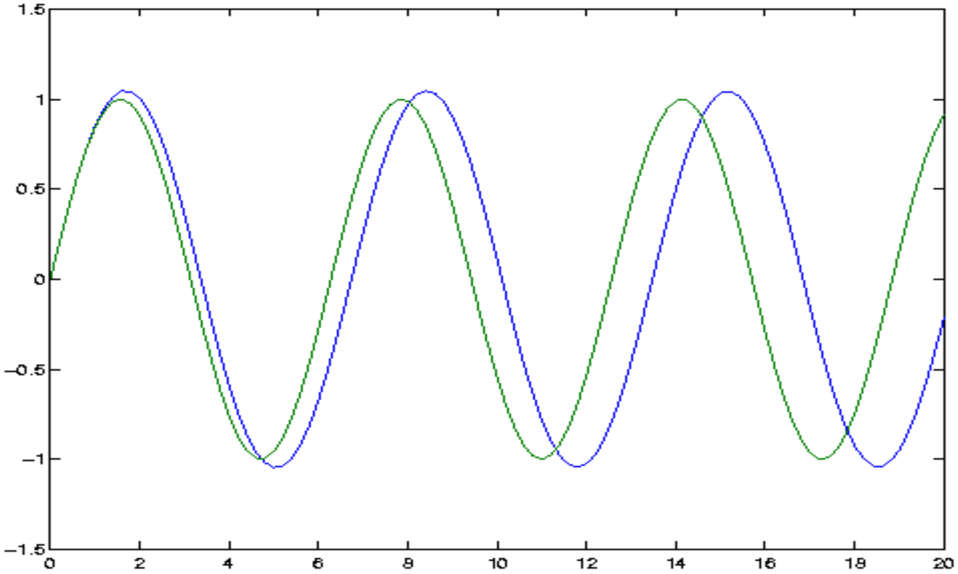


APPLICATION	Simple payoffs	Complex payoffs
DOMAIN		
Distribution 1 (“thin tailed”)	Extremely robust to Black Swans	Quite robust to Black Swans
Distribution 2 (“heavy” and/or unknown tails, no or unknown characteristic scale)	Quite robust to Black Swans	LIMITS of Statistics – extreme fragility to Black Swans

http://www.edge.org/3rd_culture/taleb08/taleb08_index.html

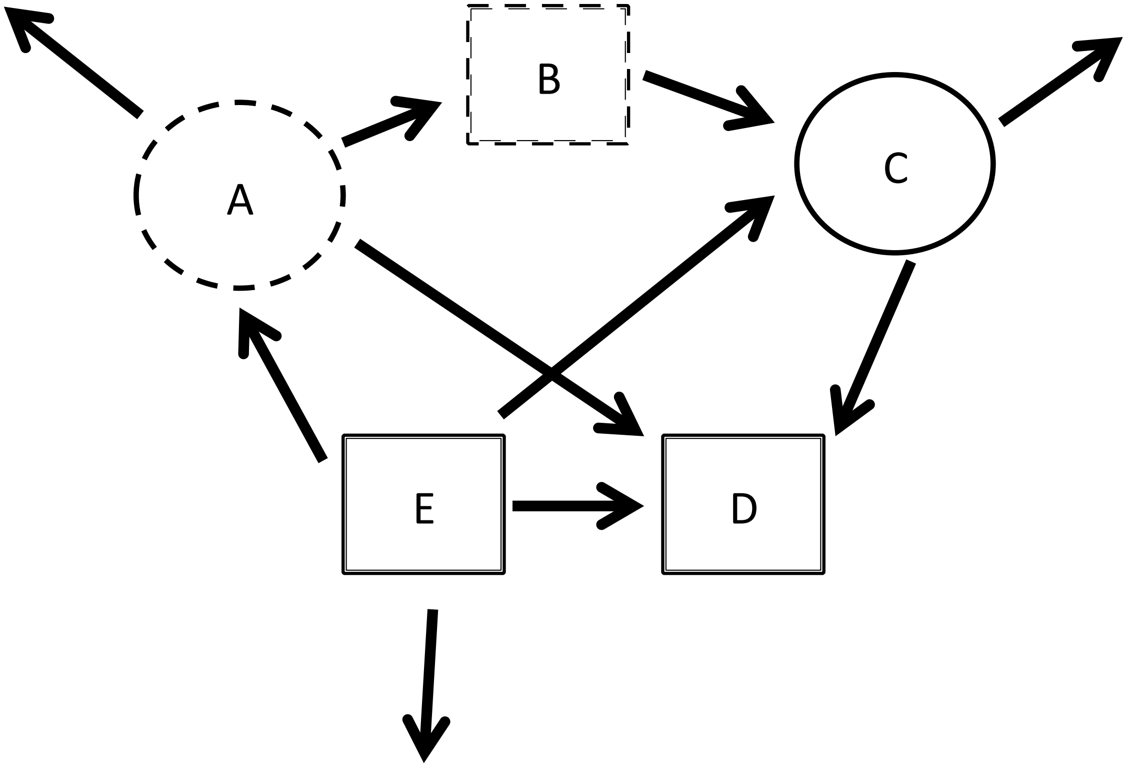
The 2rd ~~“danger”~~ of Lean misunderstanding

