



GOTO
Guide

LET US HELP YOU

Ask questions
through **the app**



also remember to rate session



THANK YOU!

#GOTOams

Team Topologies, Software Architecture and Complexity Science

James Lewis @boicy

“We cannot say there is a formal definition of the microservices architectural style...”

- Martin Fowler, James Lewis

**Componentisation
via services**

**Organised around
business capabilities**

**Decentralised data
management**

**Products not
projects**

**Decentralised
governance**

**Smart endpoints
and dumb pipes**

**Evolutionary
design**

**Infrastructure
automation**

**Designed
for failure**

**Componentisation
via services**

**Organised around
business capabilities**

**Decentralised data
management**

**Products not
projects**

**Decentralised
governance**

**Smart endpoints
and dumb pipes**

**Evolutionary
design**

**Infrastructure
automation**

**Designed
for failure**



Team Topologies and Complexity

**“The bigger we get, the easier
it becomes to get bigger.”**

**- Someone from Amazon,
can't tell you, Chatham House rules**

the goal of successful organisational design is to optimise the flow of value. all else is subordinate

***“Safely and sustainably
reduce lead time to thank-
you”***

- Daniel Terhorst-North

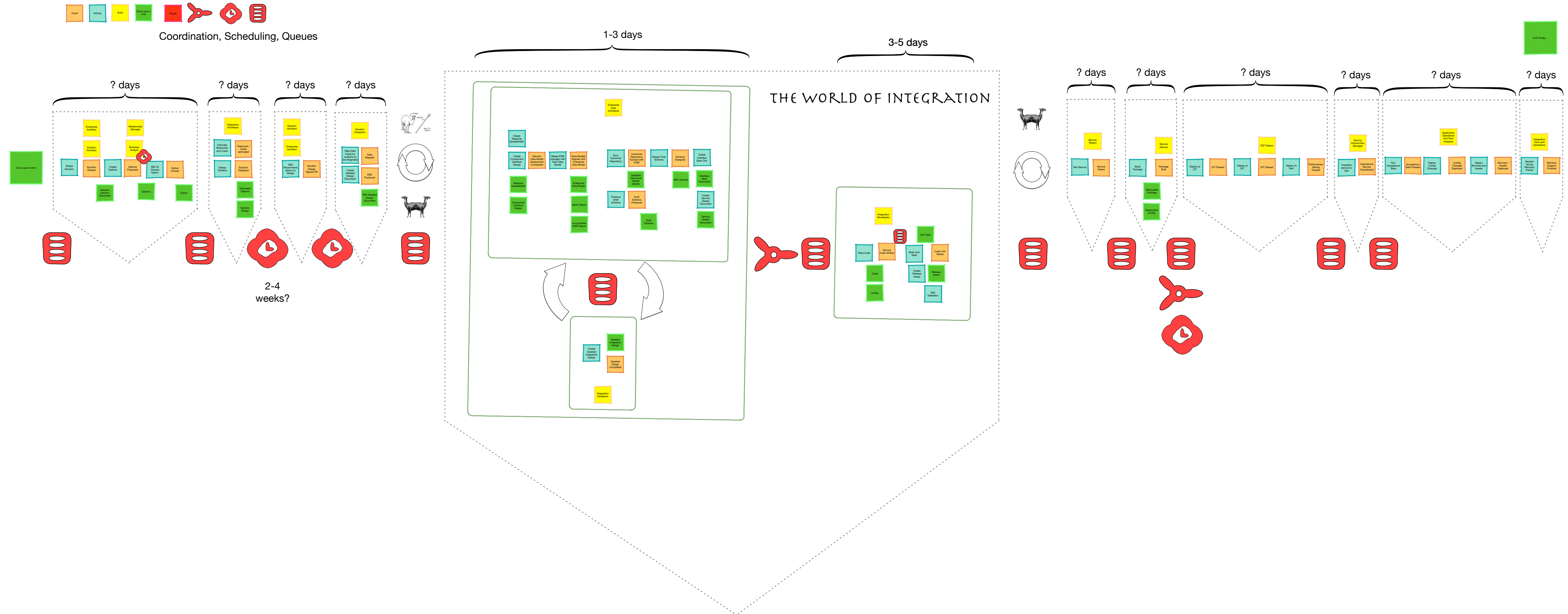
What is value?

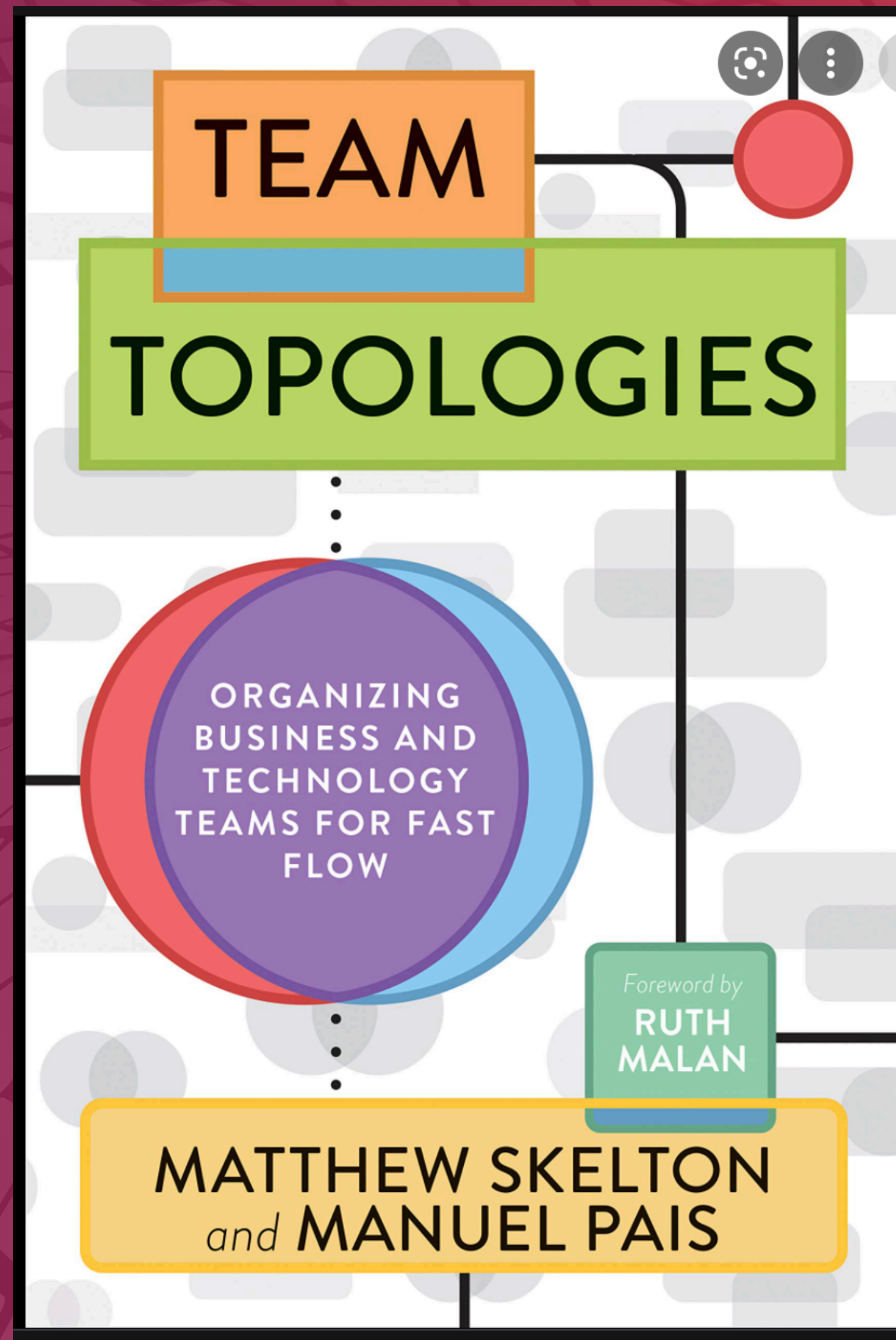
Generally it's “stuff”

Squint and physical products and knowledge work are the same

raw materials — —> a thing

How long does stuff take?





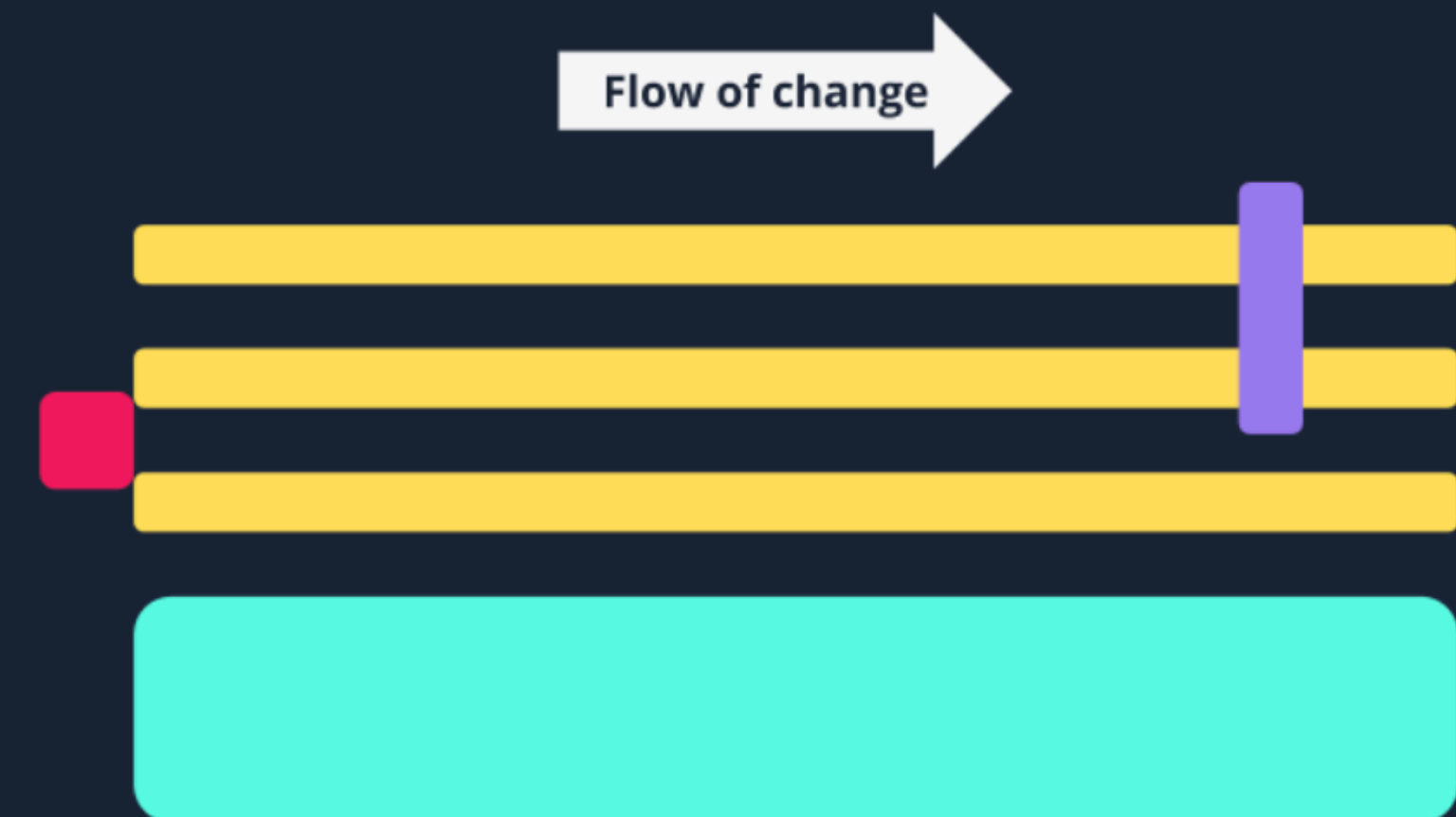
4 fundamental topologies

- Stream-aligned team
- Enabling team
- Complicated Subsystem team
- Platform team

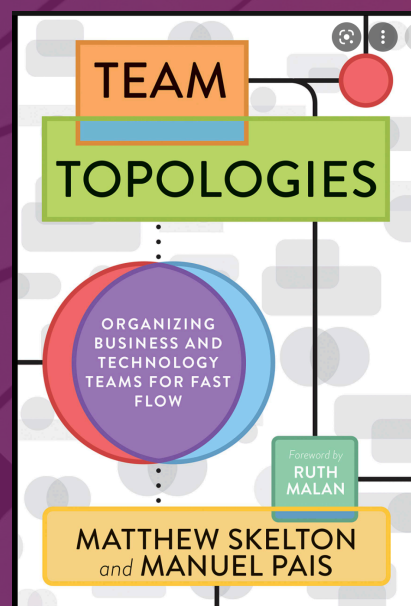


Four fundamental topologies

4 fundamental topologies



Four fundamental topologies shown with the flow of change



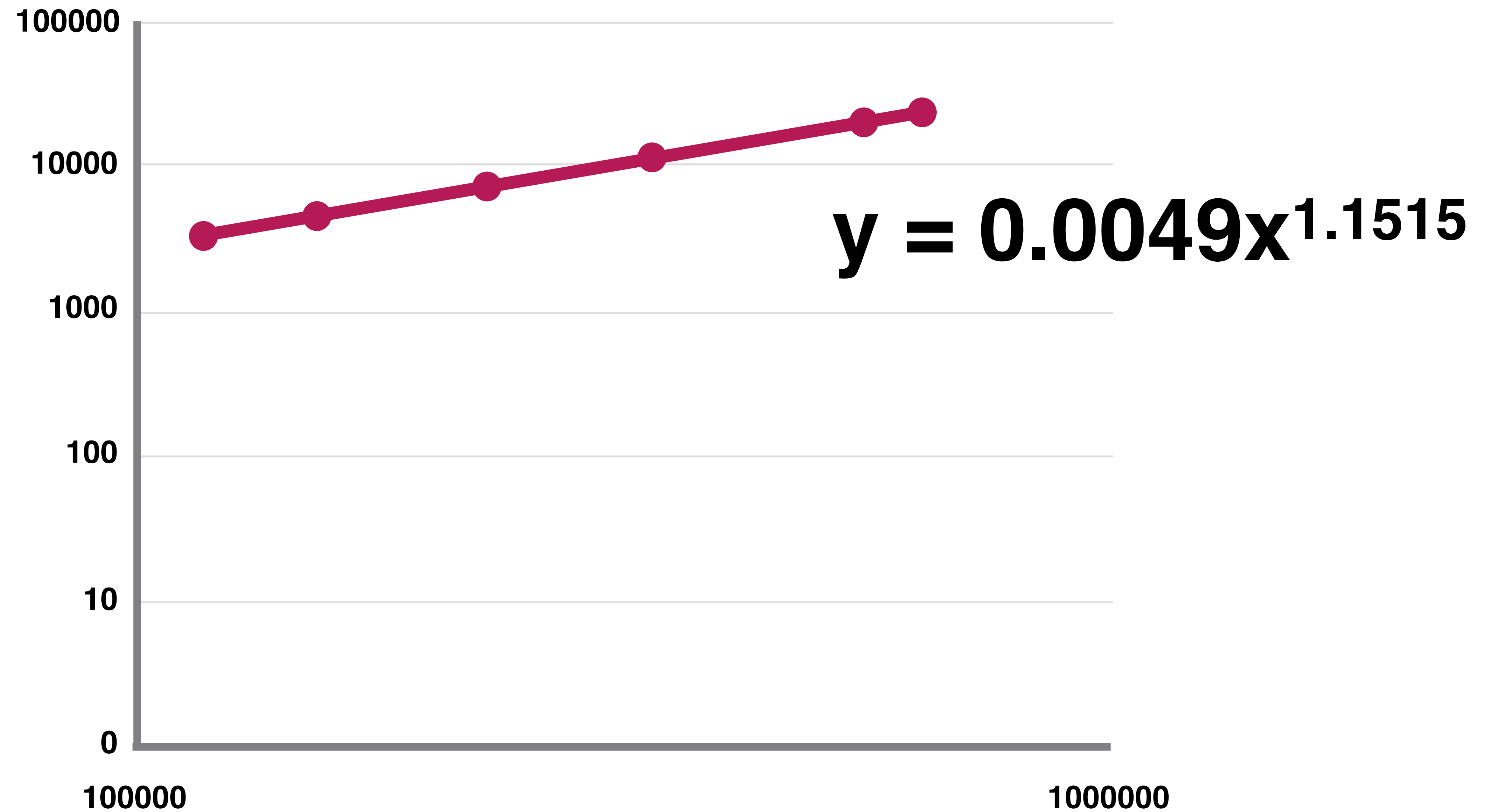


Software Architecture and Complexity

“The bigger we get, the easier
it becomes to get bigger.”

“Adding manpower to a late software project makes it later.”

- Fred Brooks, Mythical Man Month



**Teams must
communicate
via interfaces**



amazon

**Teams must
communicate
via interfaces**



**All interfaces must
be externalisable**



amazon

**Teams must
communicate
via interfaces**

**All interfaces must
be externalisable**

**2 pizza
(Dunbars #)
teams**

amazon



Forcing functions
for *flow*

**Limiting interaction to
nearby teams**

Team isolation

**Scale by Dunbar's
numbers**



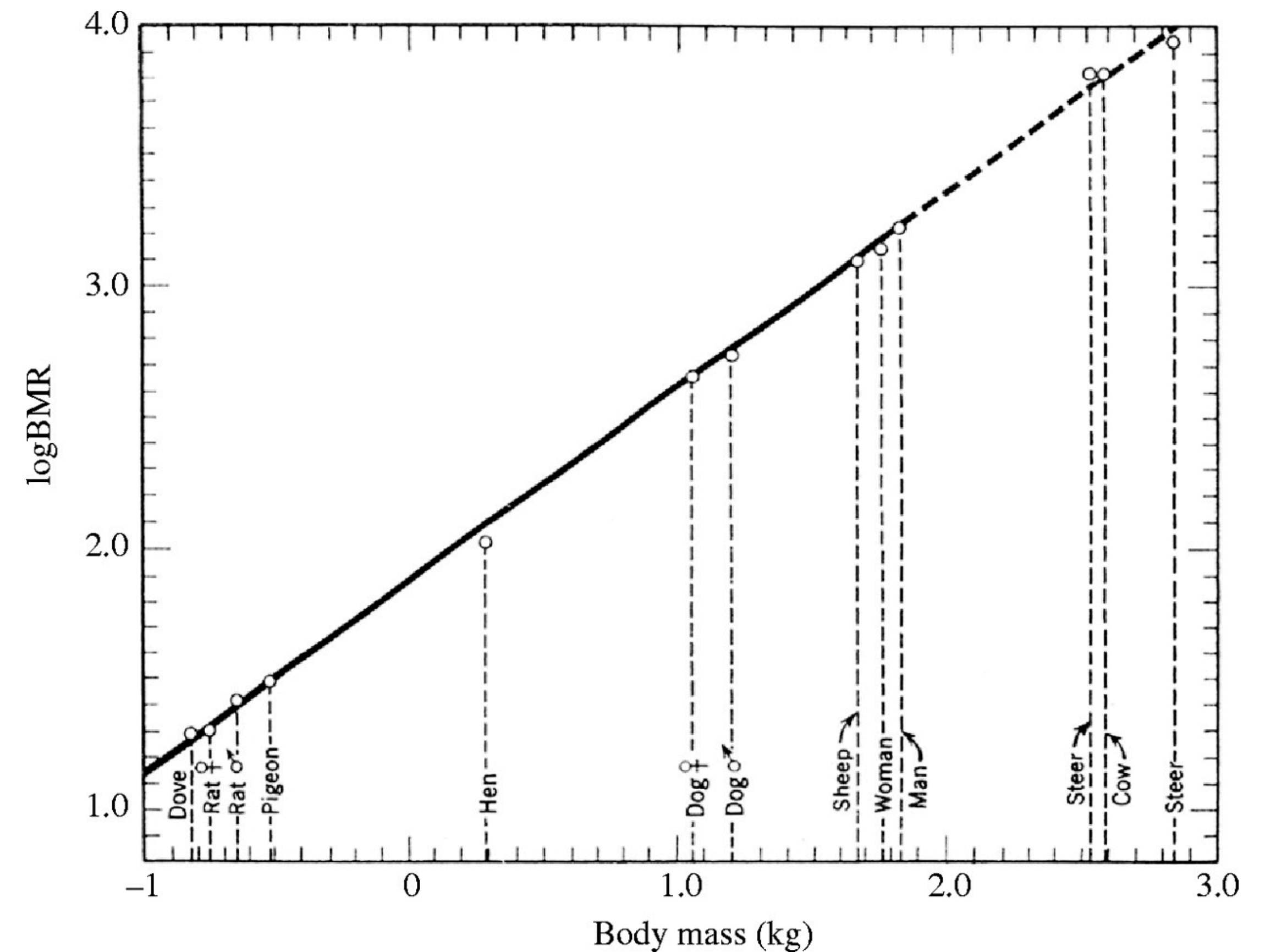
Complex Adaptive Systems

Complex adaptive systems



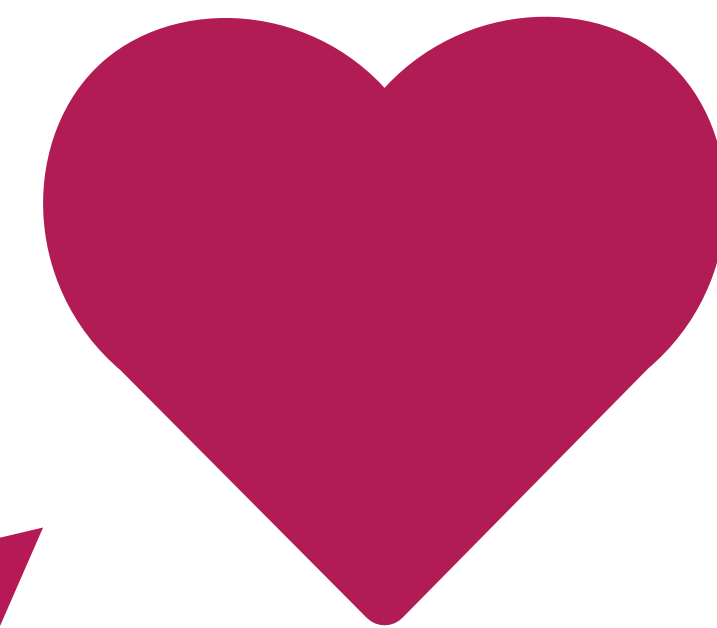
**SANTA FE
INSTITUTE**

Mice and Elephants (and us)



