

University of Washington   Seattle, WA

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# How the Information Revolution is Changing Design Practice

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Presentation posted at  
[presentations.dubberly.com/UW2019.pdf](http://presentations.dubberly.com/UW2019.pdf)

# Design practice is continually evolving, across several dimensions, including:

- **where we design** —

the **context** of designing

- **what we design** —

the “**product**” of designing

- **how we design** —

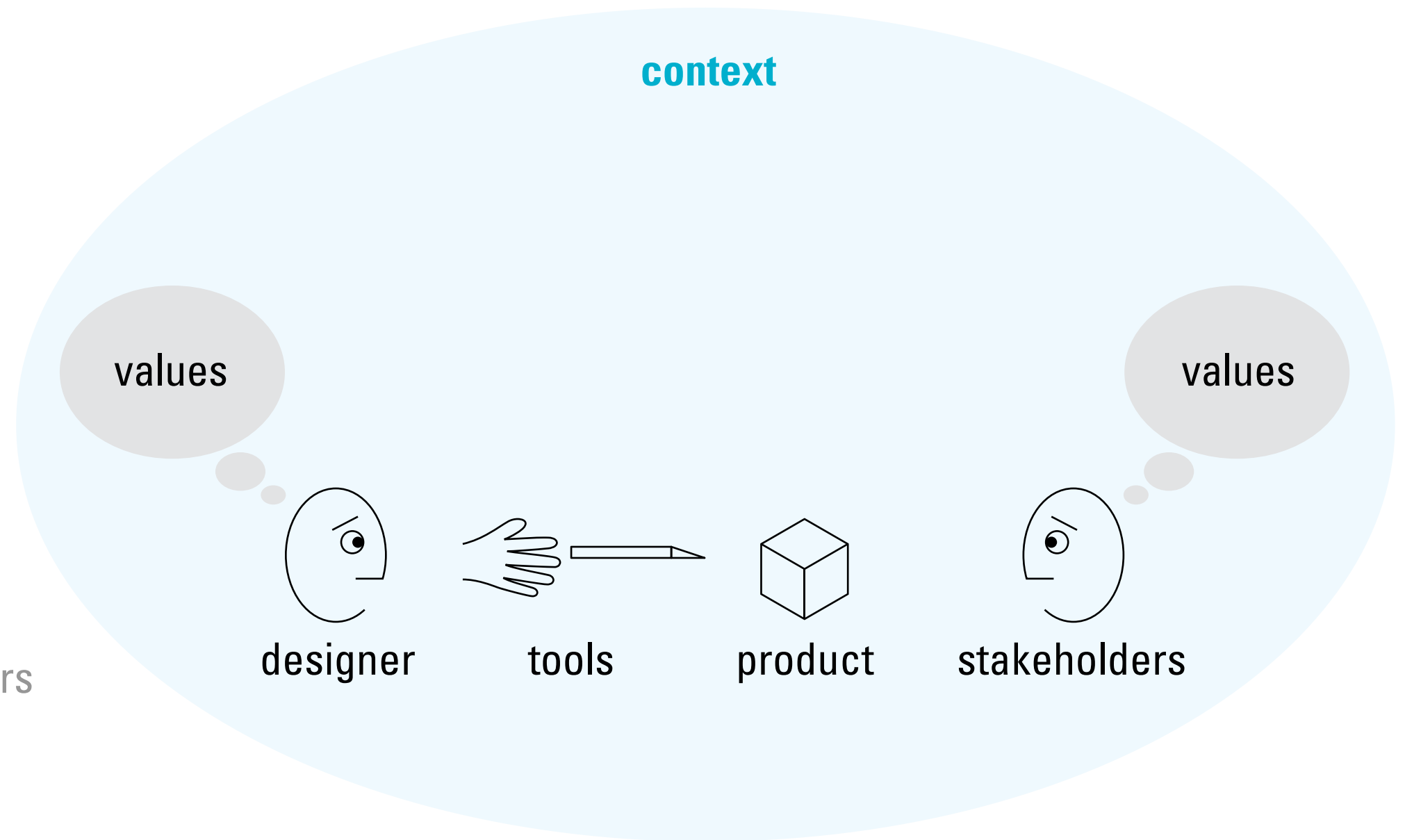
the **methods** which entail designing  
and the **tools** used in designing

- **who designs** —

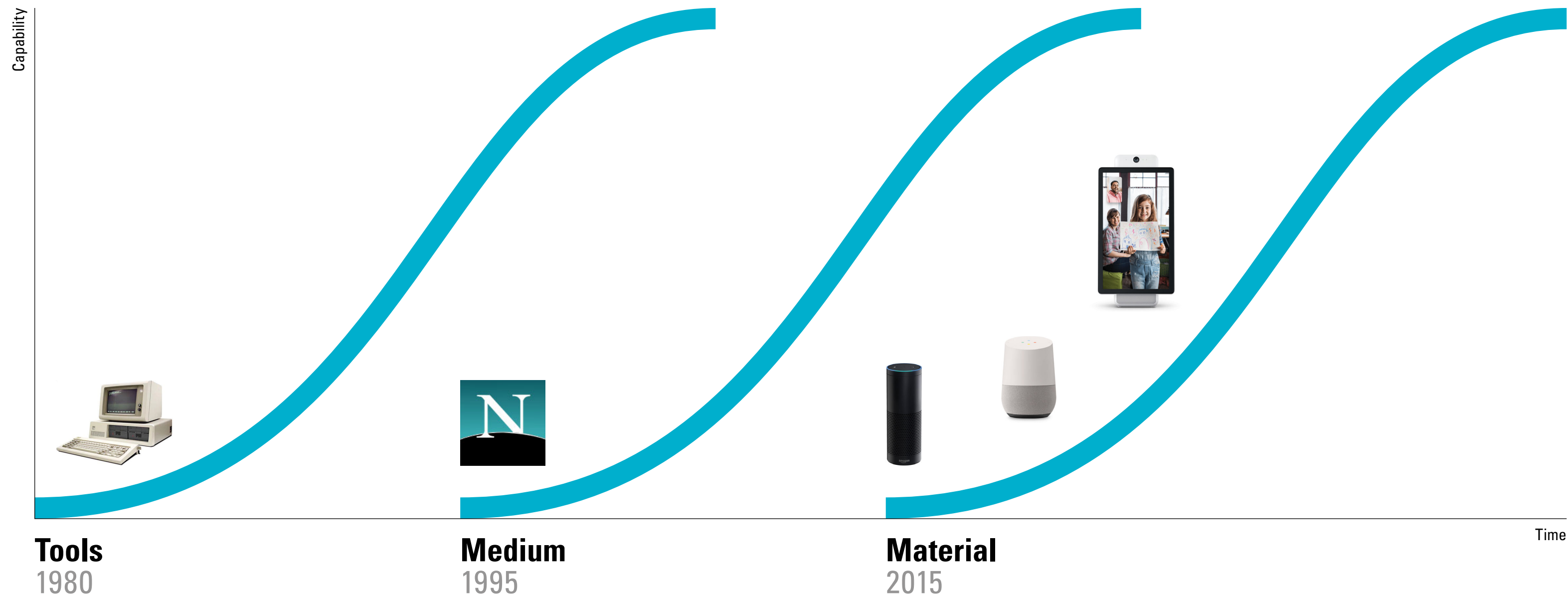
**stakeholders:** producers, consumers, sponsors

- **why we design** —

goals, **values**, language



# The most obvious change may be incorporating computers in how we design.



# Conventional wisdom\* has been

*“For designers,  
the computer is just a tool,  
like the pencil.”*

\*Science and Technology Studies (STS) provides insight into how knowledge is produced. Many ideas developed in STS apply to design practice and can describe how artifacts and other “products of design” are produced. Design Studies might take up this subject more fully, or perhaps a new discipline is needed: Design and Technology Studies (DTS).