Relying on cause and effect, ignoring non-linearity



The 3th “~~danger~~” of Lean misunderstanding

Ignoring value networks, multiple stakeholders

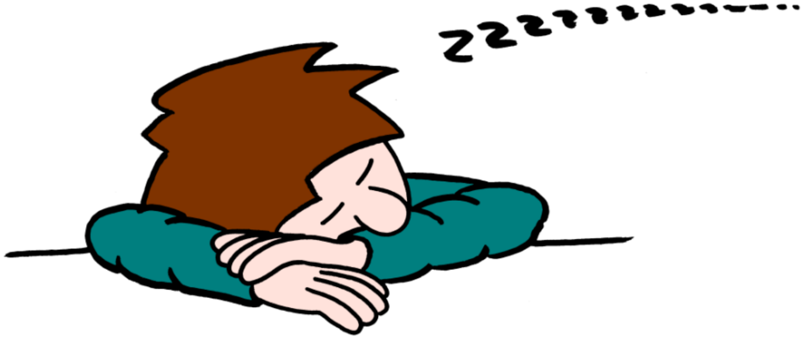


http://www.edge.org/3rd_culture/taleb08/taleb08_index.html

Lean is GREAT!

(really, it is)

But let’s not stop thinking.



the end

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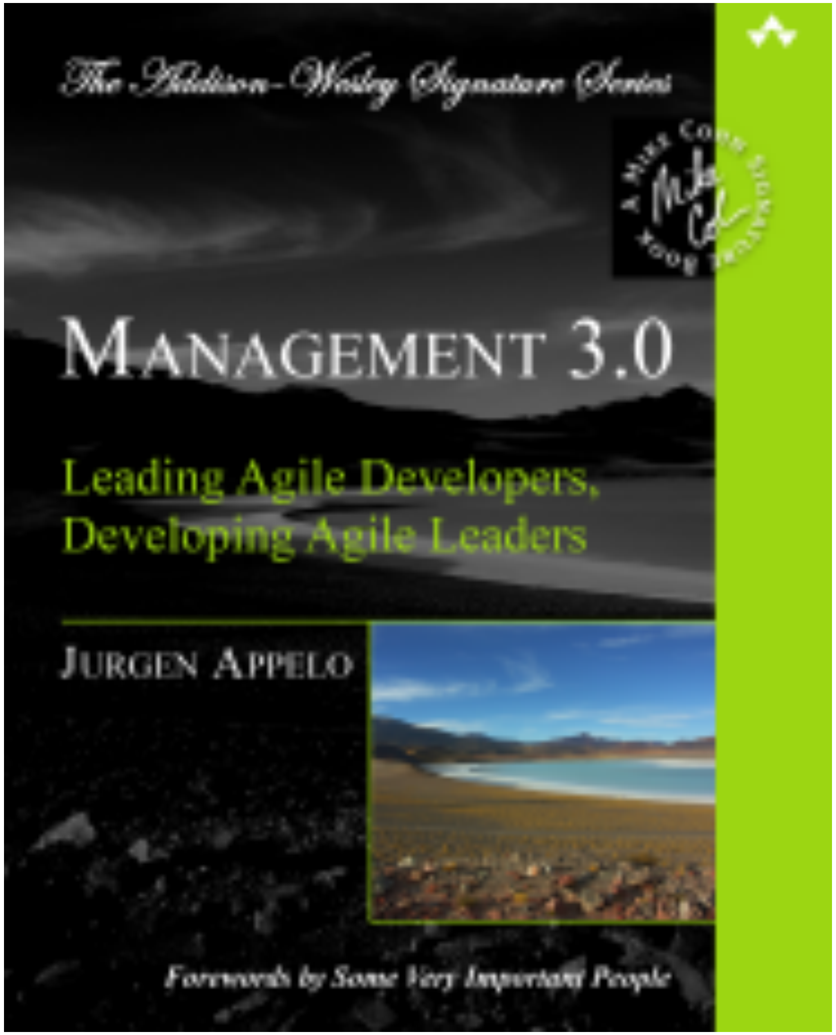

The Addison-Wesley Signature Series

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Management 3.0

Leading Agile Developers, Developing Agile Leaders

Jurgen Appelo

Forewords by Some Very Important People

Q & A

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