Geoffrey B. West, James H. Brown
Journal of Experimental Biology 2005 208: 1575-1592;
doi: 10.1242/jeb.01589

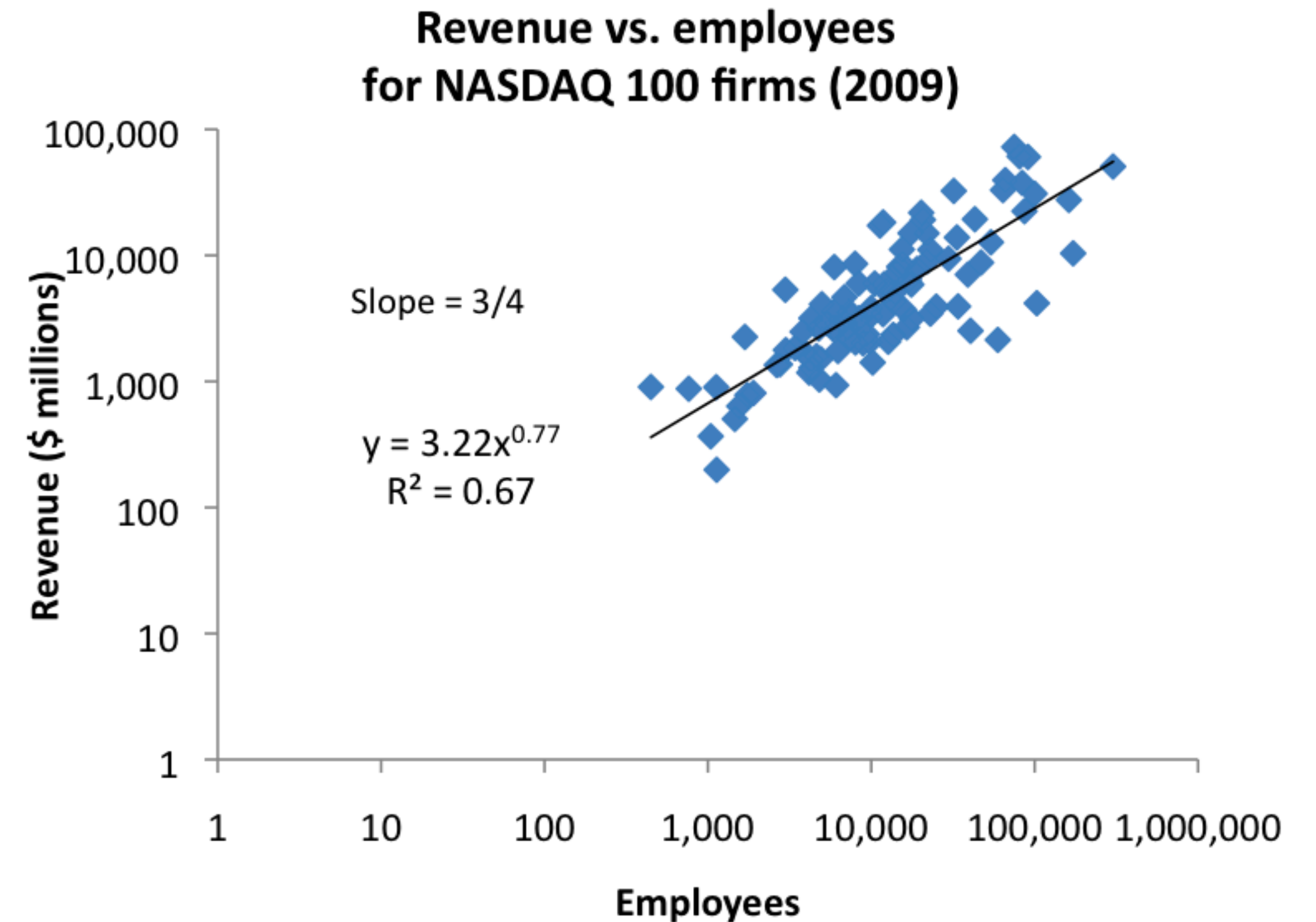
Metabolic rates in mammals follow a scaling law with an exponent of $3/4$.



0.75

As a mammal doubles in size it needs only 75% of the calories.

Mom 'n Pop stores and Aldi



Source data: Google Finance

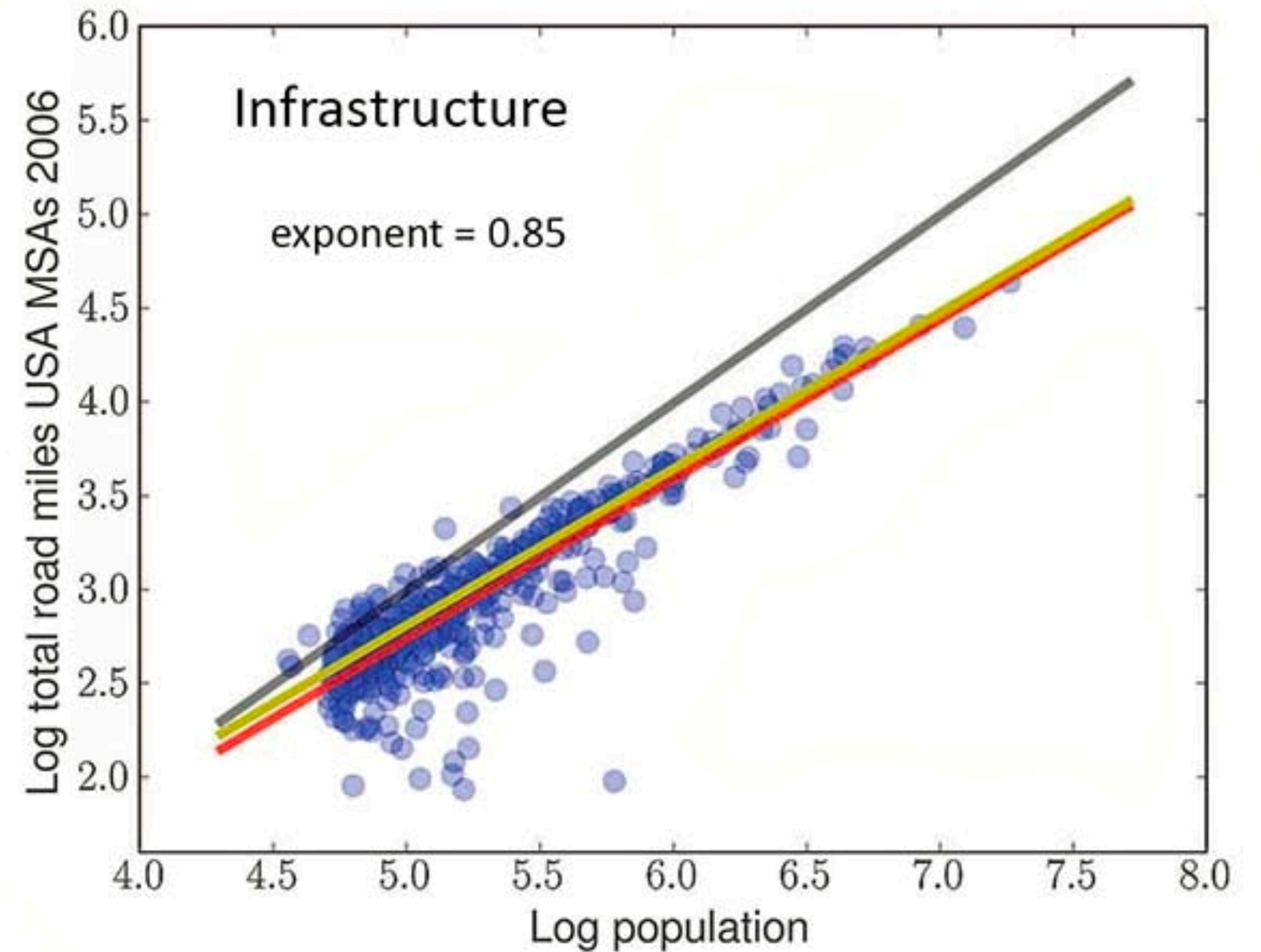
<https://protobi.com/post/revenue-per-employee-and-biologic-scaling-laws>

**Revenue scales with
employees following
a scaling law with an
exponent of 0.85.**



**As a company
doubles in size it
generates 85% of
the revenue.**

Utrecht and Rotterdam

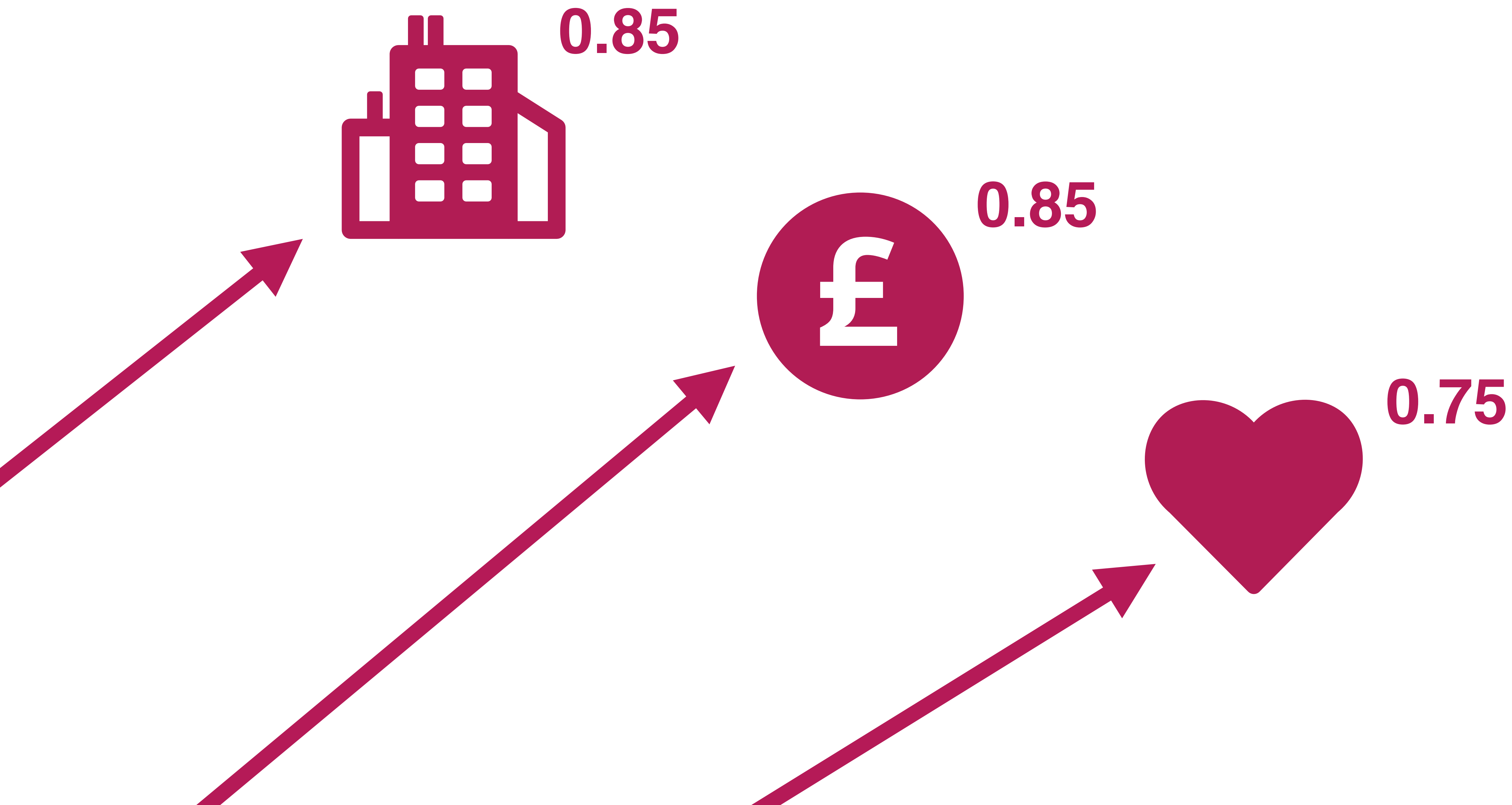


Bettencourt, Luís M. A.
2013 The Origins of Scaling in Cities. Science 340: 1438-1441.

Infrastructure scales with population with an exponent of 0.85.



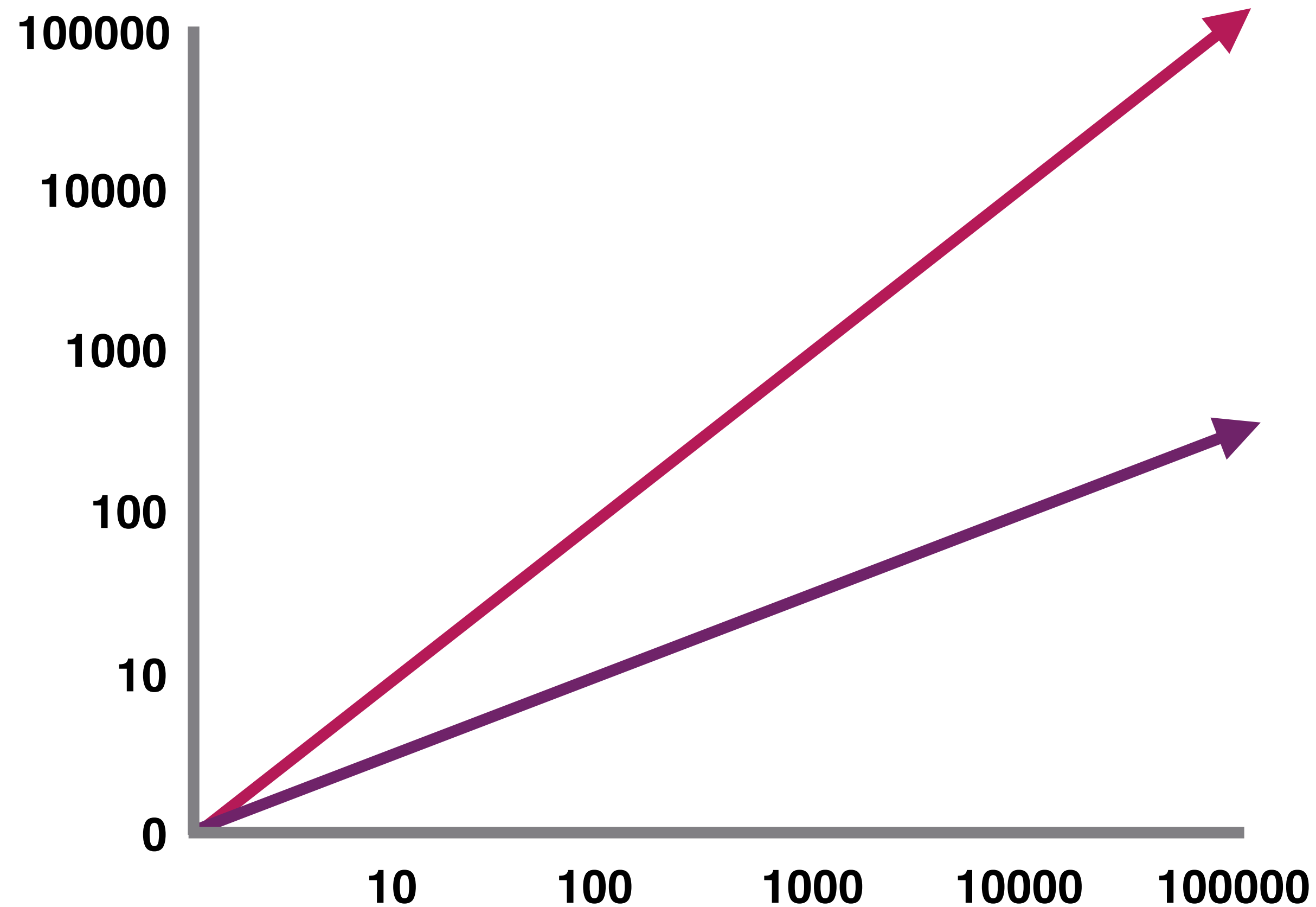
**Road length,
petrol stations,
restaurants,
water pipes,
electricity cables.**



“Quantities that do not change when other parameters of the system change play a special role in science...”

- Geoffrey West. Scale: The Universal Laws of Life and Death in Organisms, Cities and Companies.