— **Paul Rand**, 1990, (personal communication)

# Tool augmenting the design process

## — Analysis,

e.g., Christopher Alexander's decomposition of problems

## — Synthesis,

e.g., Fractals, cellular automata, genetic algorithms, neural nets

## — Production,

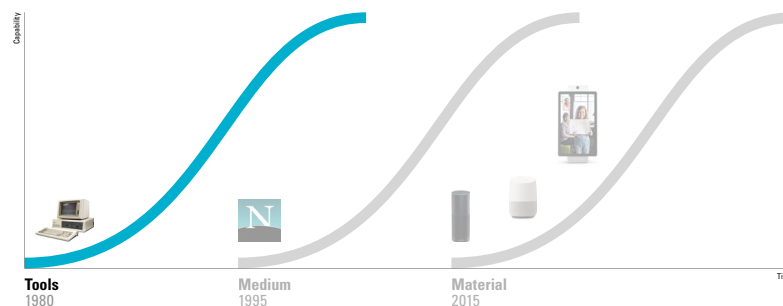
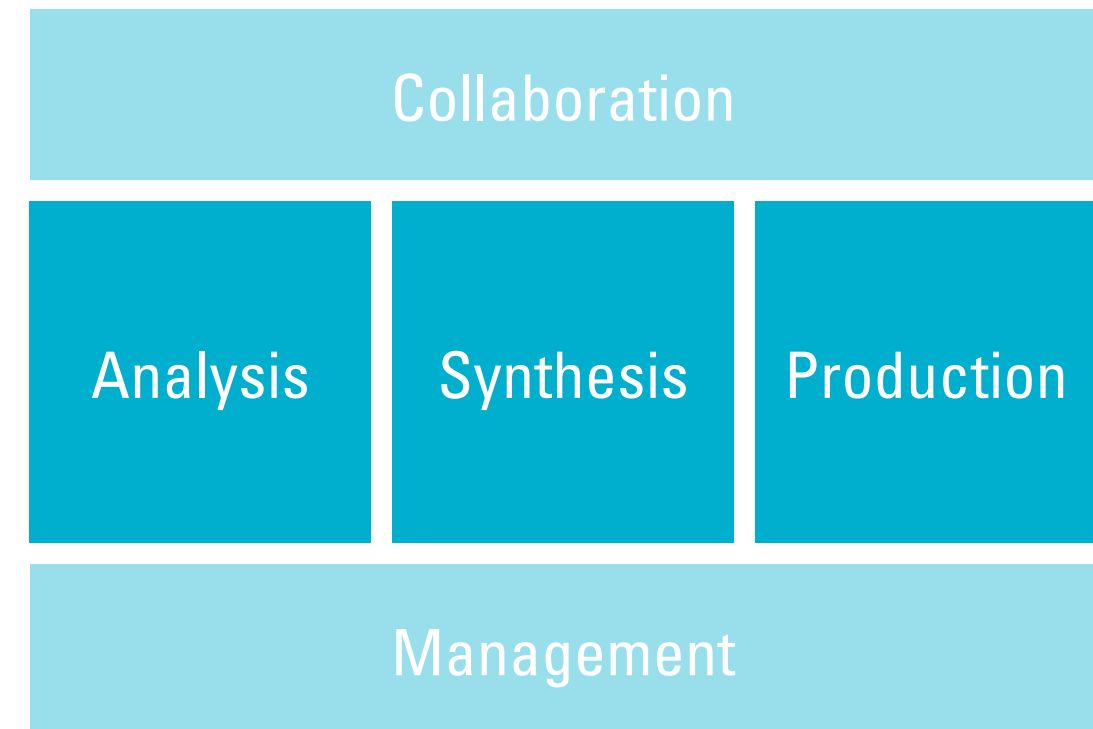
e.g., AutoCAD, PageMaker, Illustrator, Photoshop, Maya

## — Management,

i.e., budgets, schedules, and rational, e.g., Horst Rittel's IBIS

## — Collaboration,

e.g., Nicholas Negroponte's Architecture Machine



# Medium connecting the “products of design” with users

## — Portals,

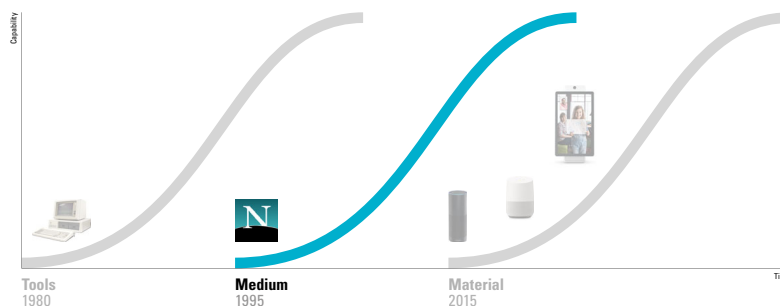
i.e., into games, apps, information spaces, dynamic environments

## — Networks,

e.g., The Well, CompuServe, Prodigy, AOL, MSN, the Internet

## — Platforms for publishing,

e.g., DNS enabling HFS, CMS such as WordPress etc.



# Material to be shaped into “products of design”

- **Information structures,**

e.g., VideoWorks-Director-Flash, HyperCard, HTML-CSS

- **Process structures,**

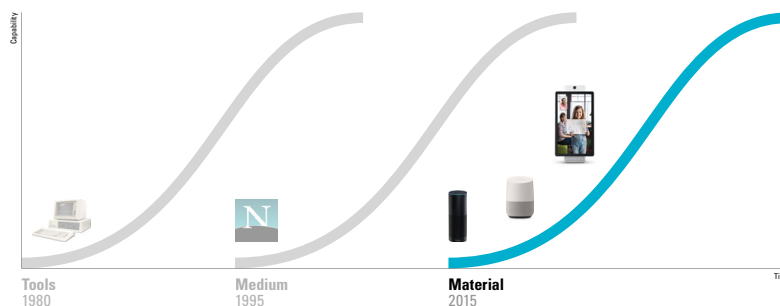
i.e., code, e.g., Seymour Papert’s Logo, JS, Processing, Jupyter

- **Data visualizations,**

e.g., D3.js, Bret Victor’s “explorable explanations”

- **Data-dependent services,**

e.g., recommendations, like search, also bought, newsfeeds

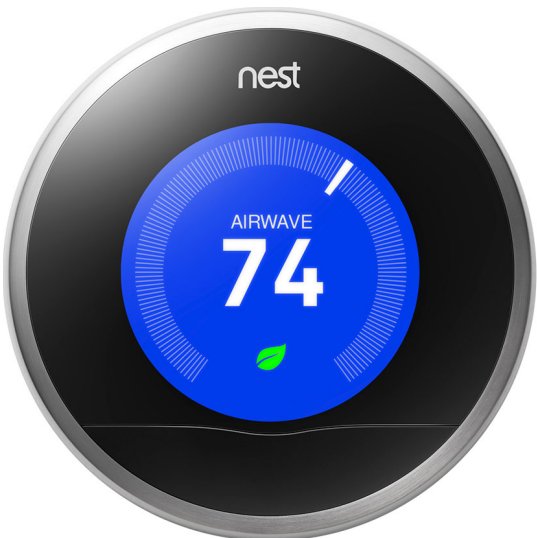
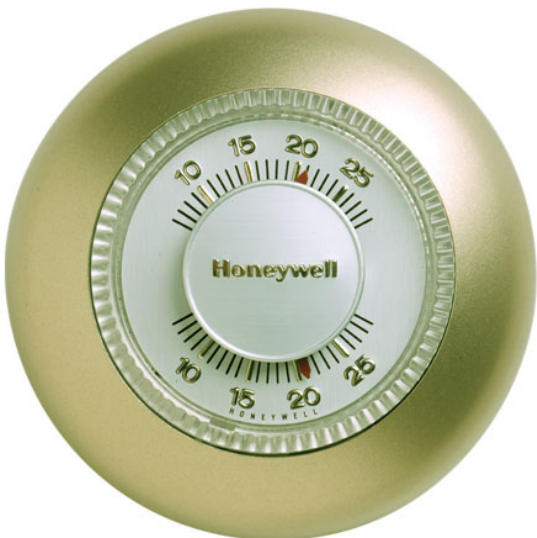