Economies of scale



Linear scaling:

As x doubles, y also doubles

Sub-linear scaling:

As x doubles, y increases by less than double

Complex adaptive systems

Self-similarity

Self-organisation

Complexity

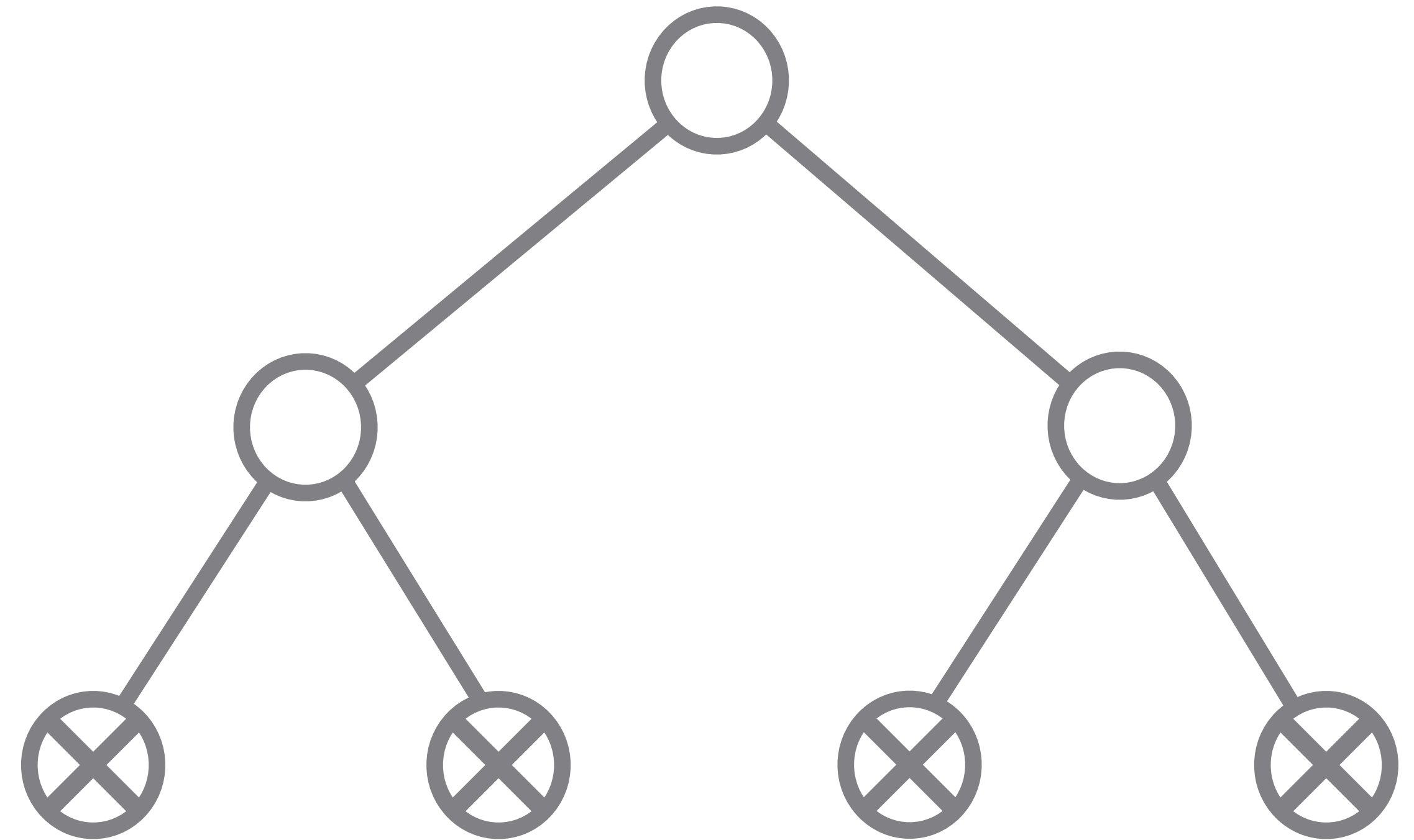
Emergence

3 simple principles

**1. Space filling
fractal networks**

**2. Invariant
terminating units**

3. Optimisation



Complex adaptive systems are everywhere

**Patterns can be described
using 3 principles**

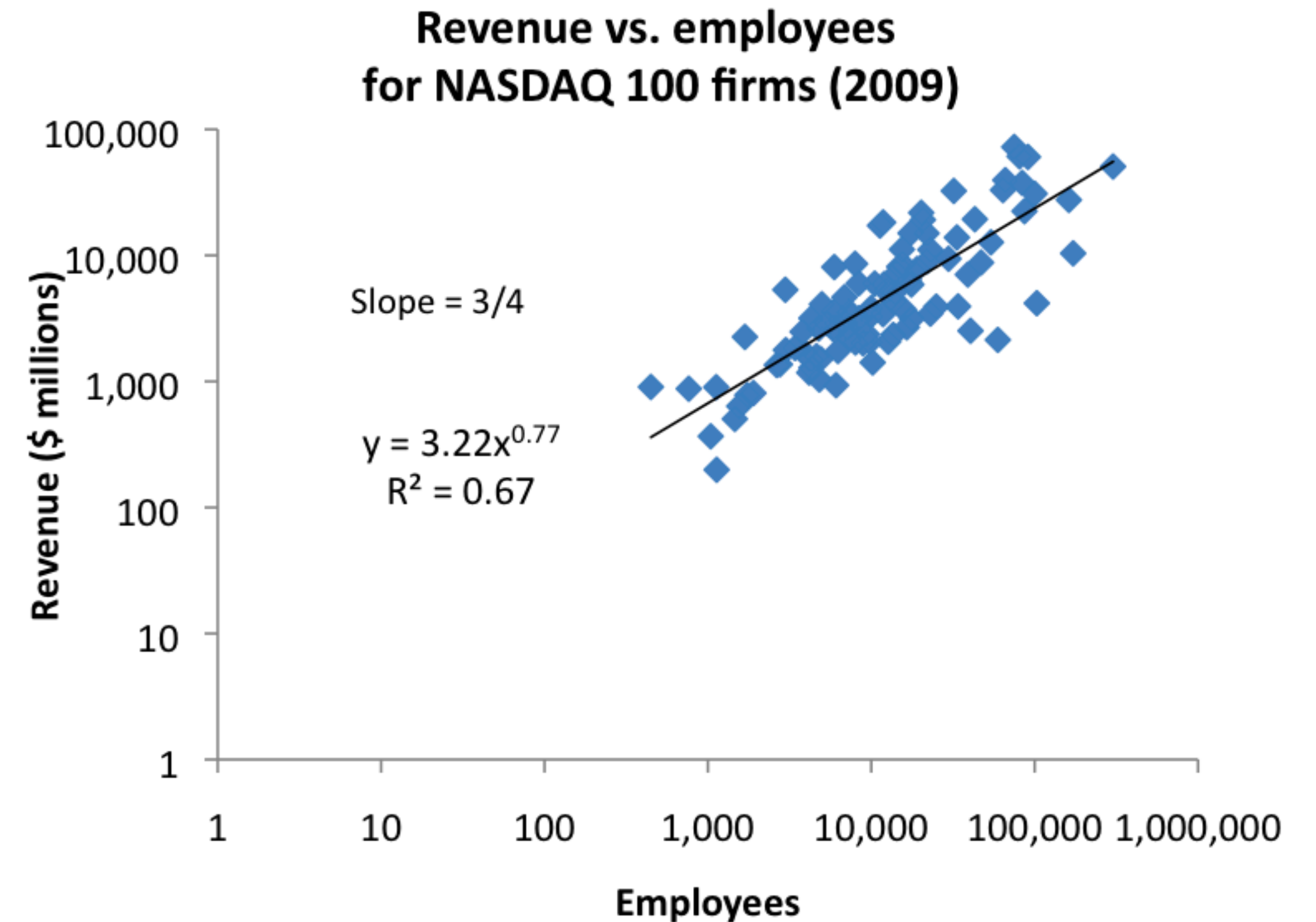
**Hierarchical fractal networks
scale following a power law
with an exponent <1**

**...Walmart and a convenience
store are the same. (just different
sizes)**



Corporate Metabolism

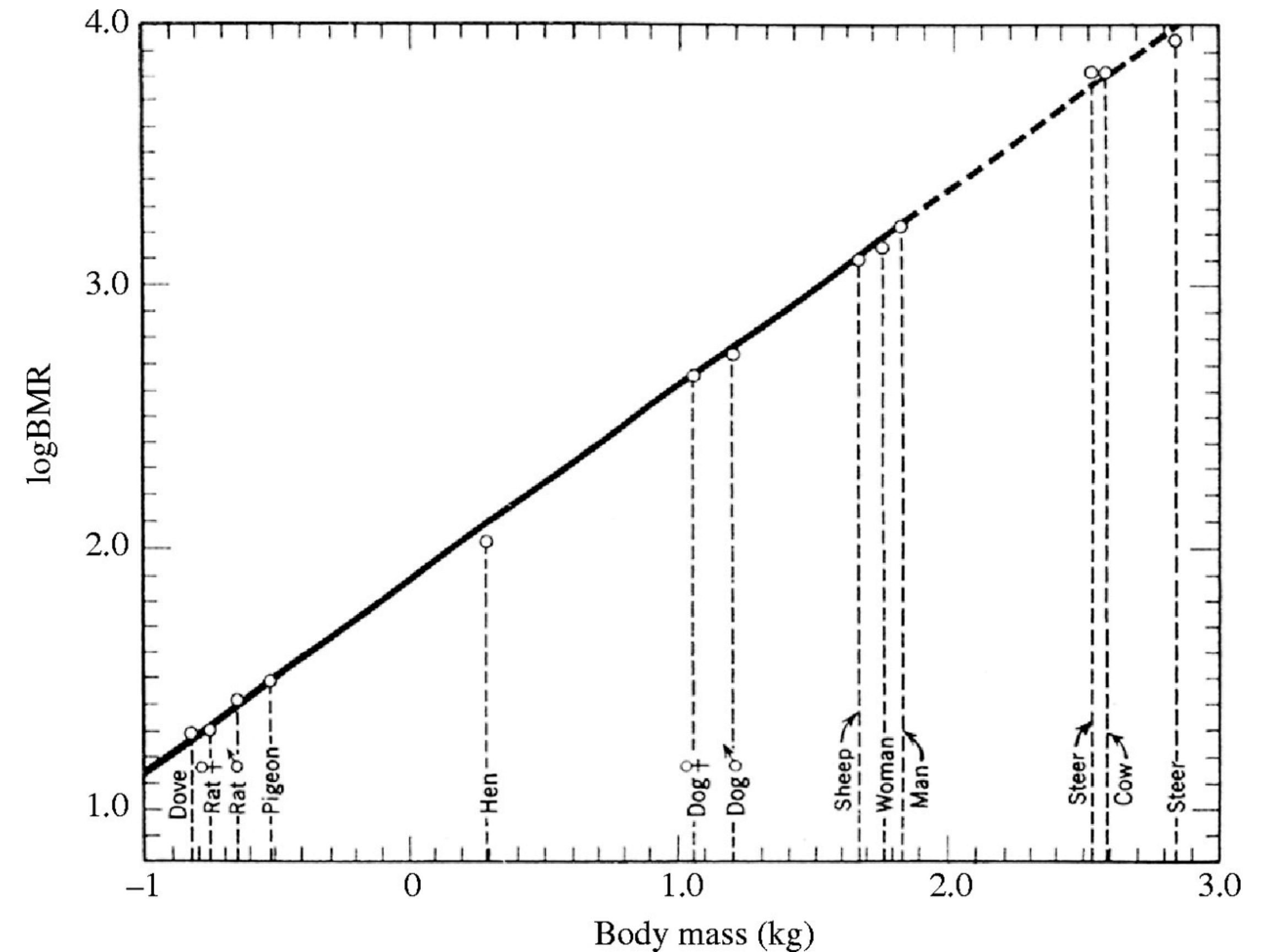
Why does revenue growth slow as size increases?



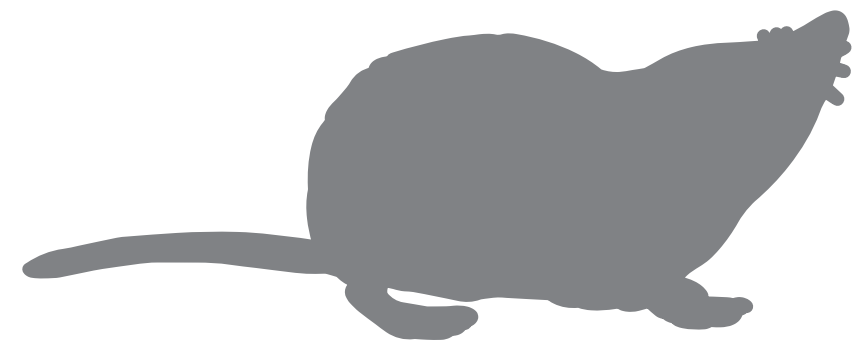
Source data: Google Finance

<https://protobi.com/post/revenue-per-employee-and-biologic-scaling-laws>

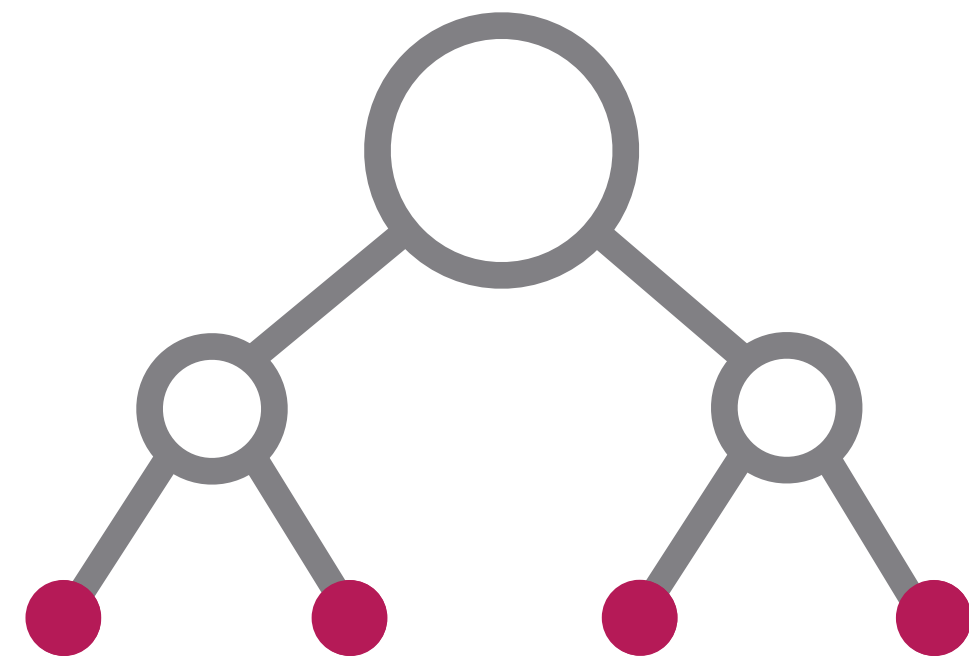
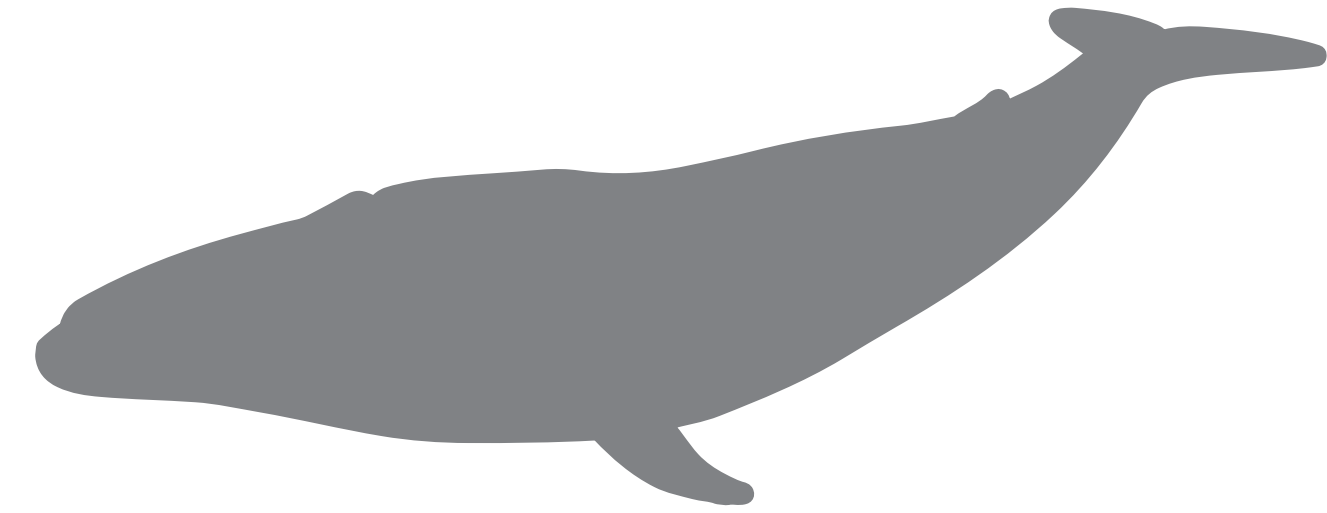
Why do metabolic rates slow as size increases?



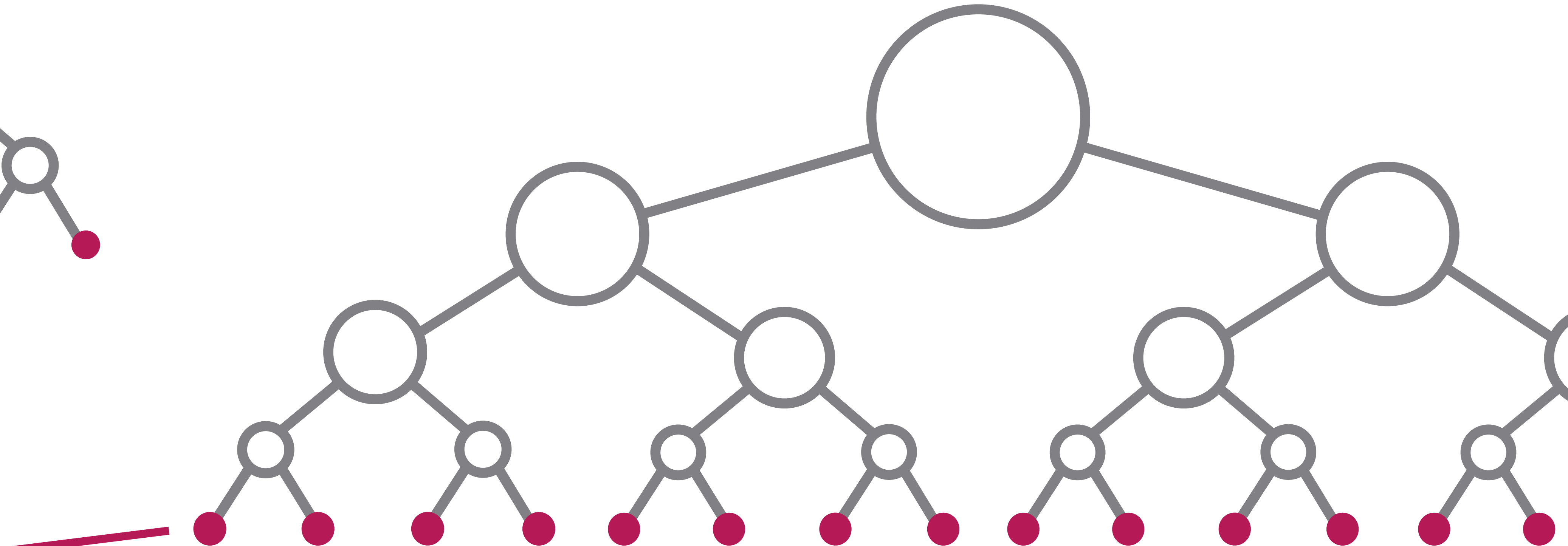
Geoffrey B. West, James H. Brown
Journal of Experimental Biology 2005 208: 1575-1592;
doi: 10.1242/jeb.01589