**The design of data-dependent services is a huge shift in how and what we design.**



From  
**Physical artifacts**  
— **objects**

To  
**Adaptive systems**  
— **ecologies**



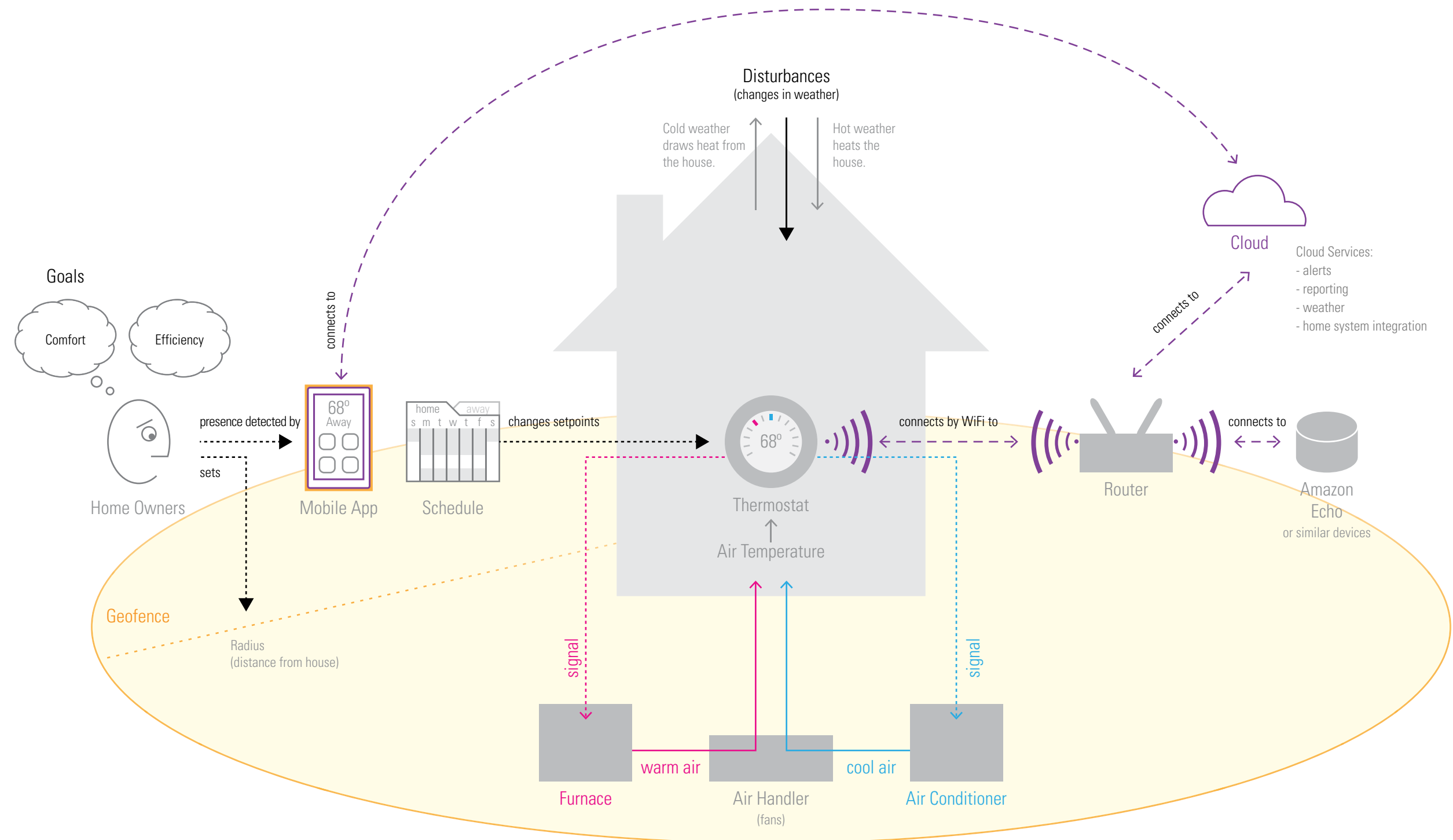
Product Design  
Focus Groups

Human Factors  
Usability Studies

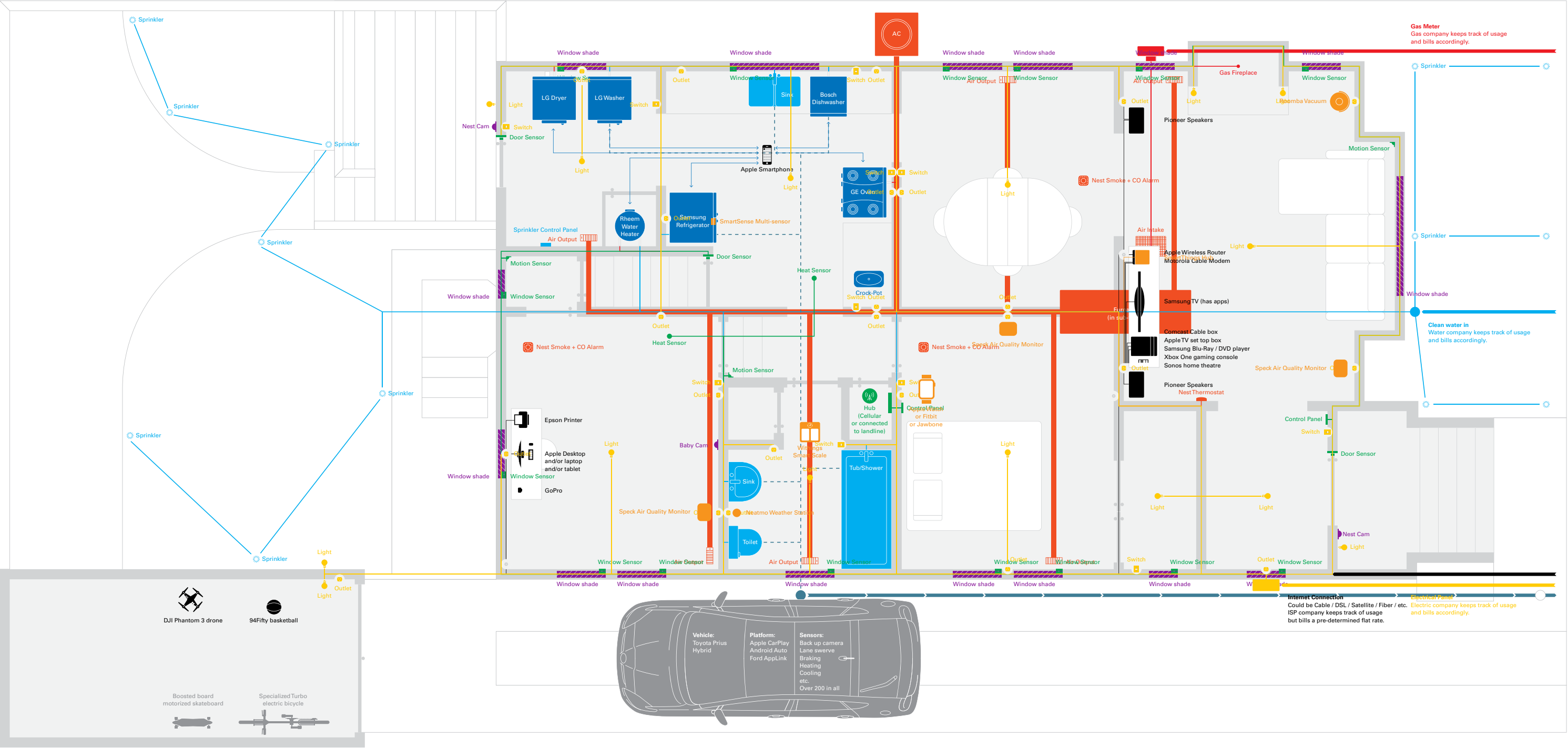
Interaction Design  
Data-driven Design

Service Design  
Model-driven Design

# A smart thermostat gathers together a larger network of products, services, people, and their interactions.



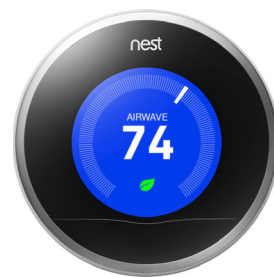
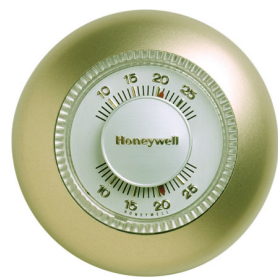
# The HVAC network is part of an even larger home ecology.



*“It seems to me that the notion of machine that was current in the course of the Industrial Revolution — and which we might have inherited — is a notion, essentially, of a machine without goal, it had no goal ‘of’, it had a goal ‘for’.*

*And this gradually developed into the notion of machines with goals ‘of’, like thermostats, which I might begin to object to because they might compete with me.*

*Now we’ve got the notion of a machine with an underspecified goal, the system that evolves. This is a new notion, nothing like the notion of machines that was current in the Industrial Revolution, absolutely nothing like it. It is, if you like, a much more biological notion, maybe I’m wrong to call such a thing a machine; I gave that label to it because I like to realize things as artifacts, but you might not call the system a machine, you might call it something else.”*

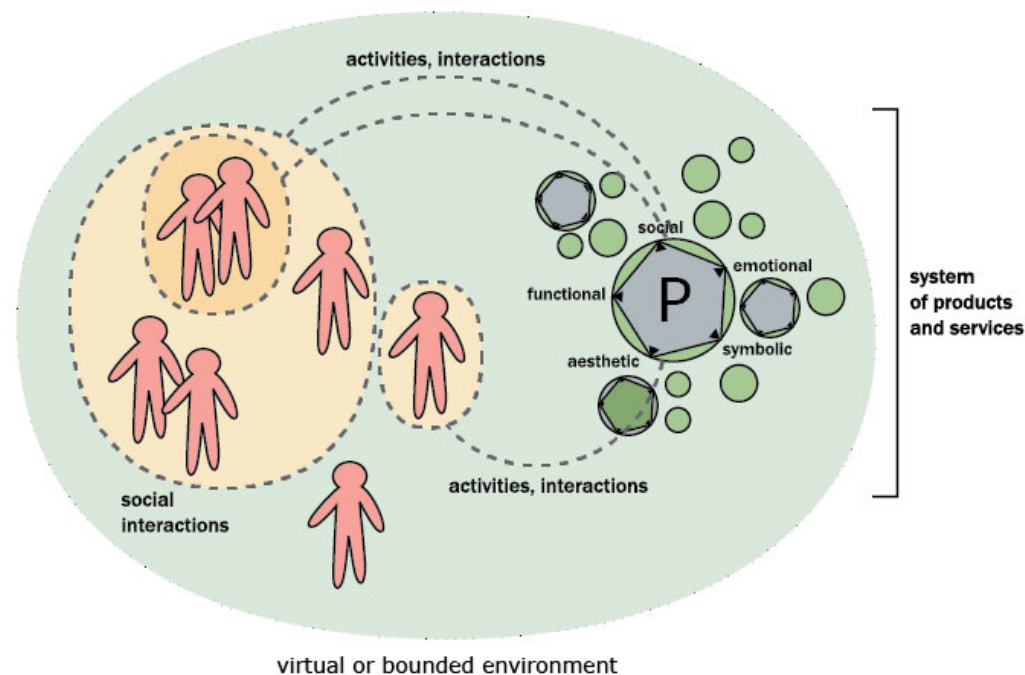


**— Gordon Pask, 1972 (See Usman Haque, 2007)**



# We might call it a “product-service ecology”.

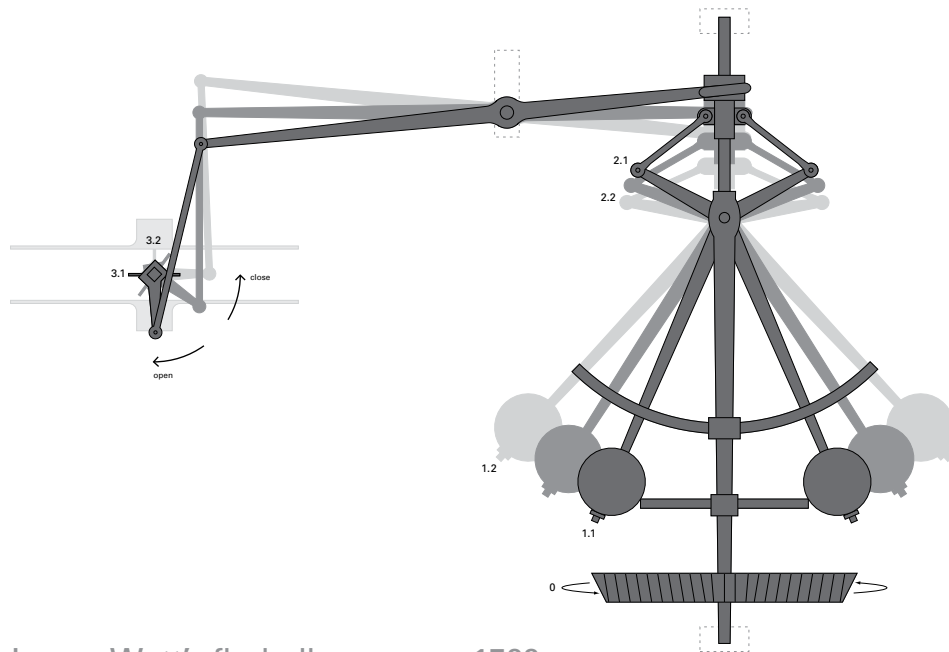
*“...networks of products, services, technology, people, and collective and collaborative interaction are generating value for the populations they serve.”*