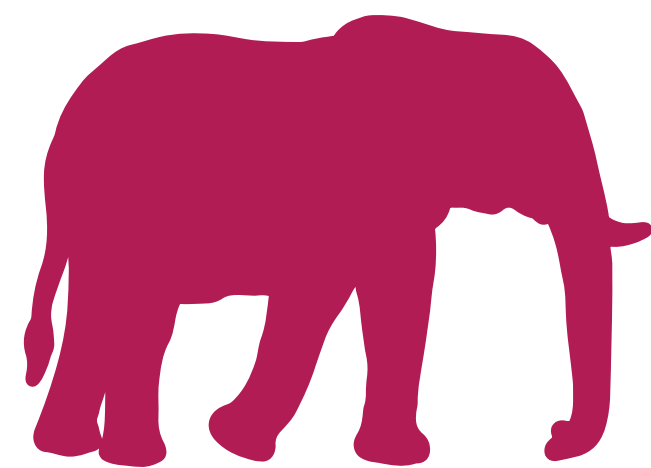


Hierarchies

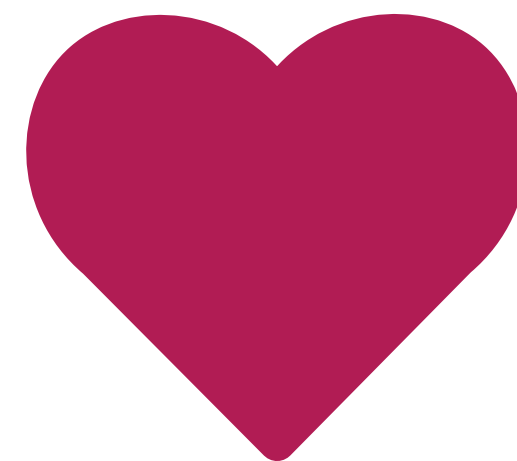


Same
size





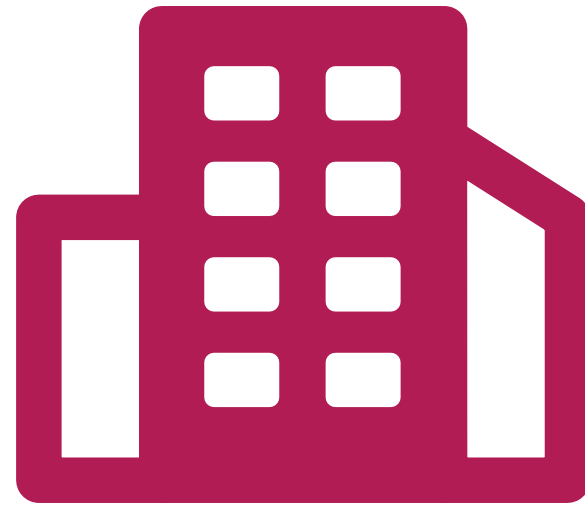
**Bigger animals
are more
efficient (0.75)**



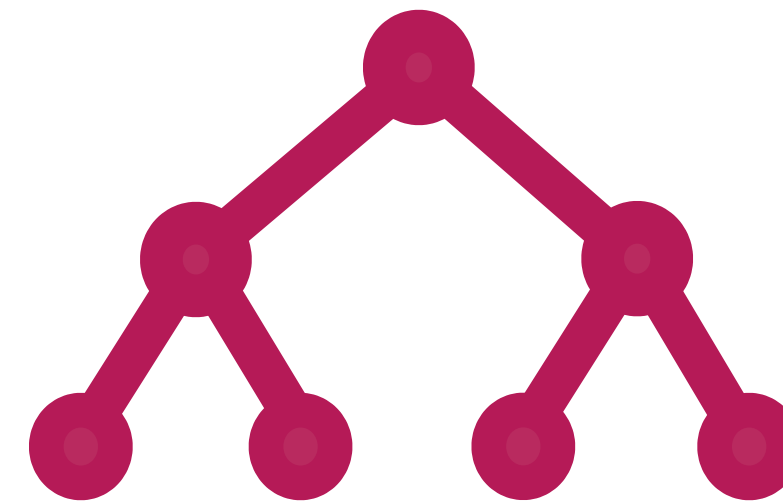
**Due to impedance
matching in the
circulatory system**



**Driven by
feedback from
evolution.**



**Bigger companies
are more efficient
(0.85)**



**They develop deeper
hierarchies as they
age**



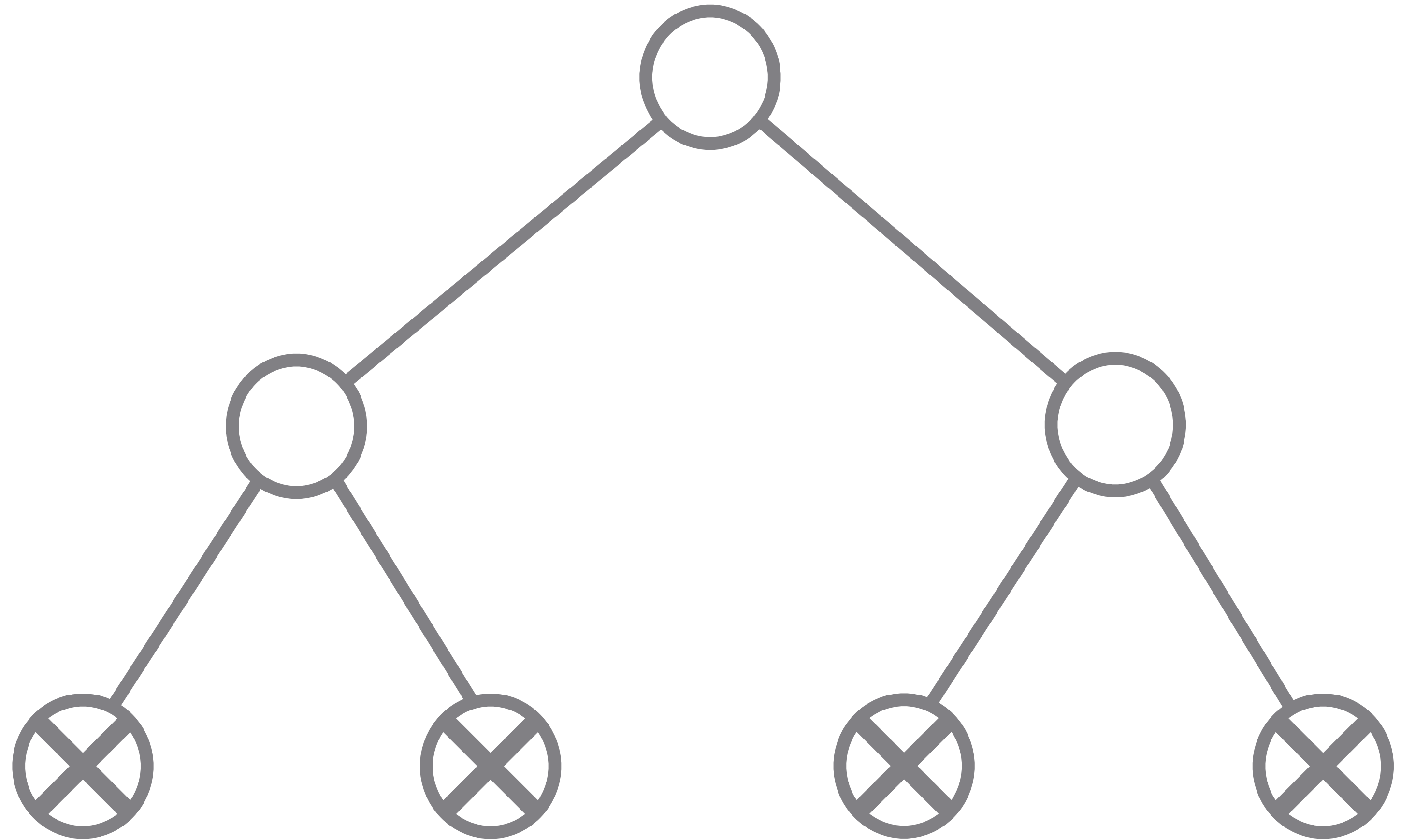
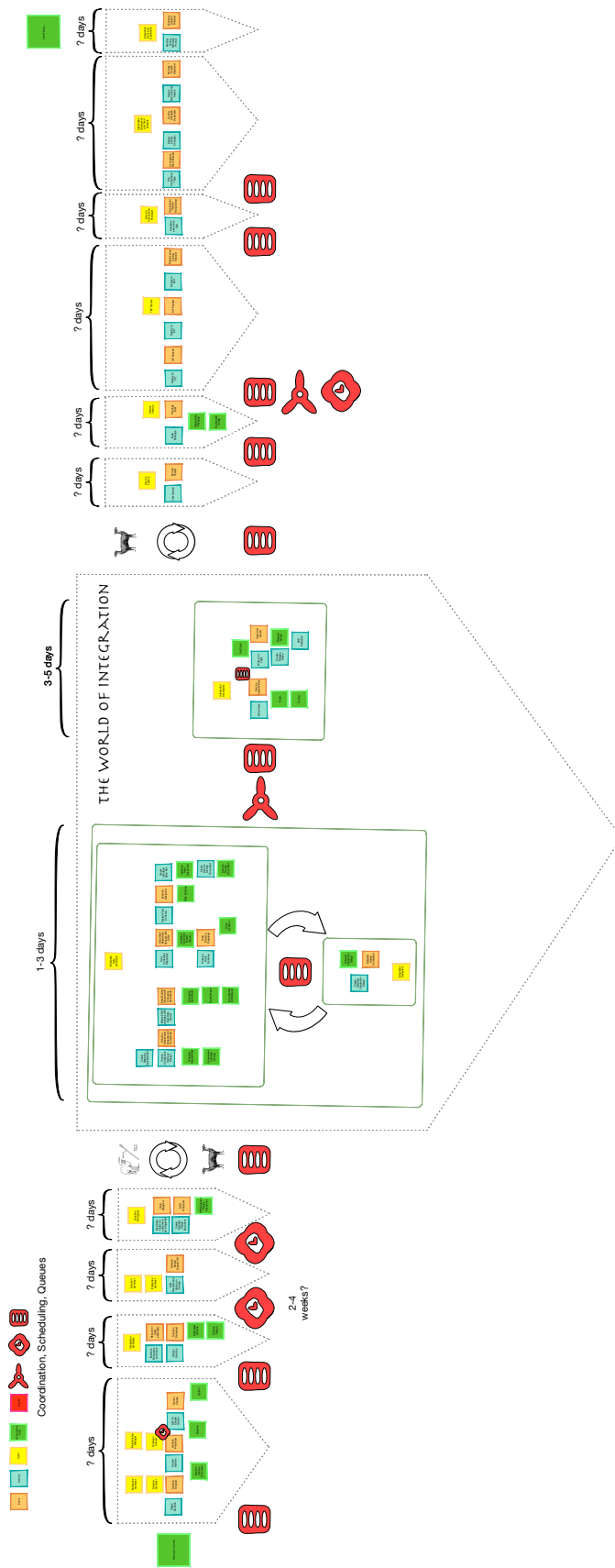
**Feedback
from market
forces.**

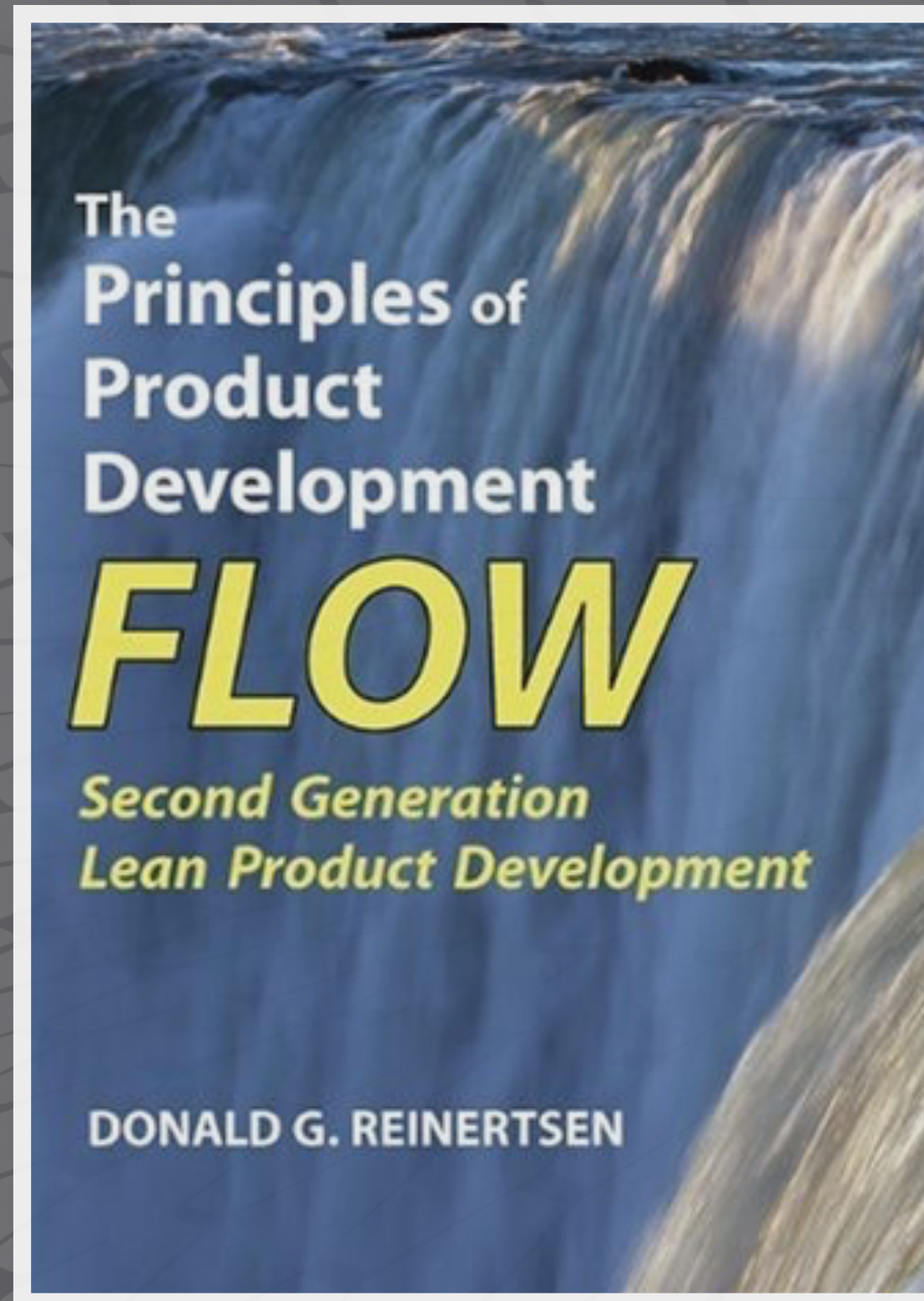


**And both slow down
as they age...**

Flow

Value stream maps





Impedance mismatching in organisations

Corporate metabolism

**As companies scale they add more
processes and hierarchy**

Therefore things slow down

**...but we also deliberately
block our corporate arteries.**

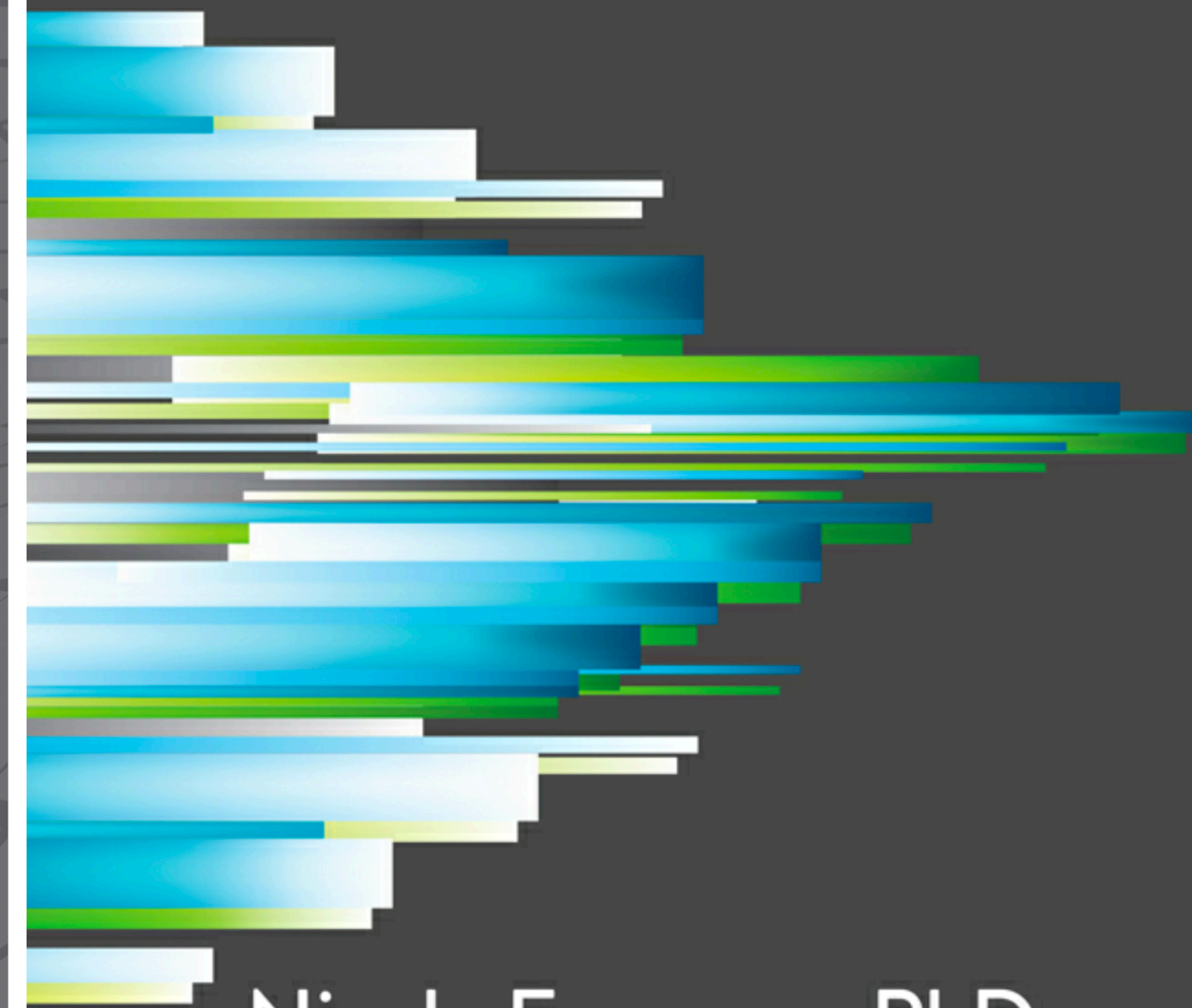


Sidebar: Identifying the signs of ageing

THE SCIENCE OF LEAN SOFTWARE AND DEVOPS

ACCELERATE

Building and Scaling High Performing
Technology Organizations



Nicole Forsgren, PhD
Jez Humble, *and* Gene Kim

*with forewords by Martin Fowler and Courtney Kissler
and a case study contributed by Steve Bell and Karen Whitley Bell*

Fun Fact:

Change Request Boards

Monitoring org. health

MTTR

Cycle time

**Change
failure rate**

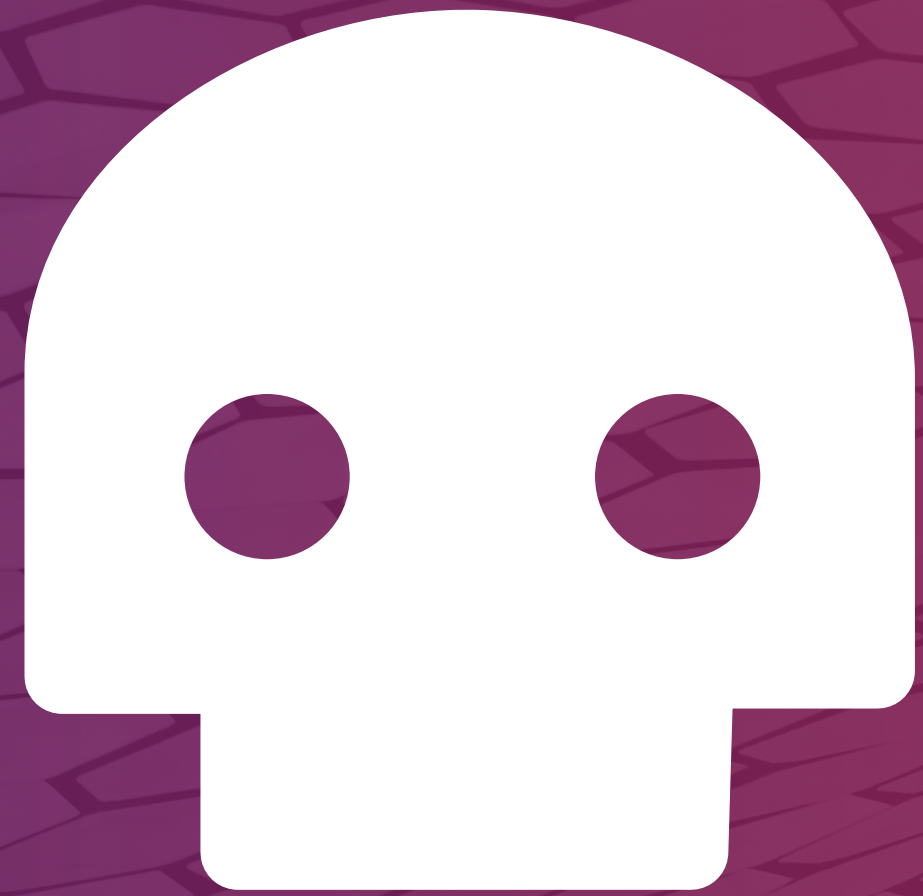
**Number
of deploys**

Identifying the signs of ageing

**4 key metrics are leading
indicators org. health**

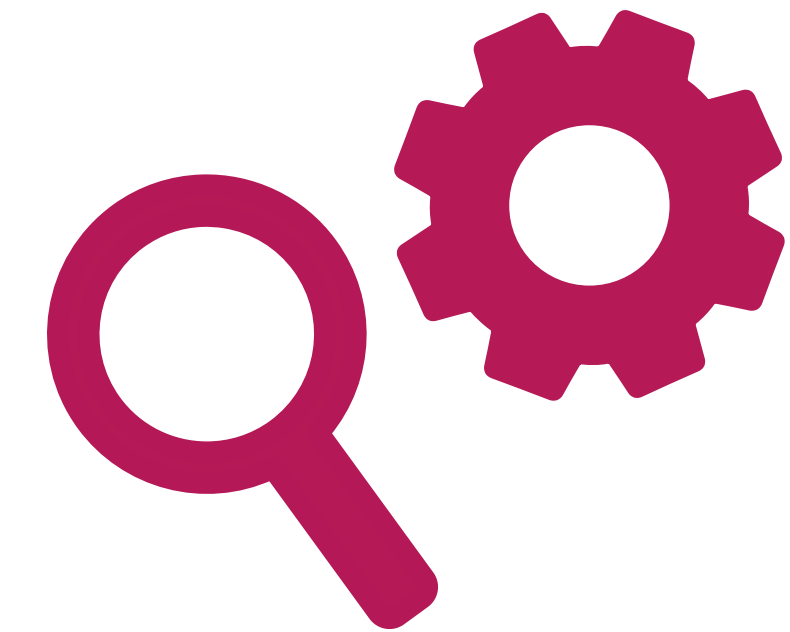
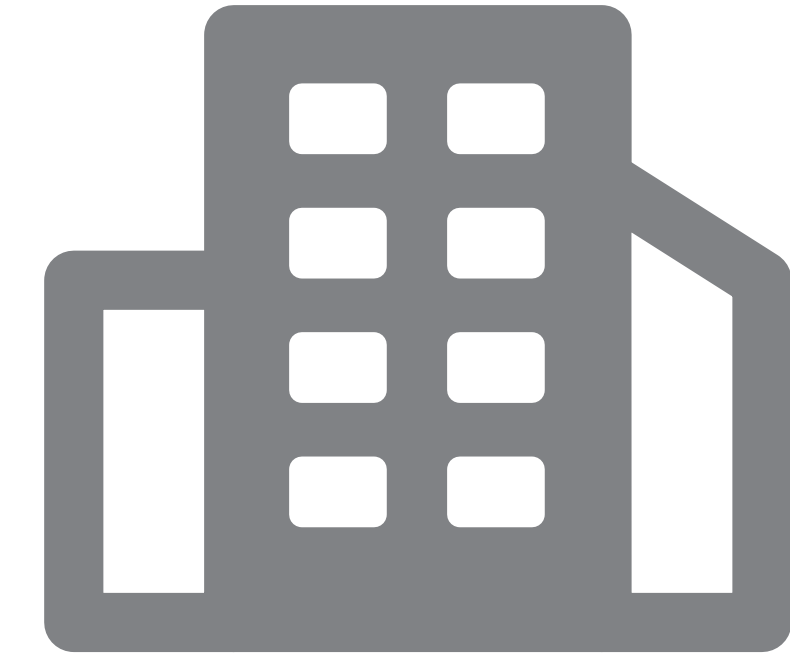
**Like monitoring heart
rate & blood pressure**

**Improvement limited by
hierarchy and scaling laws**

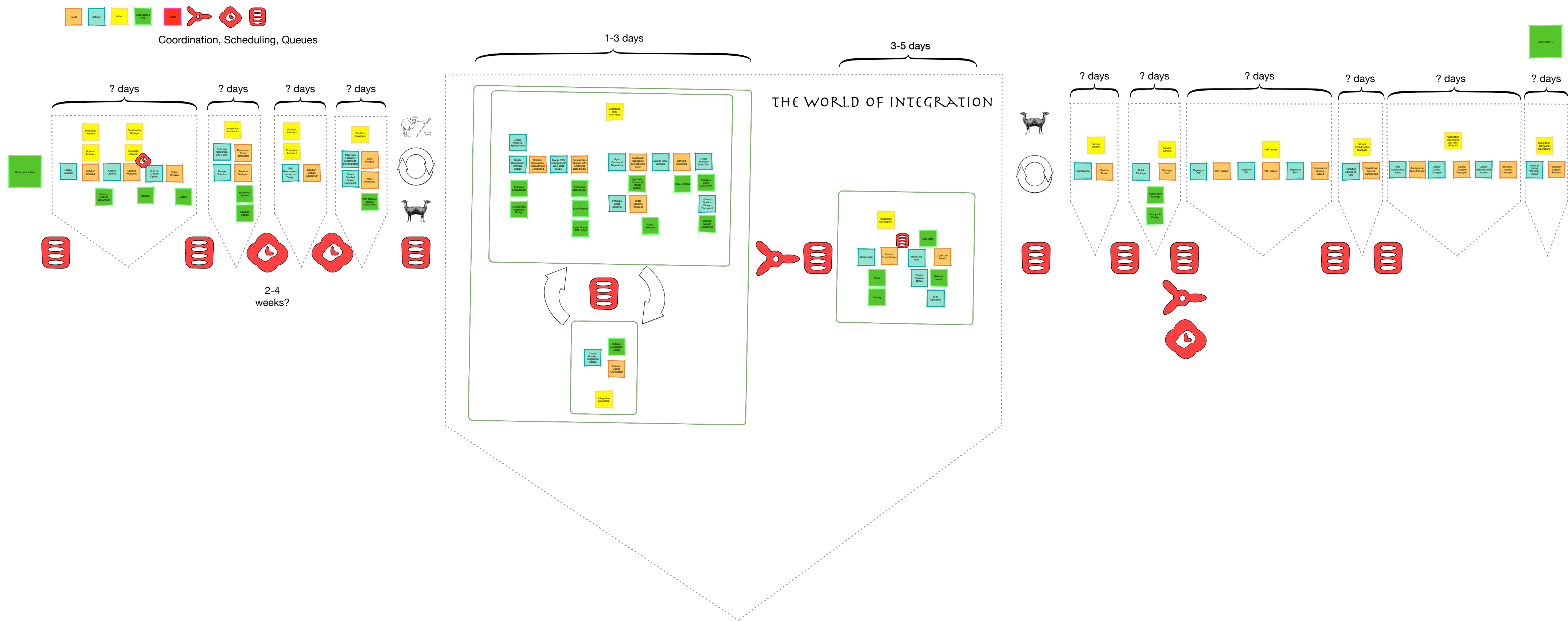


Organisational mortality

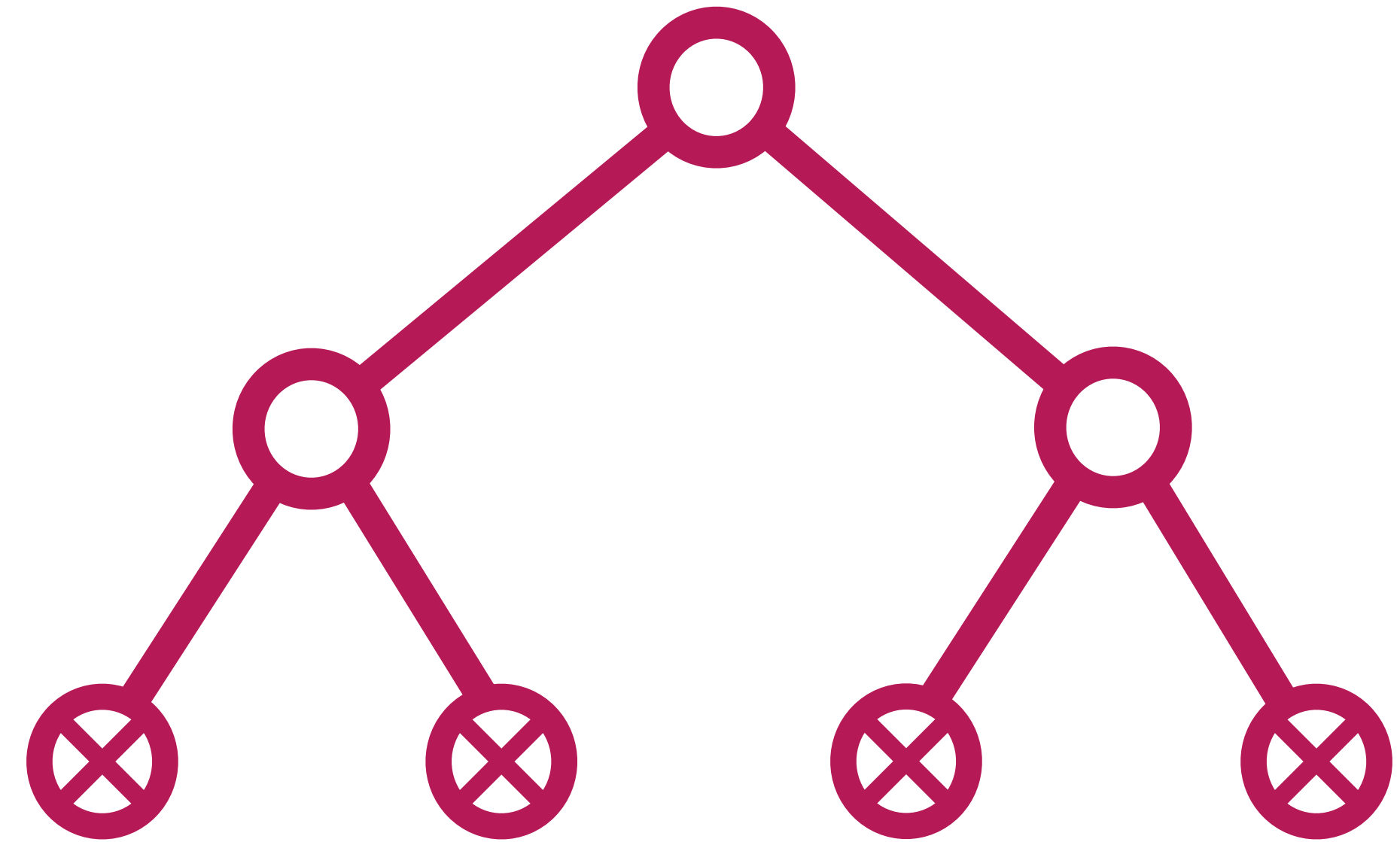
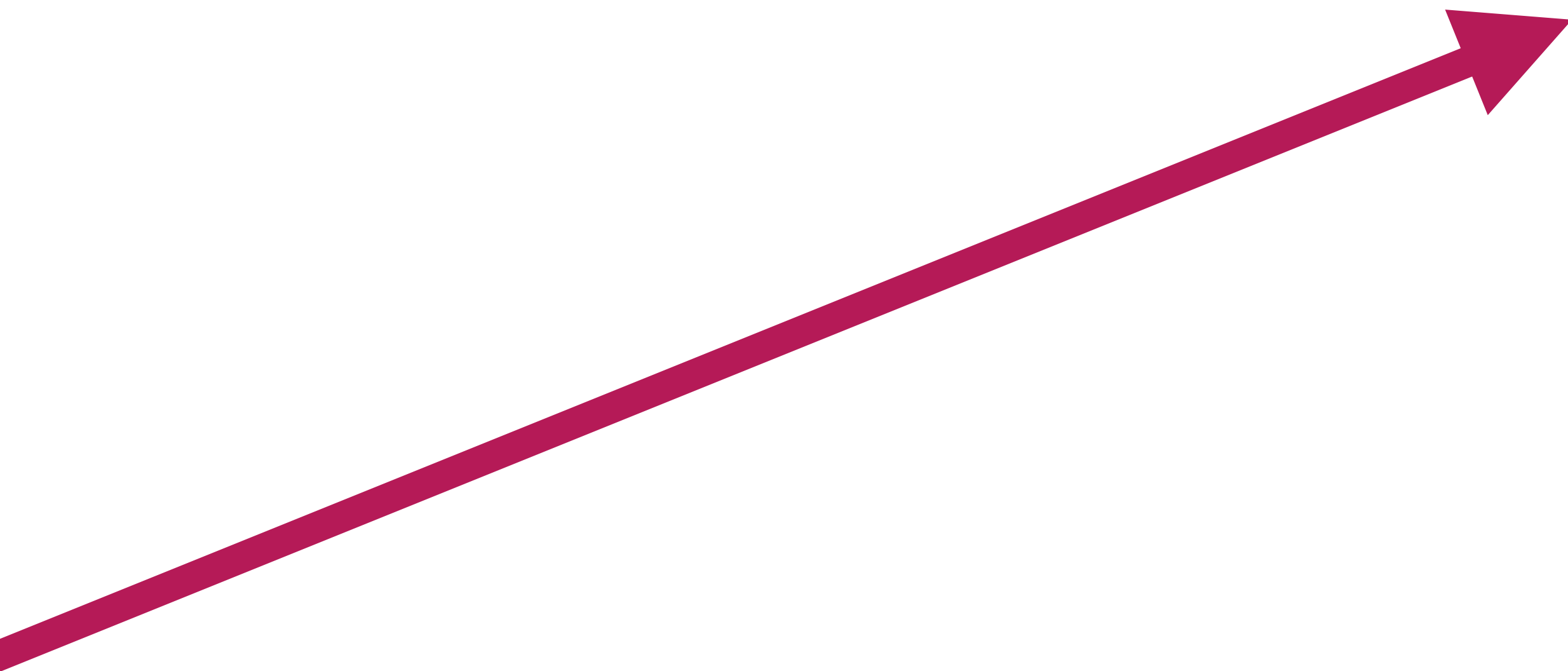
**Larger organisations
spend less of their
revenue on R&D.**



+ more and more process & constraints



Hierarchies grow and grow...



Hierarchical organisations:

**Gain economies of scale
for infrastructure (~ 0.85)**

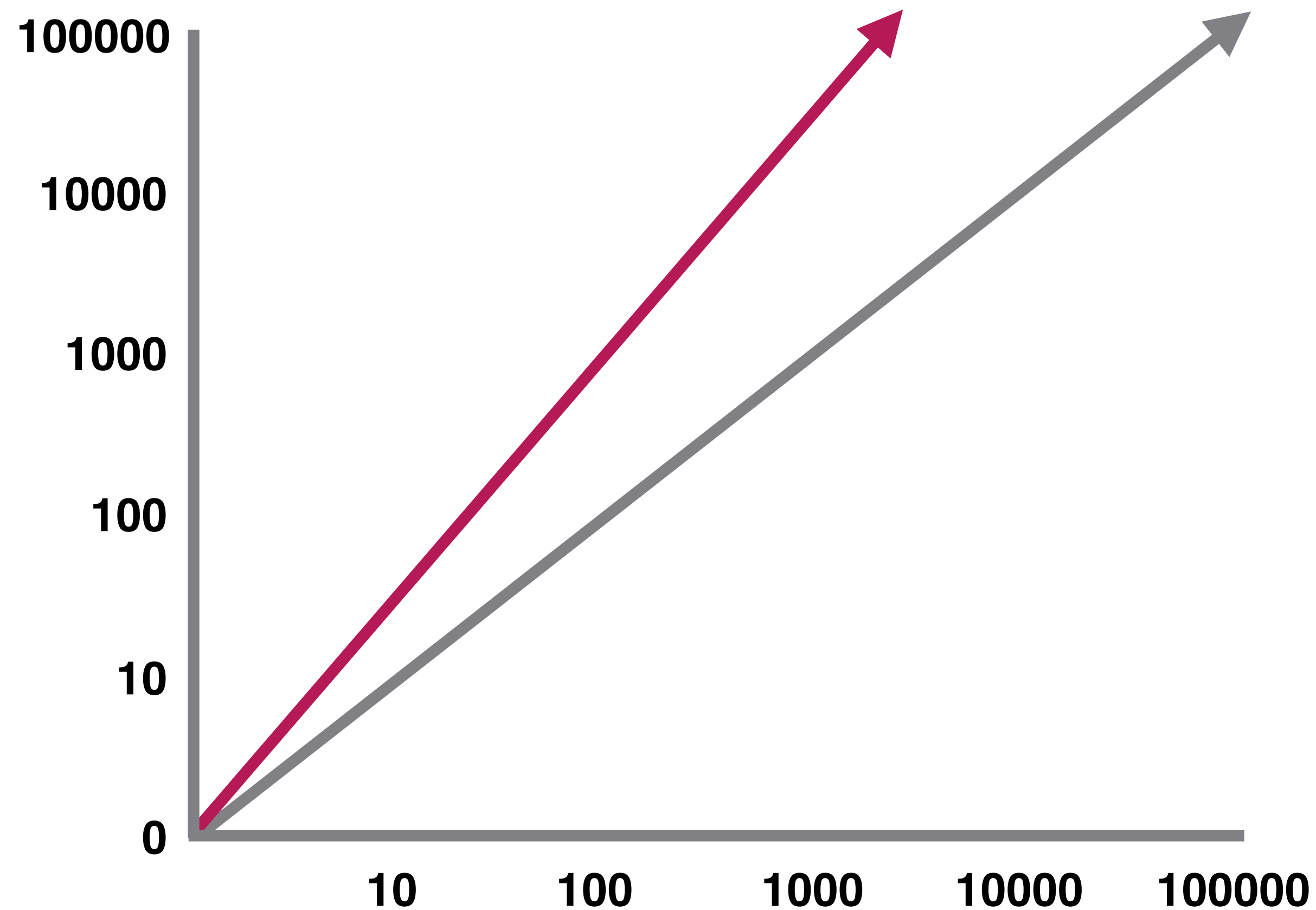
**Achieve sub-linear
growth in revenue (~ 0.85)**