— **Jodi Forlizzi**, HCII, CMU, 2008

# Information has been critical from the beginning.

*“There could not have been an industrial revolution without a parallel (though hidden) information revolution at the same time, launched by the rapid spread of the automatic feedback system.”*



James Watt's fly-ball governor, 1788.



— **Kevin Kelly**, *Out of Control*, 2000

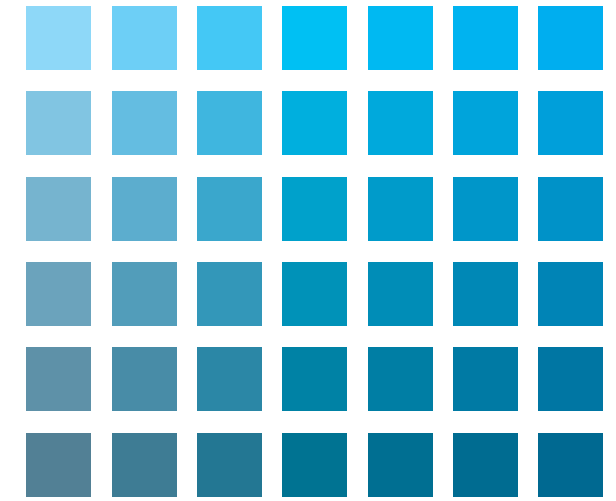
**Yet only recently, have we begun to talk about data and its role in designing and as a material.**

# A-B testing has become the norm on large services.

*“When a company is filled with engineers,...  
data eventually becomes a crutch for every  
decision,...*

*Yes, it's true that a team at Google couldn't  
decide between two blues, so they're testing  
41 shades between each blue to see which  
one performs better....*

*I can't operate in an environment like that.”*



— **Douglas Bowman, 2009**

<https://stopdesign.com/archive/2009/03/20/goodbye-google.html>



**A lot is at stake —  
personal values and shareholder value.**

*“It turns out, the difference  
between one shade of blue and another,  
at the scale of Google search,  
can be worth millions of dollars per year.”*

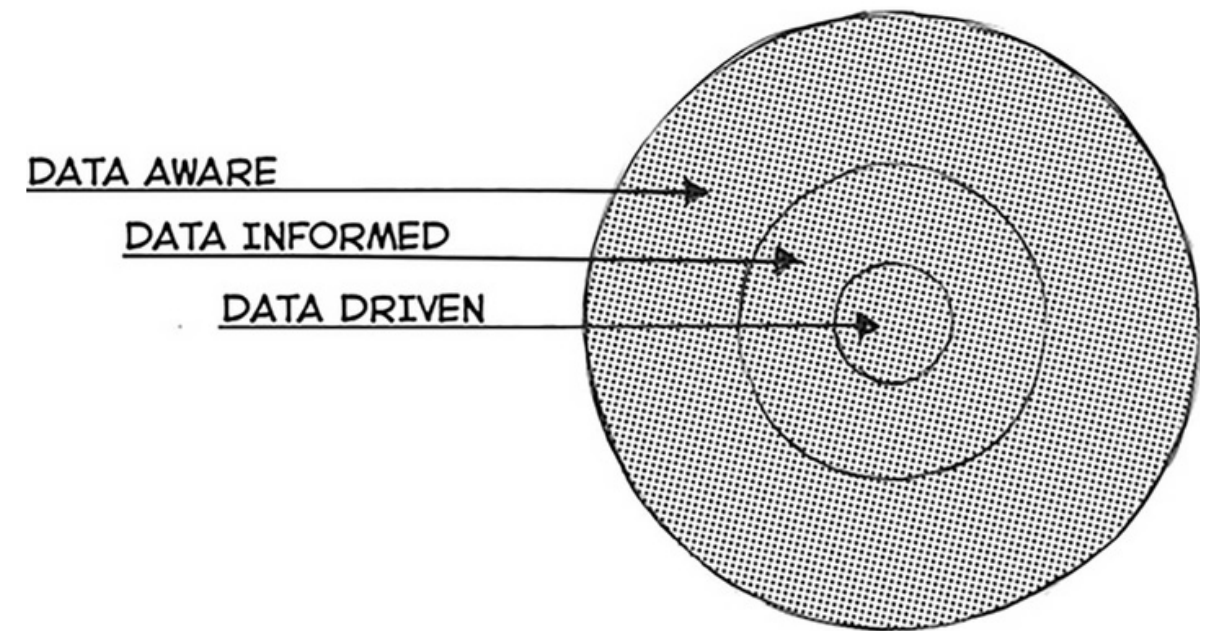


— **Irene Au**, 2012, personal communications

# A Model of Data-driven Design

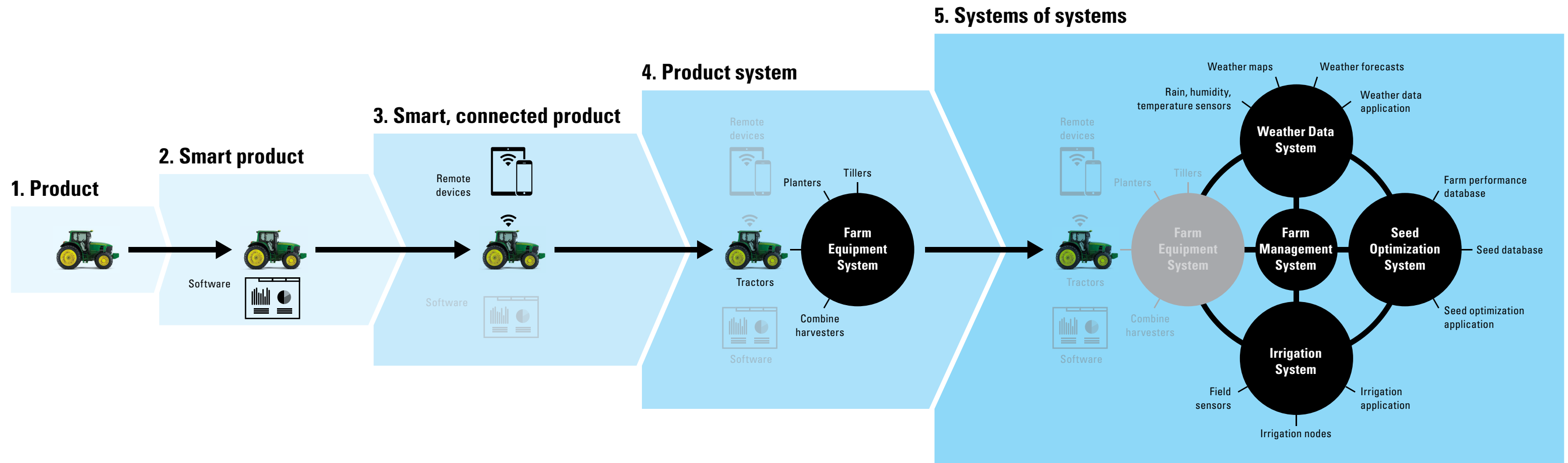
*“Design is and always has been informed by data....*