**reduce their metabolic rate... and
eventually die.**



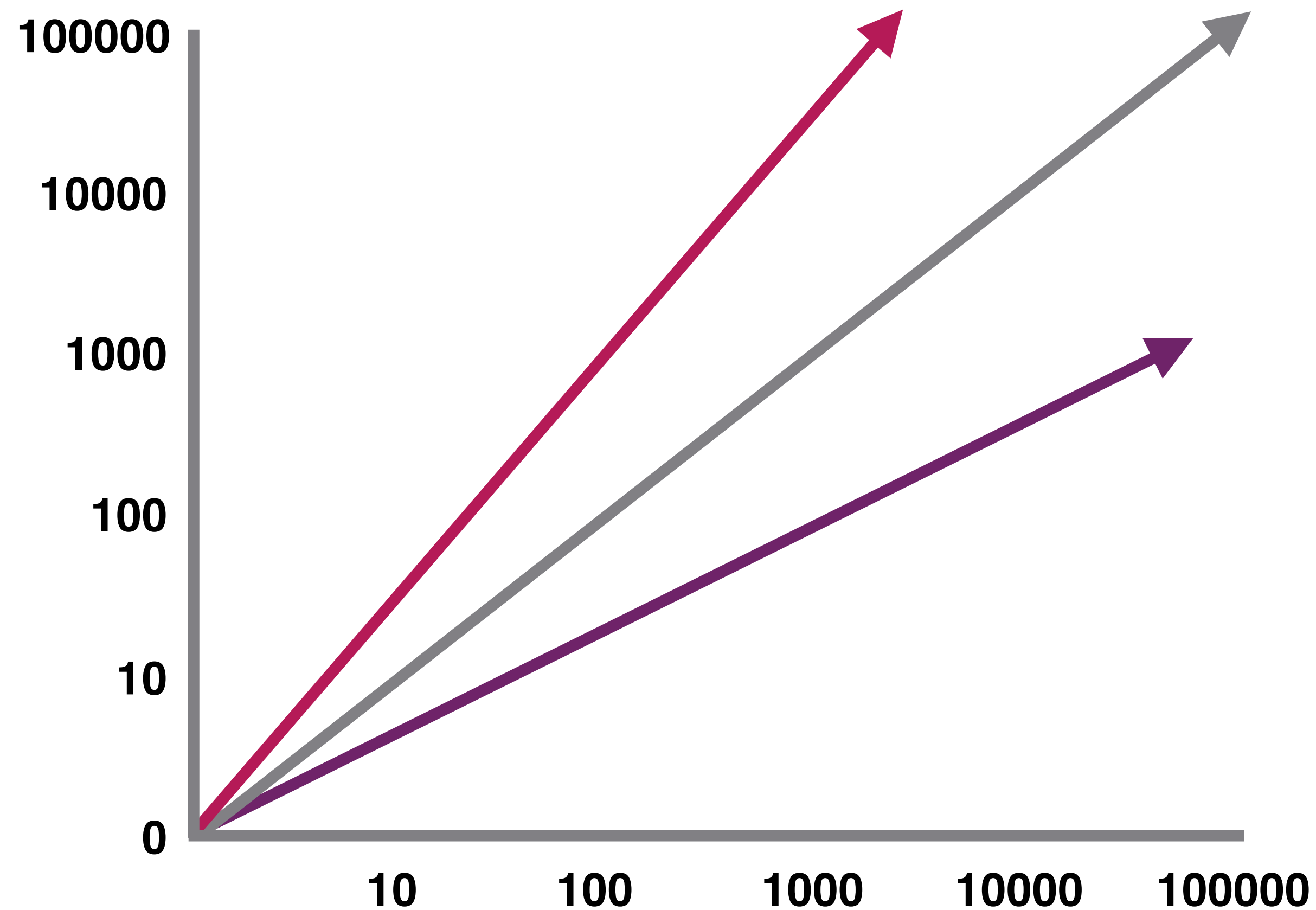
Scaling Complex Adaptive Systems

Returns to scale



Super-linear scaling:
As x doubles, y increases
by more than double

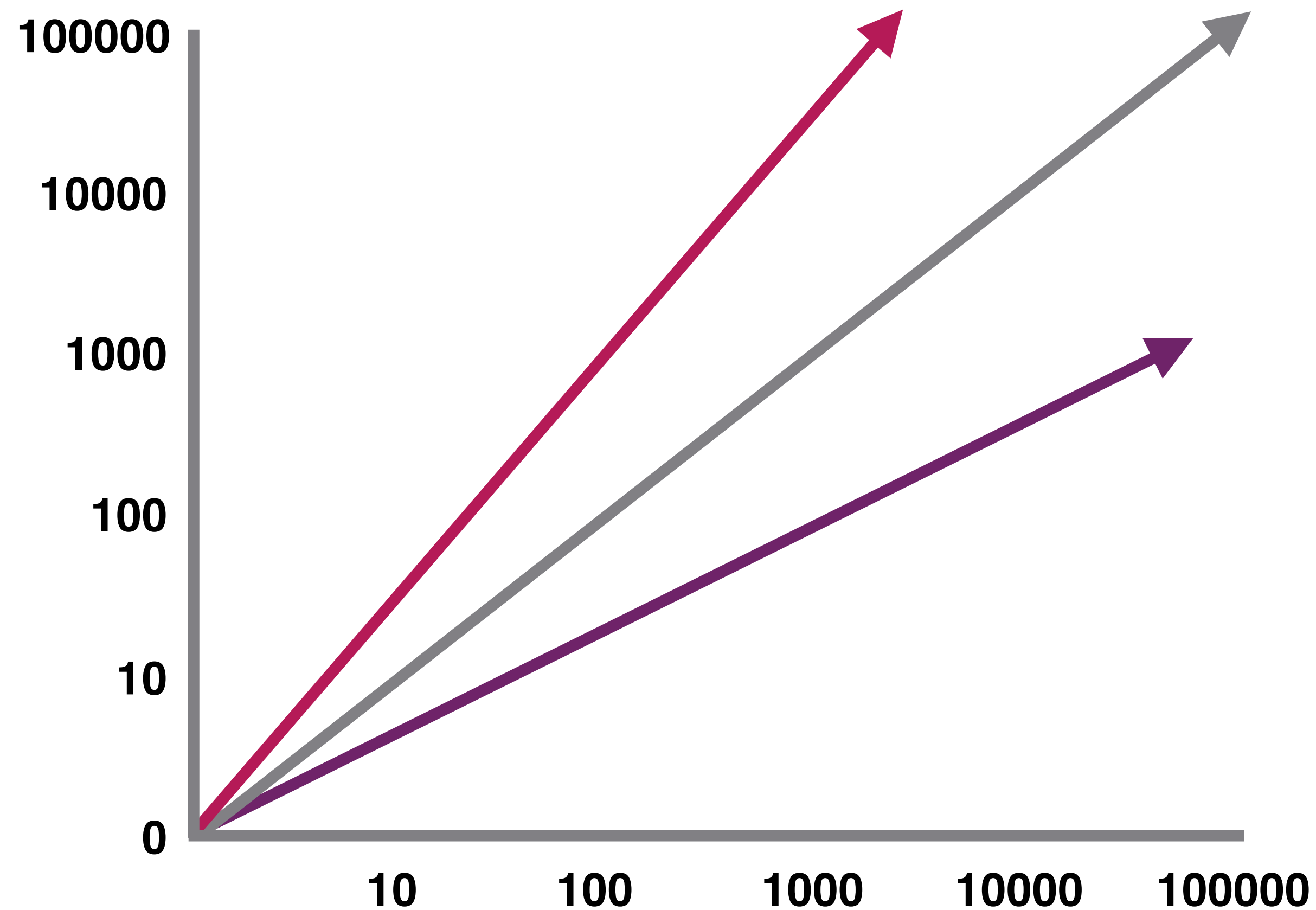
Cities exhibit both



**Innovation, wages,
professionals, crime,
disease, pollution (1.15)**

**Road length, # petrol stations
& restaurants, water pipes,
electricity cables (0.85)**

Cities exhibit both

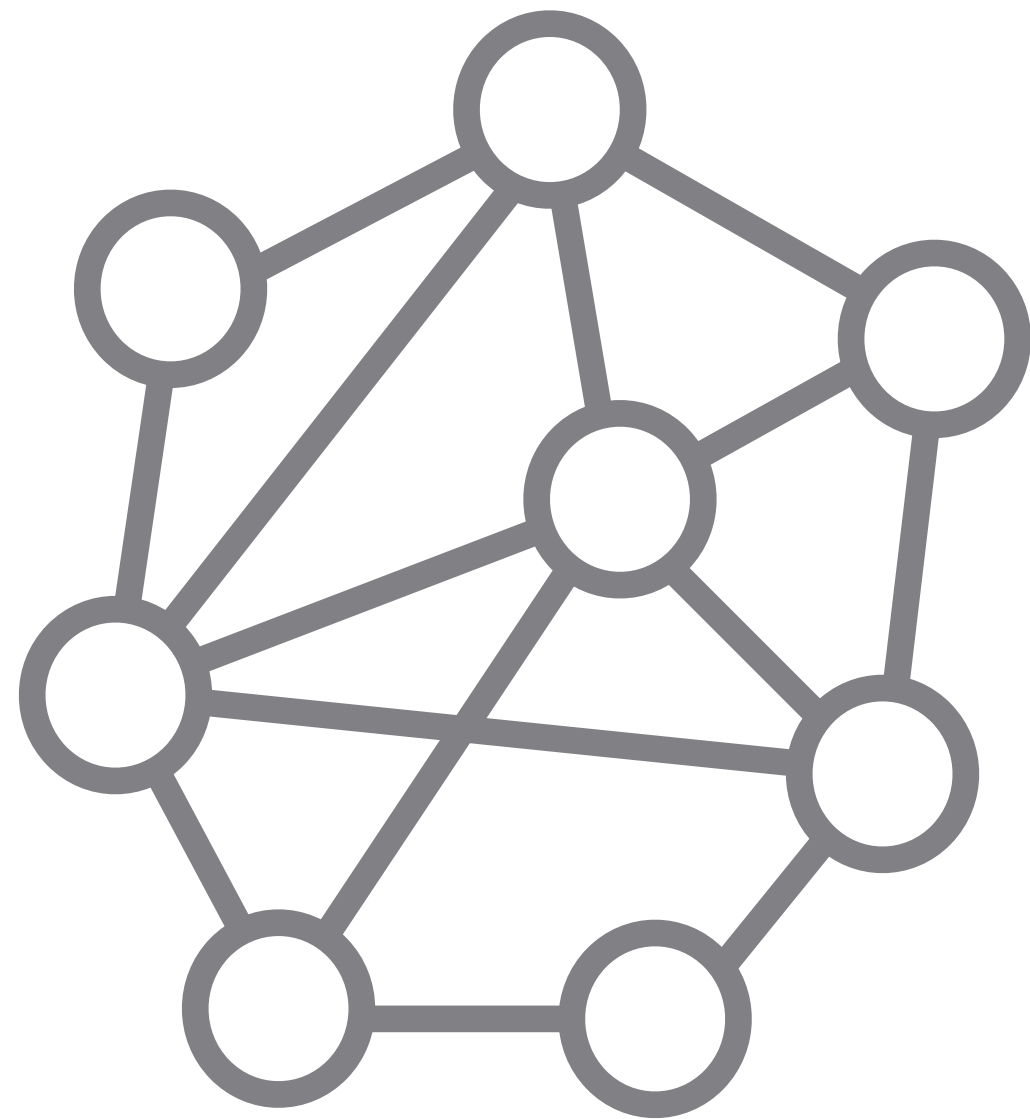


Innovation, wages,
professionals, crime,
disease, pollution (1.15)

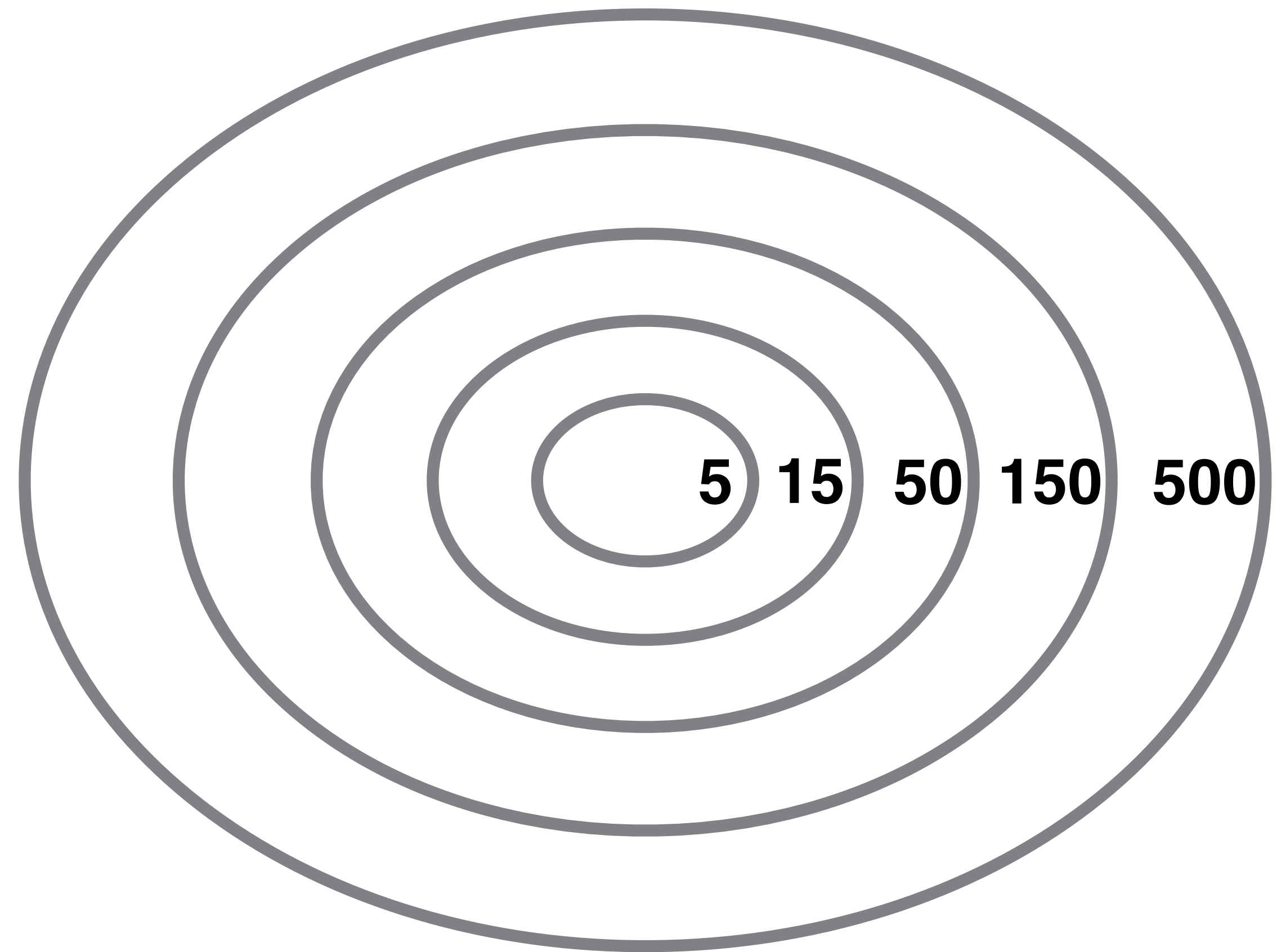
Walking speed (1.10)

Road length, # petrol stations
& restaurants, water pipes,
electricity cables (0.85)

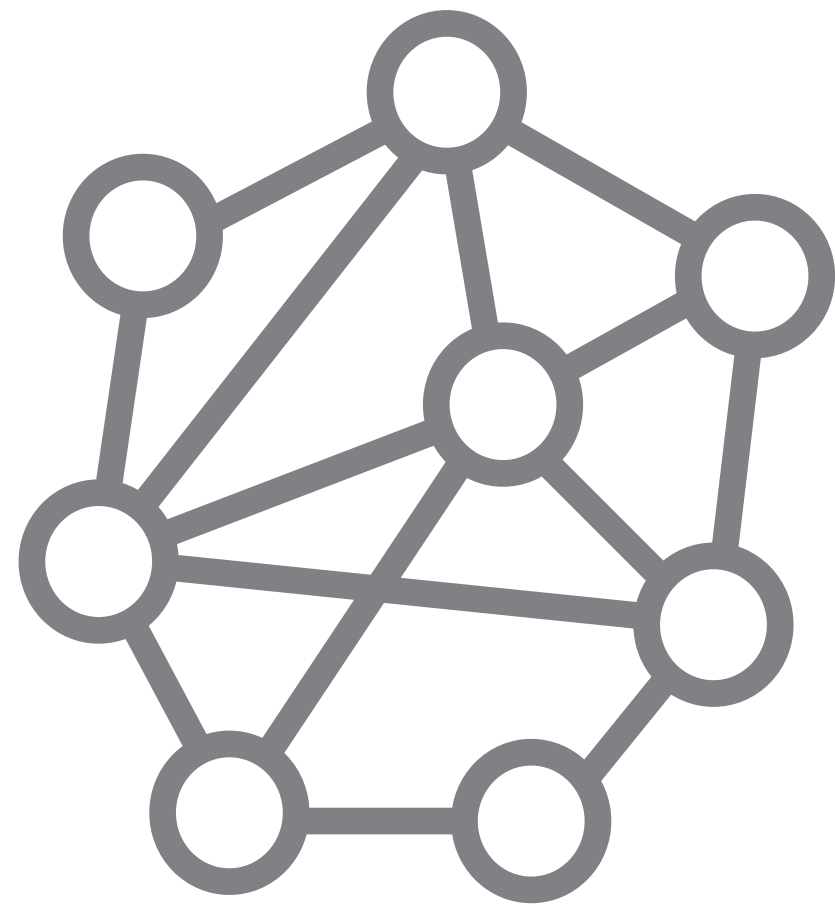
Social networks are the driver super-linear growth