*By harnessing and leveraging the power of data at scale... new ways to understand people, ‘users,’ are emerging.”*



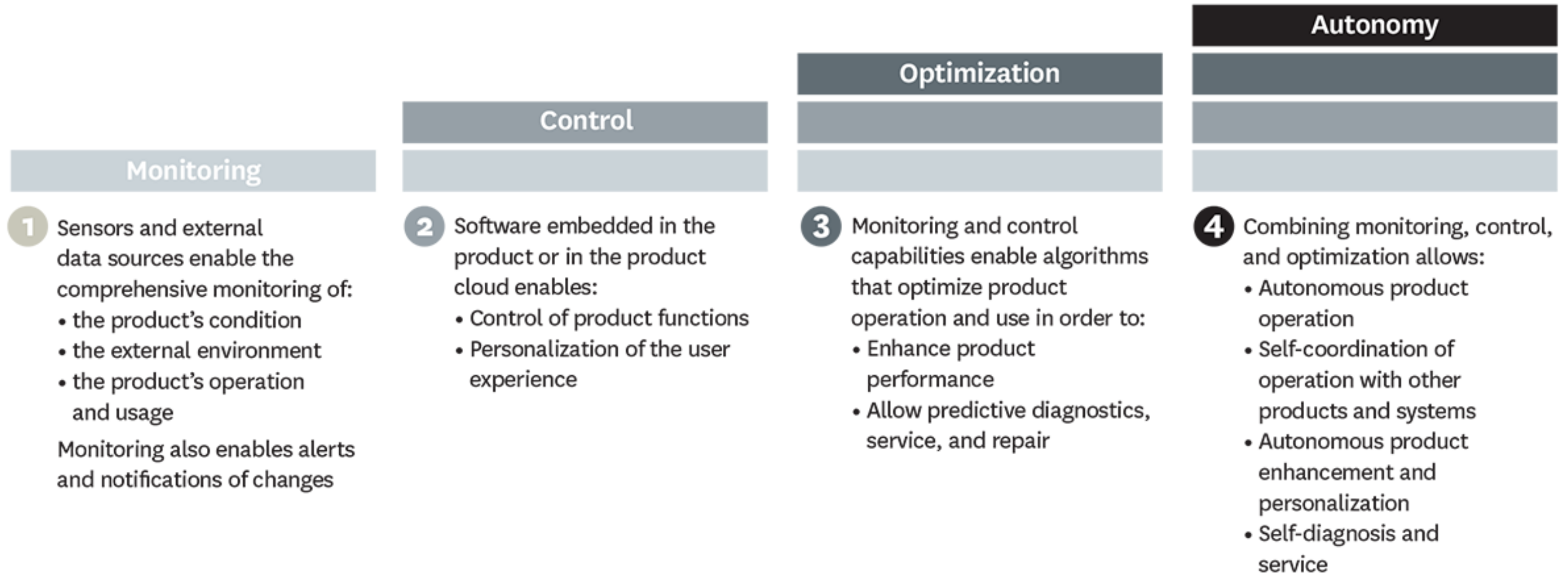
— **Elizabeth Churchill et al.**, *Designing with Data: Improving the User Experience with A/B Testing*, 2017

# “...smart, connected products are transforming competition” and “redefining industry boundaries”



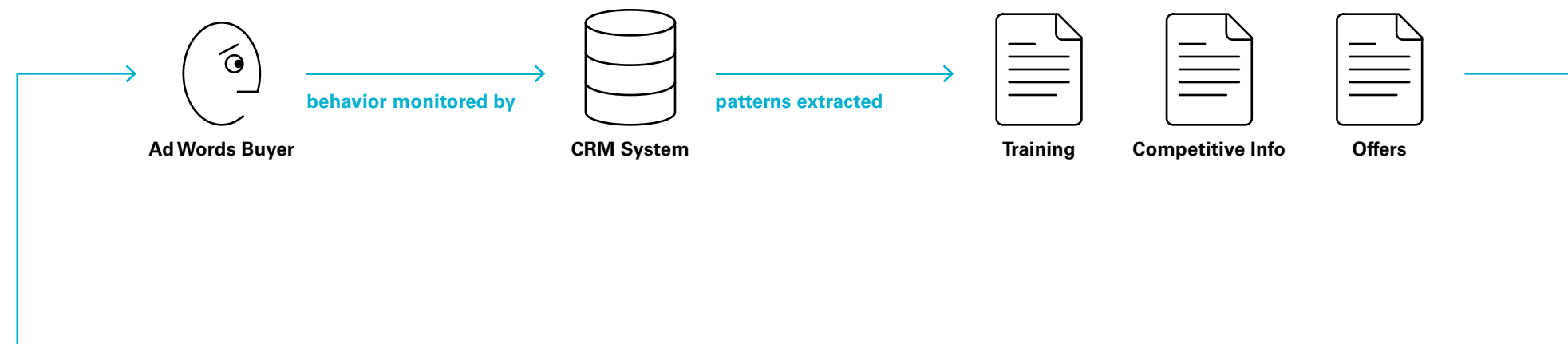
— Michael Porter, HBR, 2014

# “Capabilities of Smart, Connected Products”



— **Michael Porter**, HBR, 2014

# An exemplar of Porter's “optimization” capability is Google's CRM system.



Google CRM (GRM) is a sort of machine driving ad-words revenue.  
It tracks buyer behavior and responds to changes with “encouragement”.  
It has the *goal of* “regulating” buyer behavior.  
Human managers still introduce new offers,  
but the system learns and operates largely on its own.