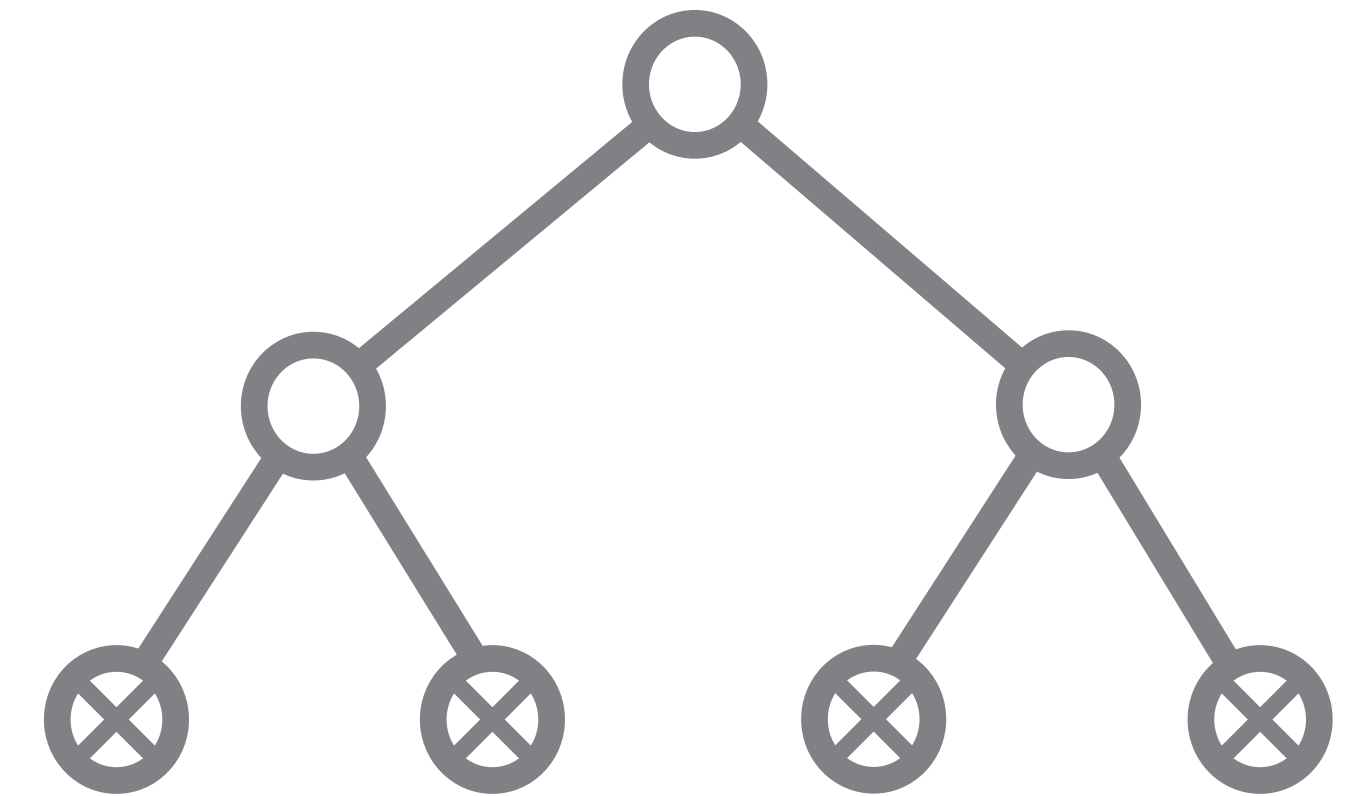
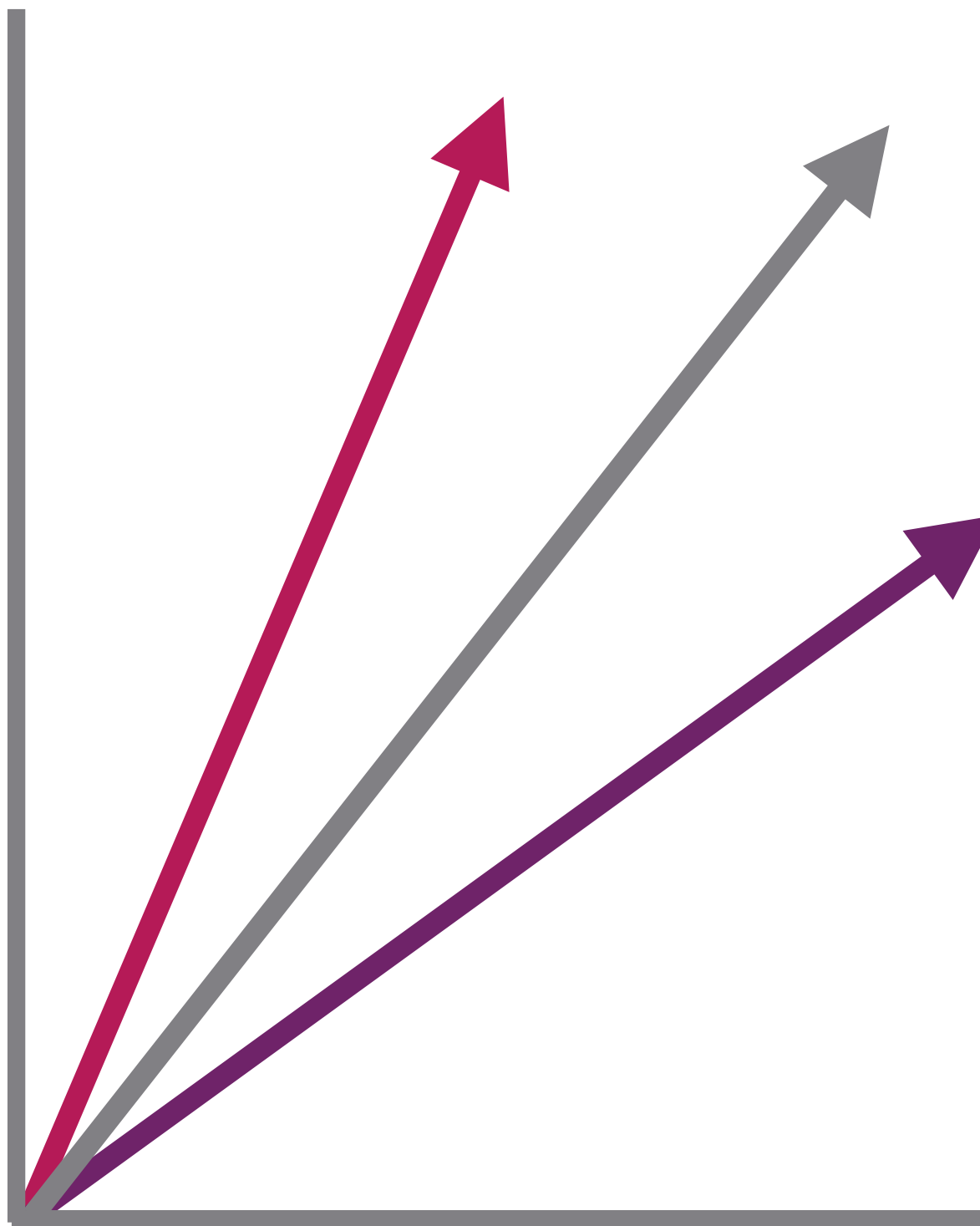
**Small world fractal space
filling network**