# How can we reconcile the Churchill and Porter models?

# A model of Data-dependent Services

New Kind of Nature

Autonomous / self-driving

Semi-autonomous

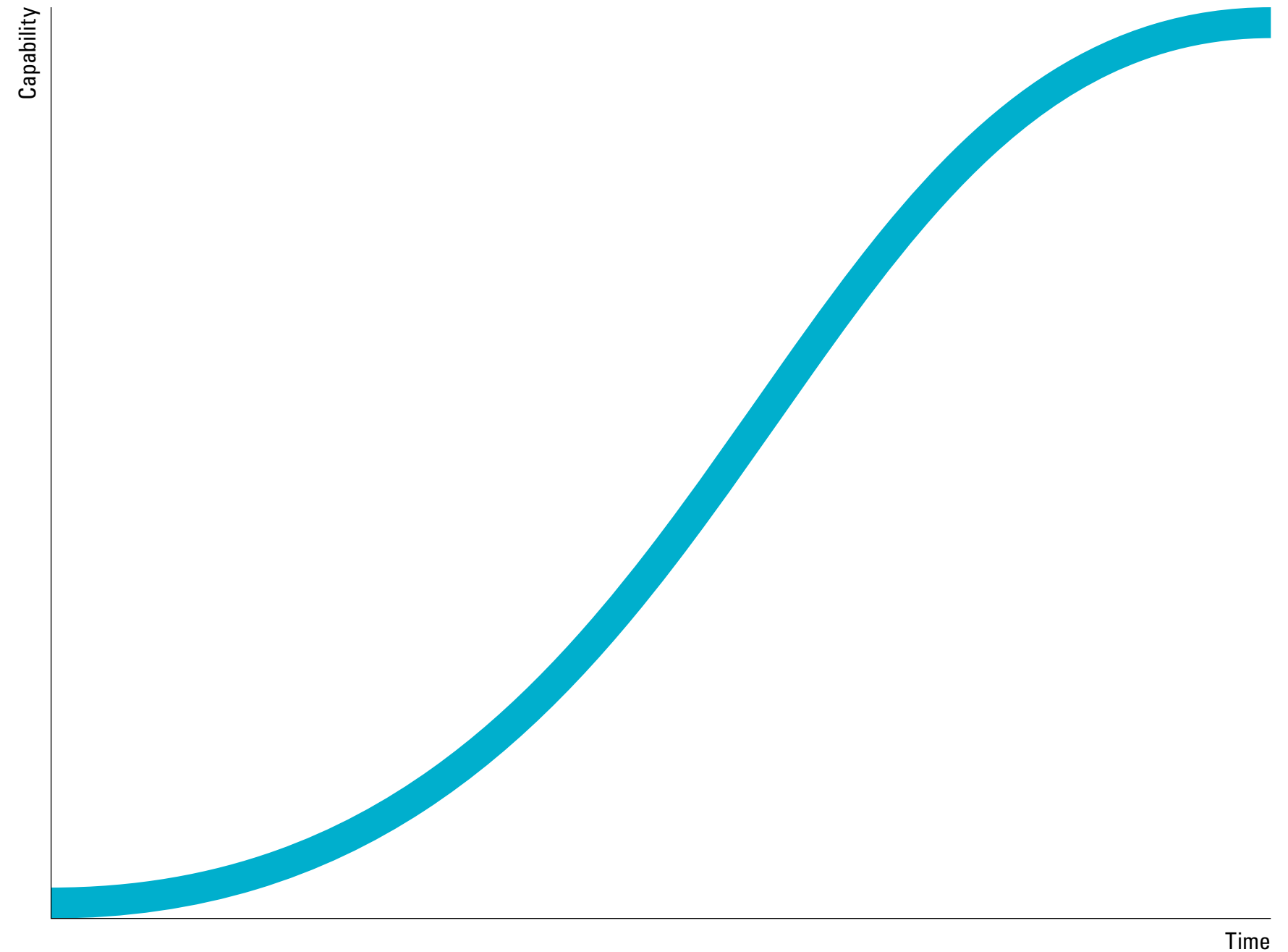
Model driven / data animated

Data driven

Data informed

Data aware

State of nature





# **Example:**

# **An individual managing diabetes**



## State of nature

**Metabolism happens on its own.**

**The individual is unaware.**

(But the body *is* aware.)