Returns to scale vs economy of scale

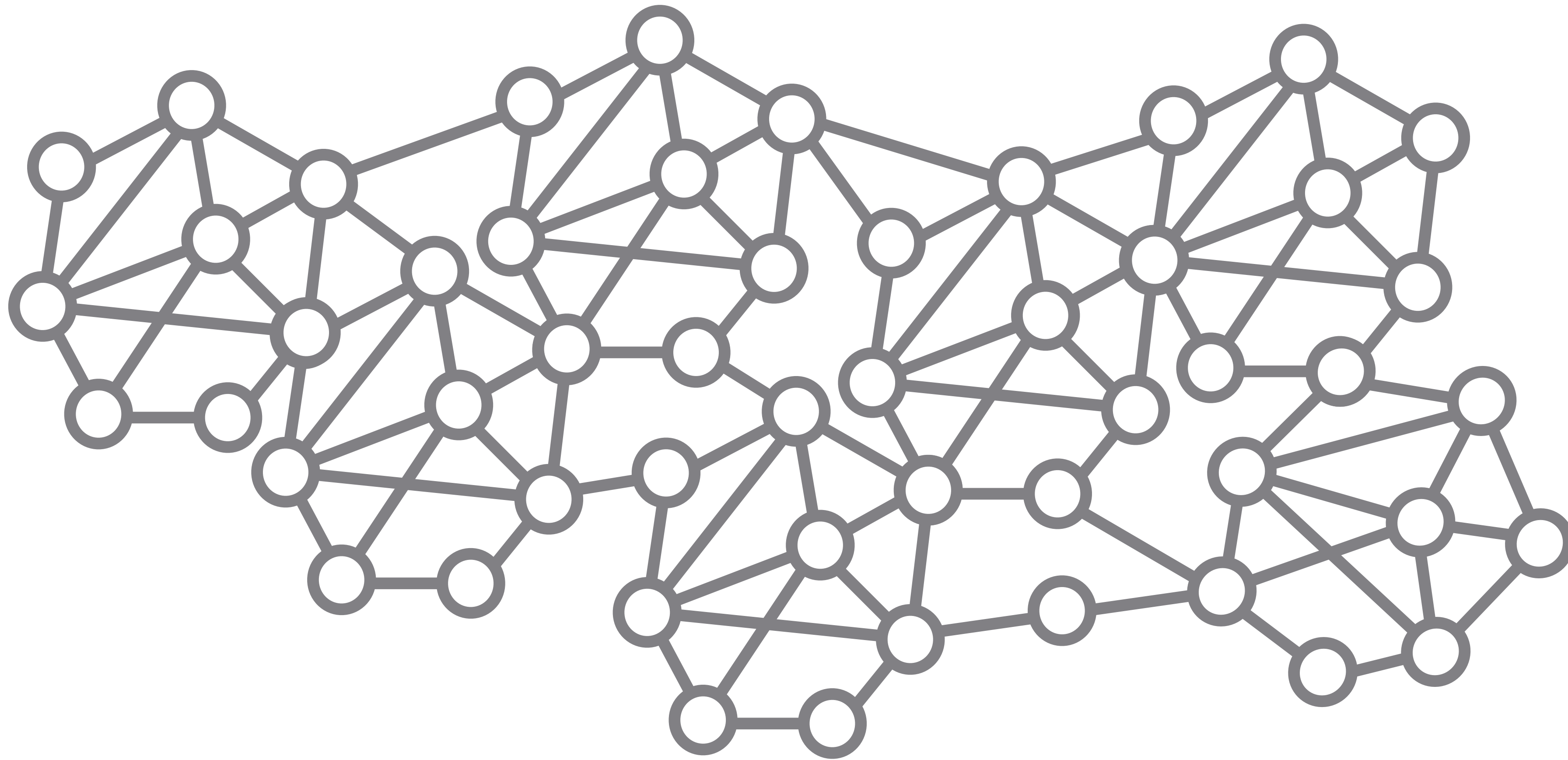


**Small world fractal
space filling network**



**Hierarchical fractal space
filling network**

Small world network growth



As cities grow they

**Gain economies
of scale for
infrastructure**


**Gain returns to
scale for socio-
economic factors**

Rarely die

**Get 115% more
stuff for 85% of
the cost!**

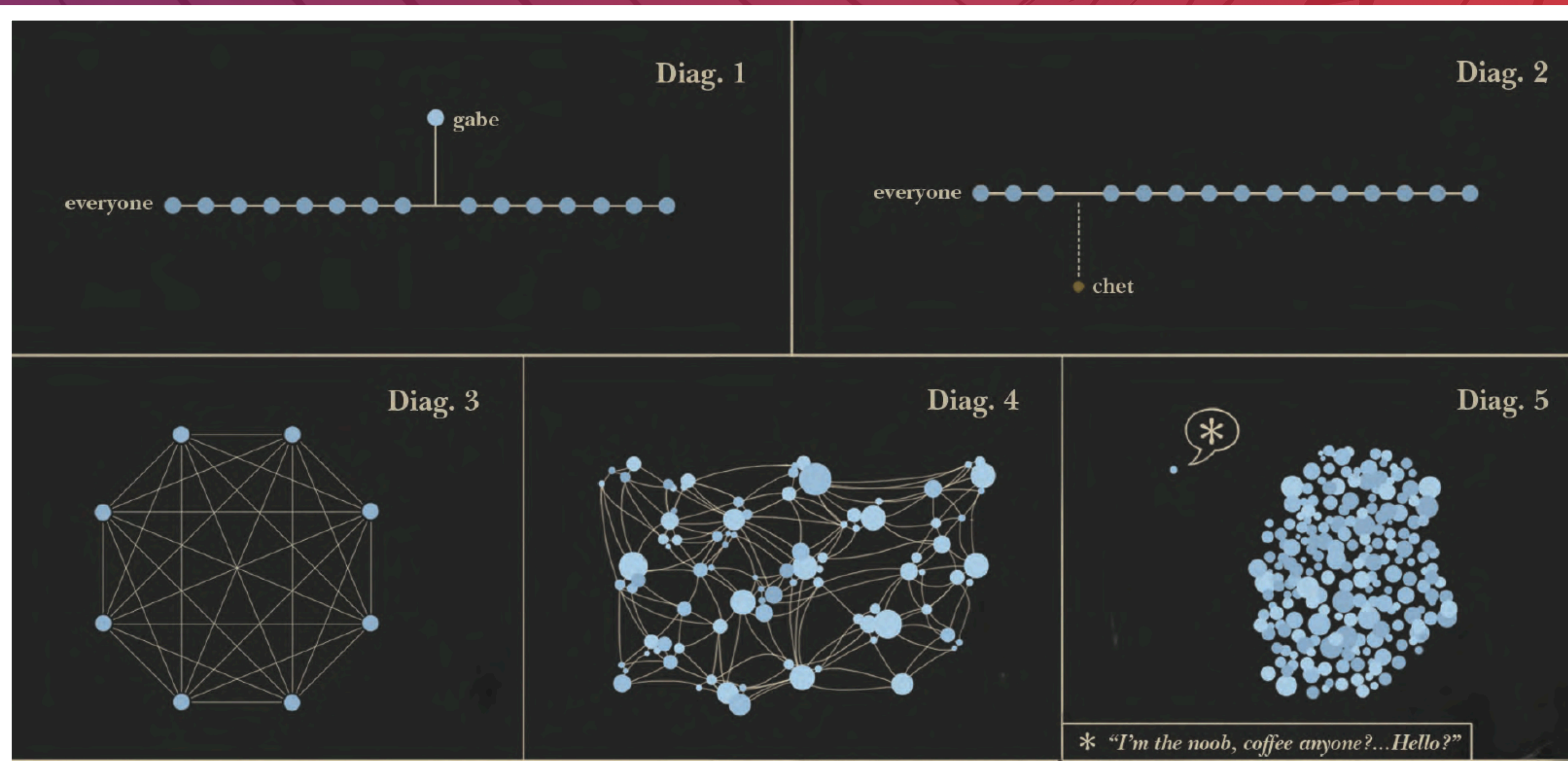


/thoughtworks

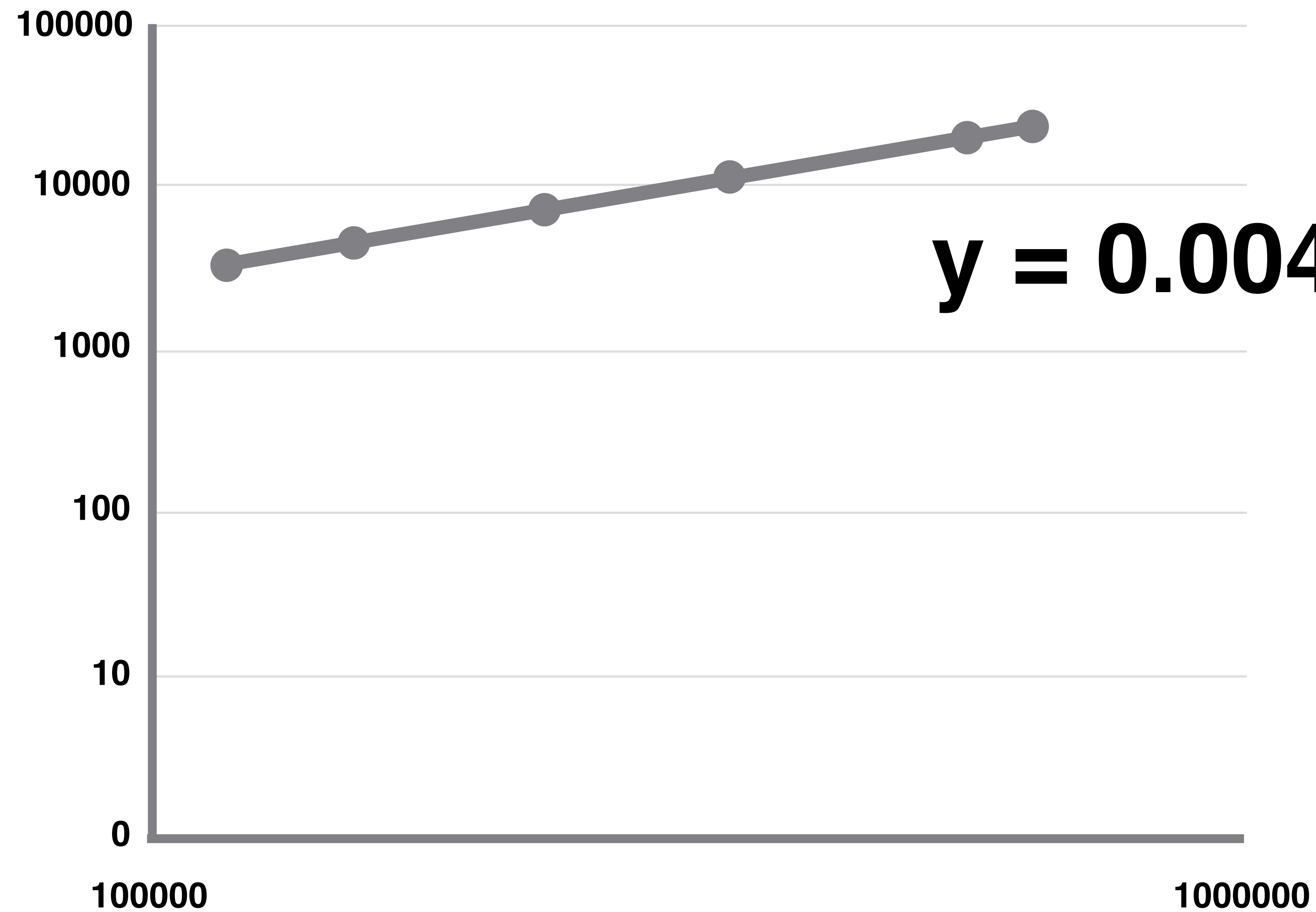


VALVE

VALVE







$$y = 0.0049x^{1.1515}$$

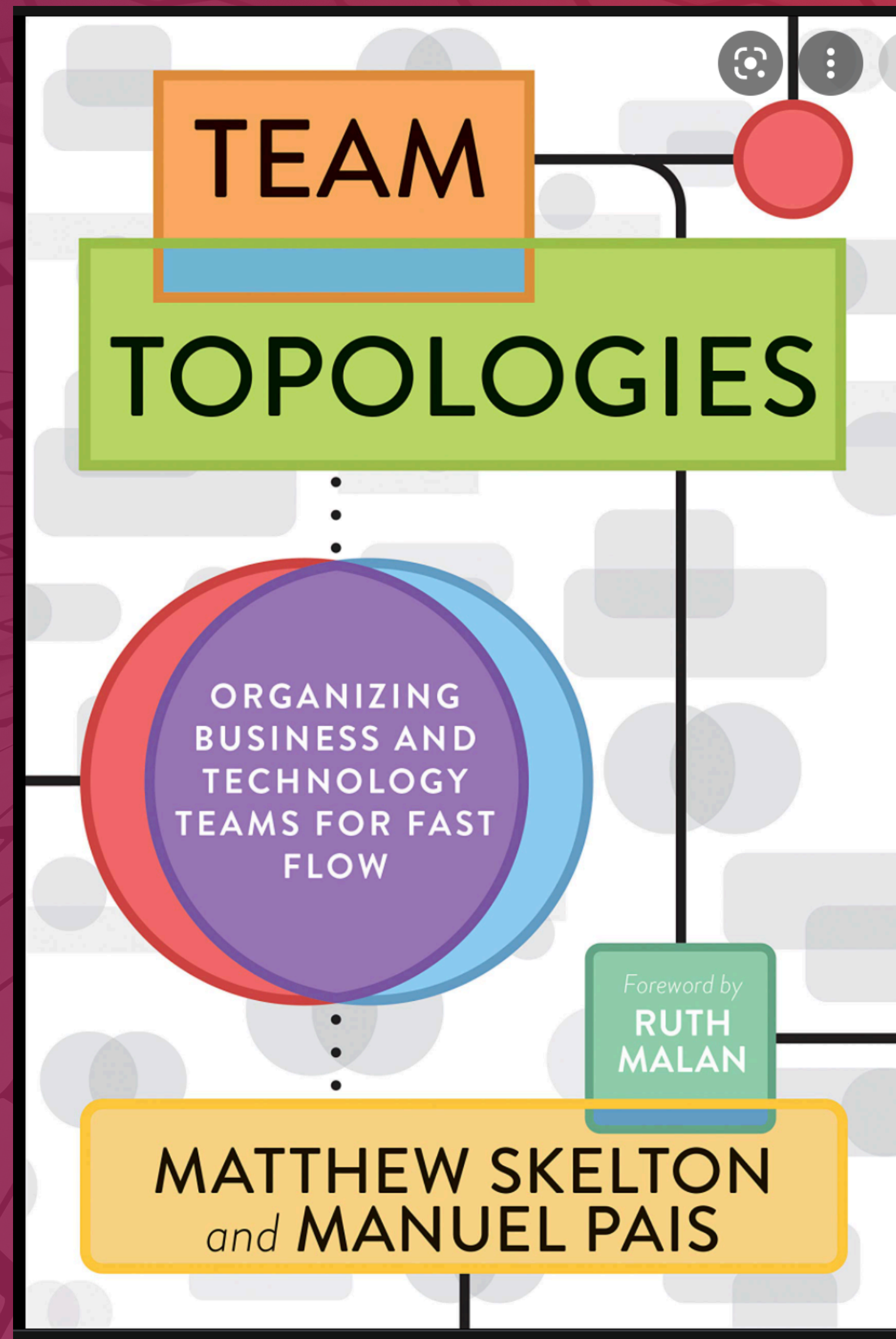
amazon



**As most companies get bigger,
it gets harder to get bigger.**



**As Amazon gets bigger,
it gets easier to get bigger.**



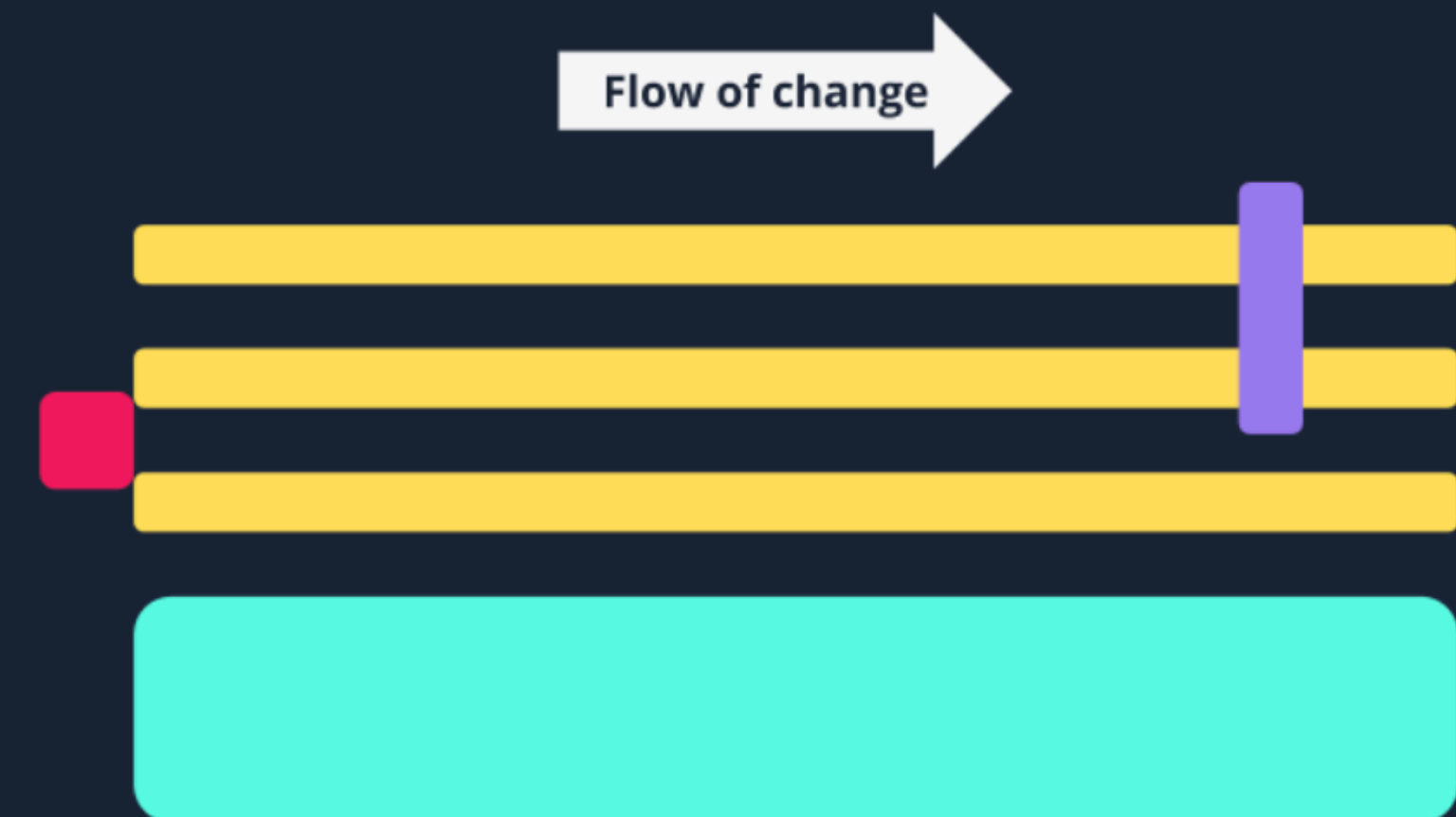
4 fundamental topologies

- Stream-aligned team
- Enabling team
- Complicated Subsystem team
- Platform team

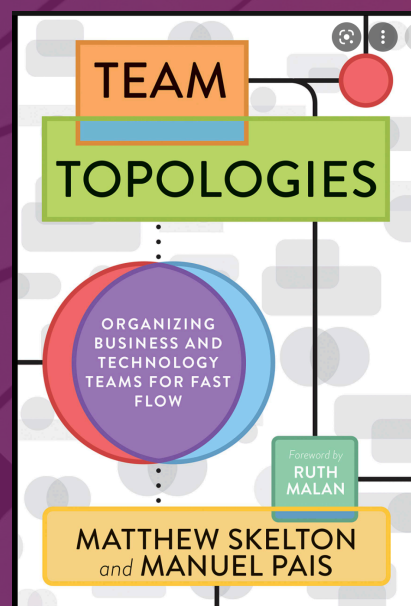


Four fundamental topologies

4 fundamental topologies



Four fundamental topologies shown with the flow of change



Software Architecture, Team Topologies and Complexity Science

**Componentisation
via services**

**Organised around
business capabilities**

**Decentralised data
management**

**Products not
projects**

**Decentralised
governance**

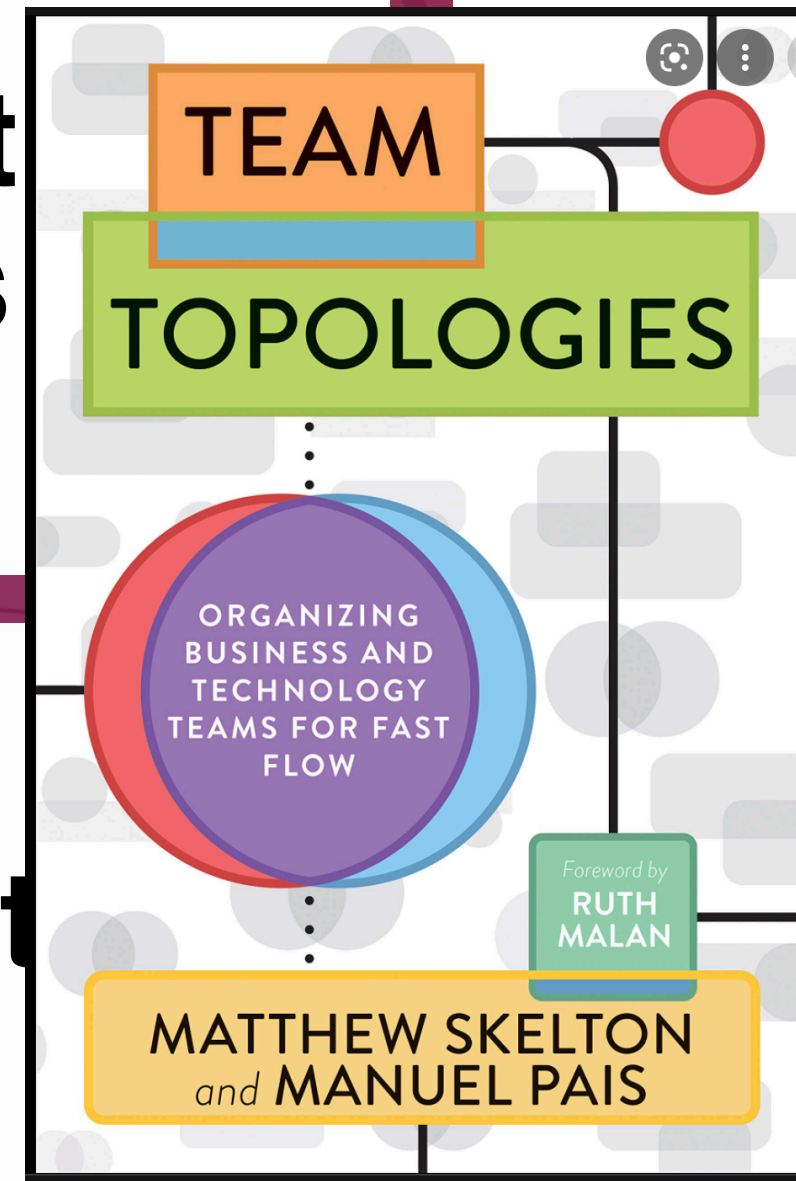
**Smart endpoints
and dumb pipes**

**Evolutionary
design**

**Infrastructure
automation**

**Designed
for failure**

**Componentisation
via services**



**Organised around
business capabilities**

**Products not
projects**

**Decentralised
governance**

**Decentralised data
management**

**Smart endpoints
and dumb pipes**

**Evolutionary
design**

**Infrastructure
automation**

**Designed
for failure**

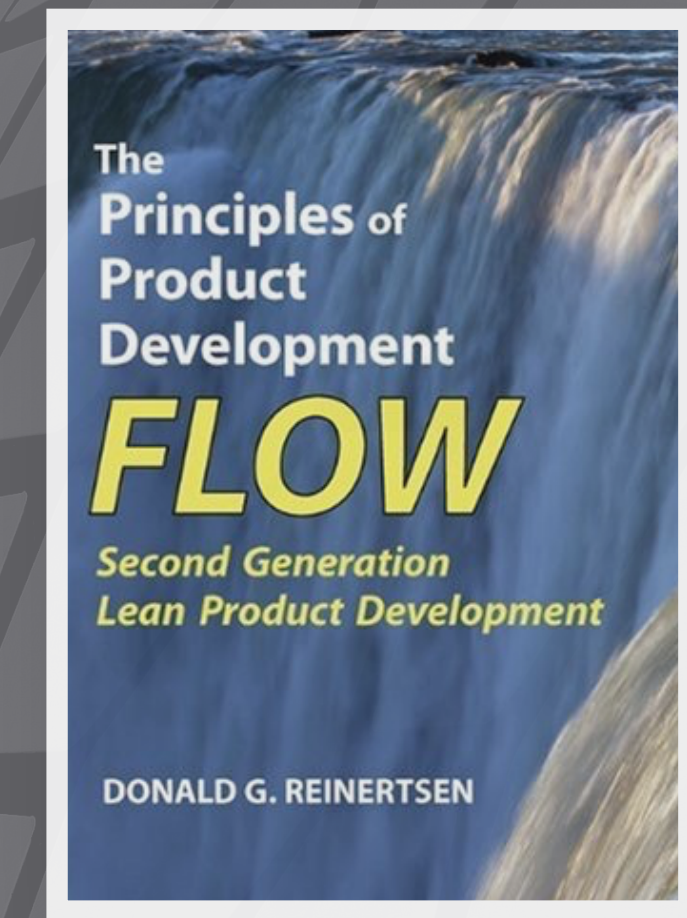
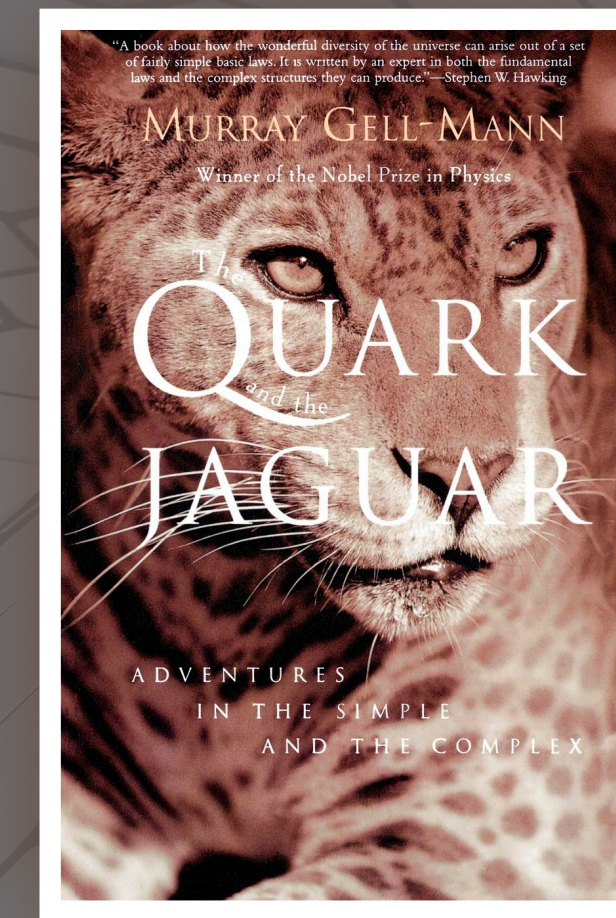
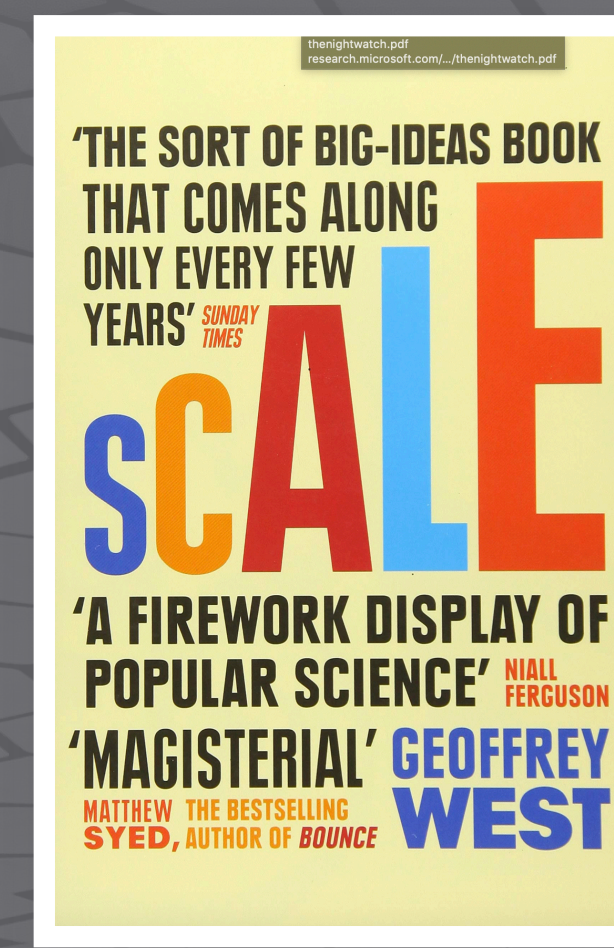
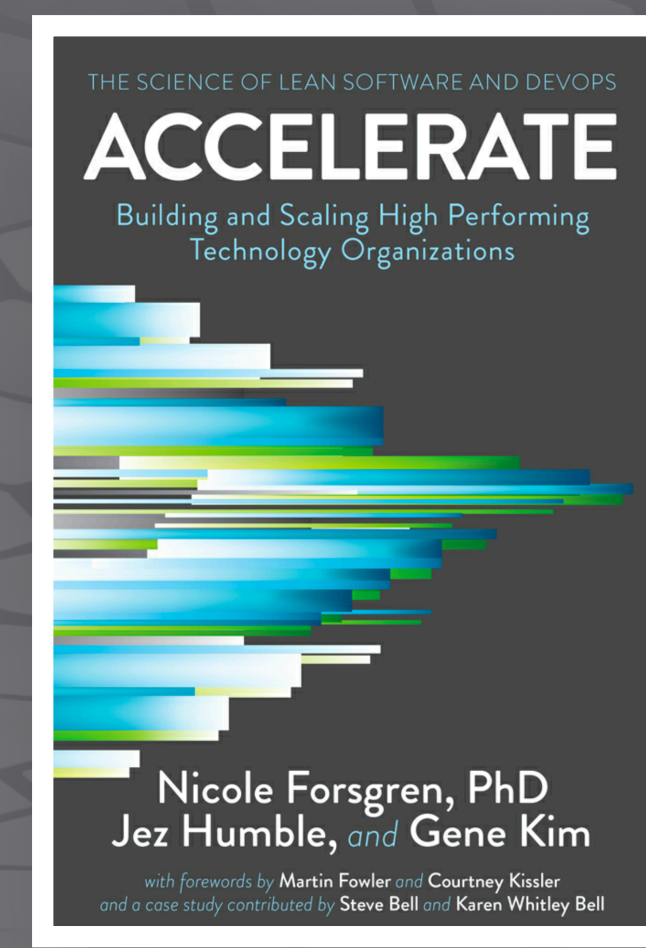
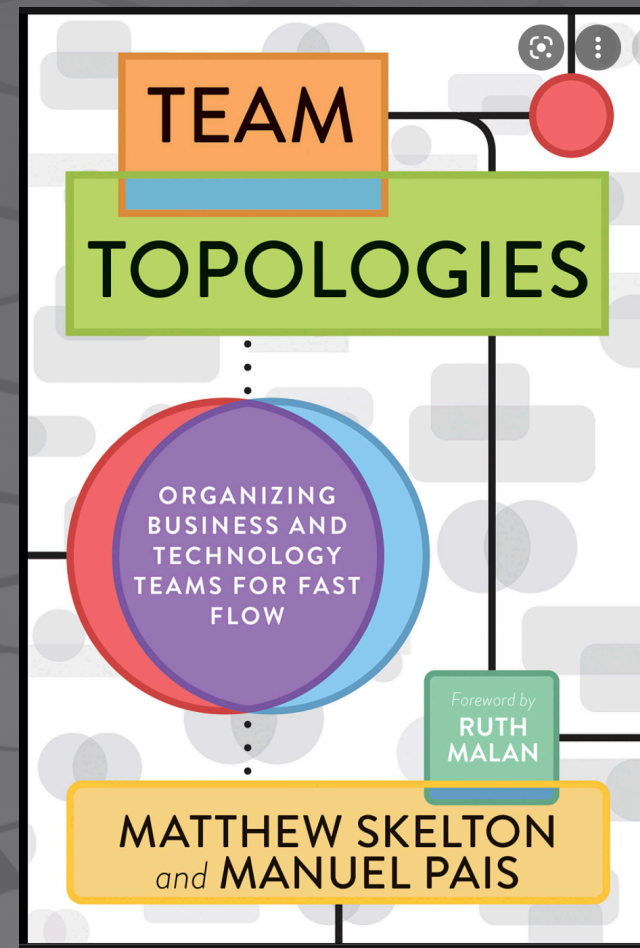


Social network effects imply super-exponential growth

Hierarchies slow metabolic rate

Team shapes for Flow

Forcing functions for Flow



A General Model for the Origin of Allometric Scaling Laws in Biology Geoffrey B. West, James H. Brown, Brian J. Enquist

Bettencourt, Luís M. A. 2013, The Origins of Scaling in Cities. Science 340: 1438-1441.

<https://protobi.com/post/revenue-per-employee-and-biologic-scaling-laws>

The origin of allometric scaling laws in biology from genomes to ecosystems:
towards a quantitative unifying theory of biological structure and organization

Geoffrey B. West, James H. Brown. Journal of Experimental Biology 2005 208: 1575-1592; doi: 10.1242/jeb.01589



GOTO
Guide



Remember to
rate this session

THANK YOU!



#GOTOams