New Kind of Nature

Autonomous / self-driving

Semi-autonomous

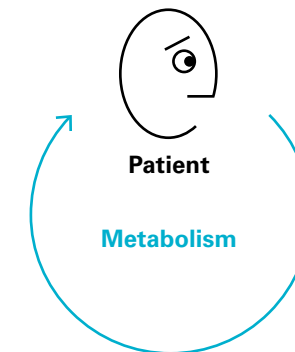
Model driven / data animated

Data driven

Data informed

Data aware

State of nature



## Data aware

**The individual learns diet + exercise affect weight, blood glucose, and general health.**

New Kind of Nature

Autonomous / self-driving

Semi-autonomous

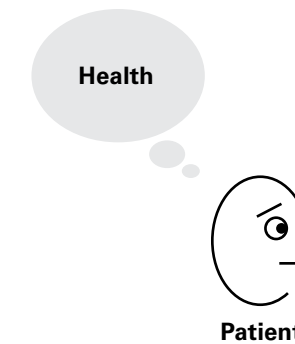
Model driven / data animated

Data driven

Data informed

Data aware — reflecting, possible sensing

State of nature



# Data informed

**The individual counts carbs and steps;  
choices start to affect behavior.**

New Kind of Nature

Autonomous / self-driving

Semi-autonomous

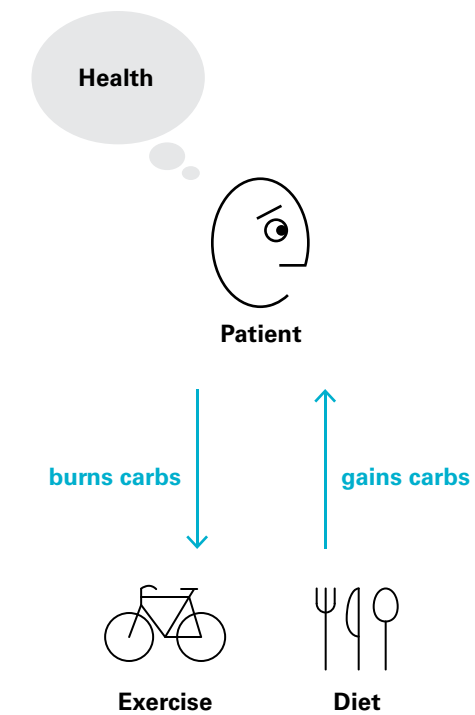
Model driven / data animated

Data driven

**Data informed** — sensing, reflecting, possible acting, “open loop”

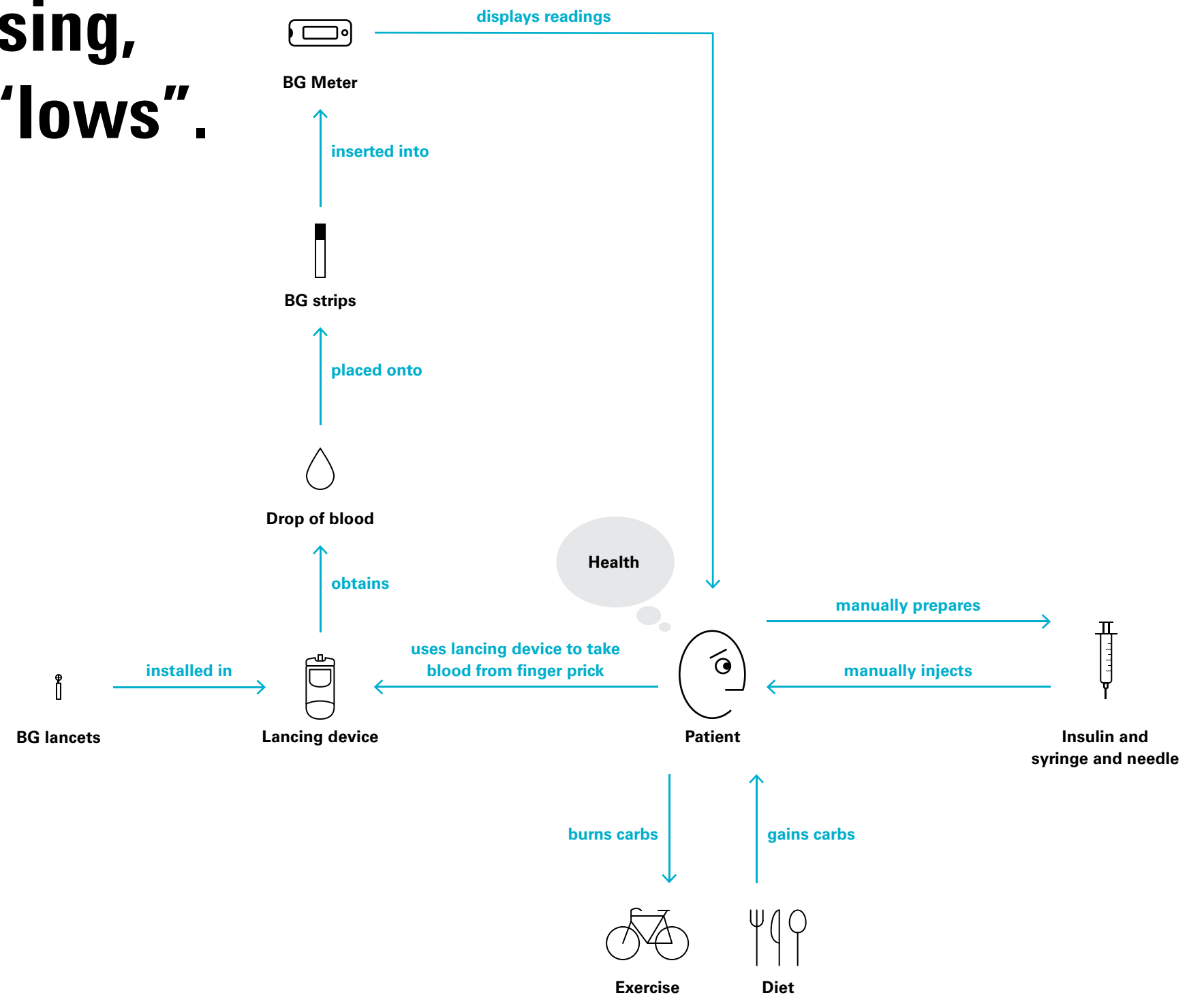
Data aware

State of nature



# Data driven

## Measuring BG drives insulin dosing, reducing “highs” and avoiding “lows”.



New Kind of Nature

Autonomous / self-driving

Semi-autonomous

Model driven / data animated

Data driven — sensing, reflecting, acting on feedback (human closes the loop)

Data informed

Data aware

State of nature

# Model driven / data animated

## A CGM recognizes “trends” and provides prompts and warnings.

New Kind of Nature

Autonomous / self-driving

Semi-autonomous

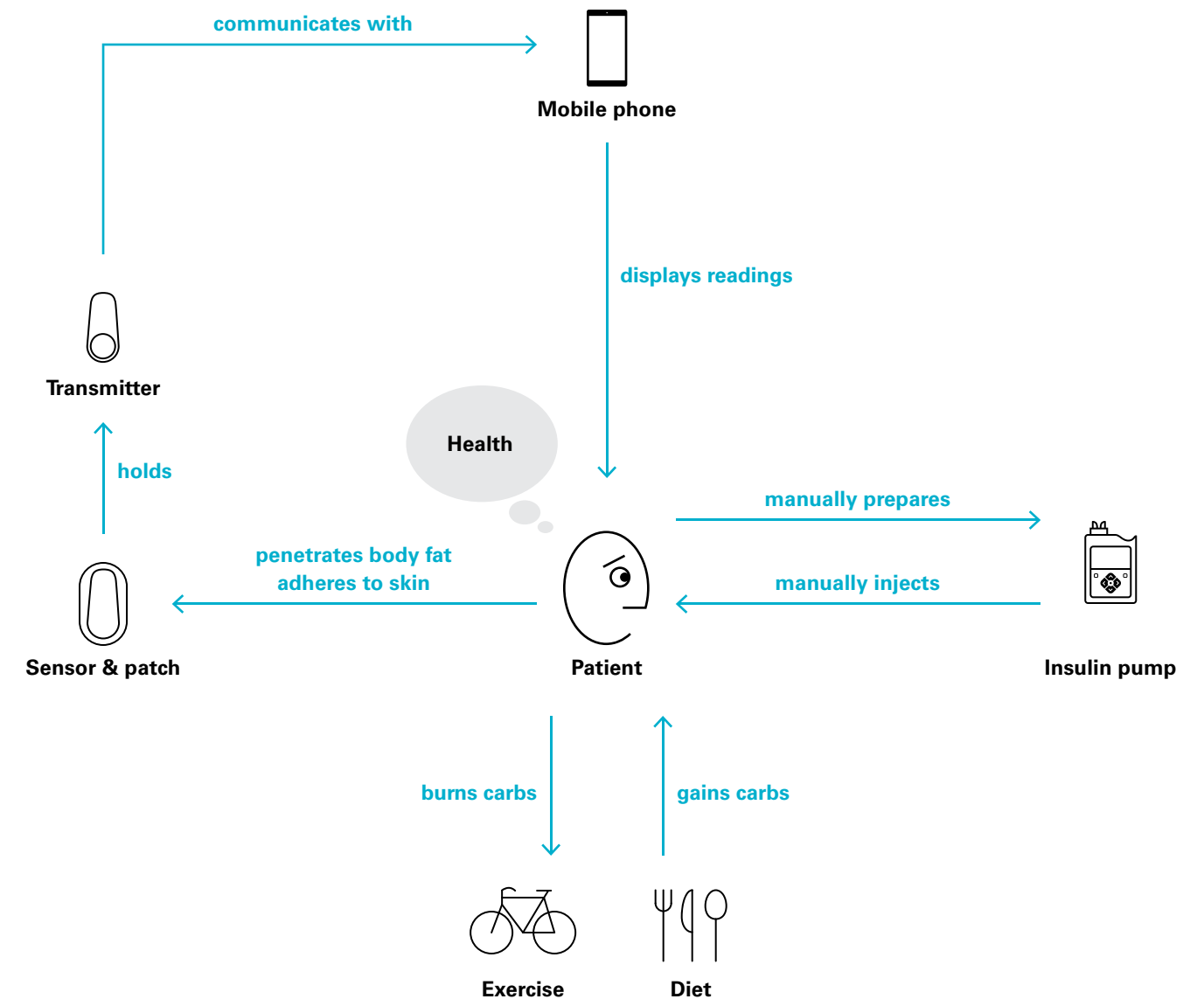
Model driven / data animated — collecting data history, recognizing patterns, predicting outcomes

Data driven

Data informed

Data aware

State of nature



# Semi-autonomous CGM connects to a pump; person still inputs carbs and exercise.

New Kind of Nature

Autonomous / self-driving

Semi-autonomous — closed loop with minimal human inputs

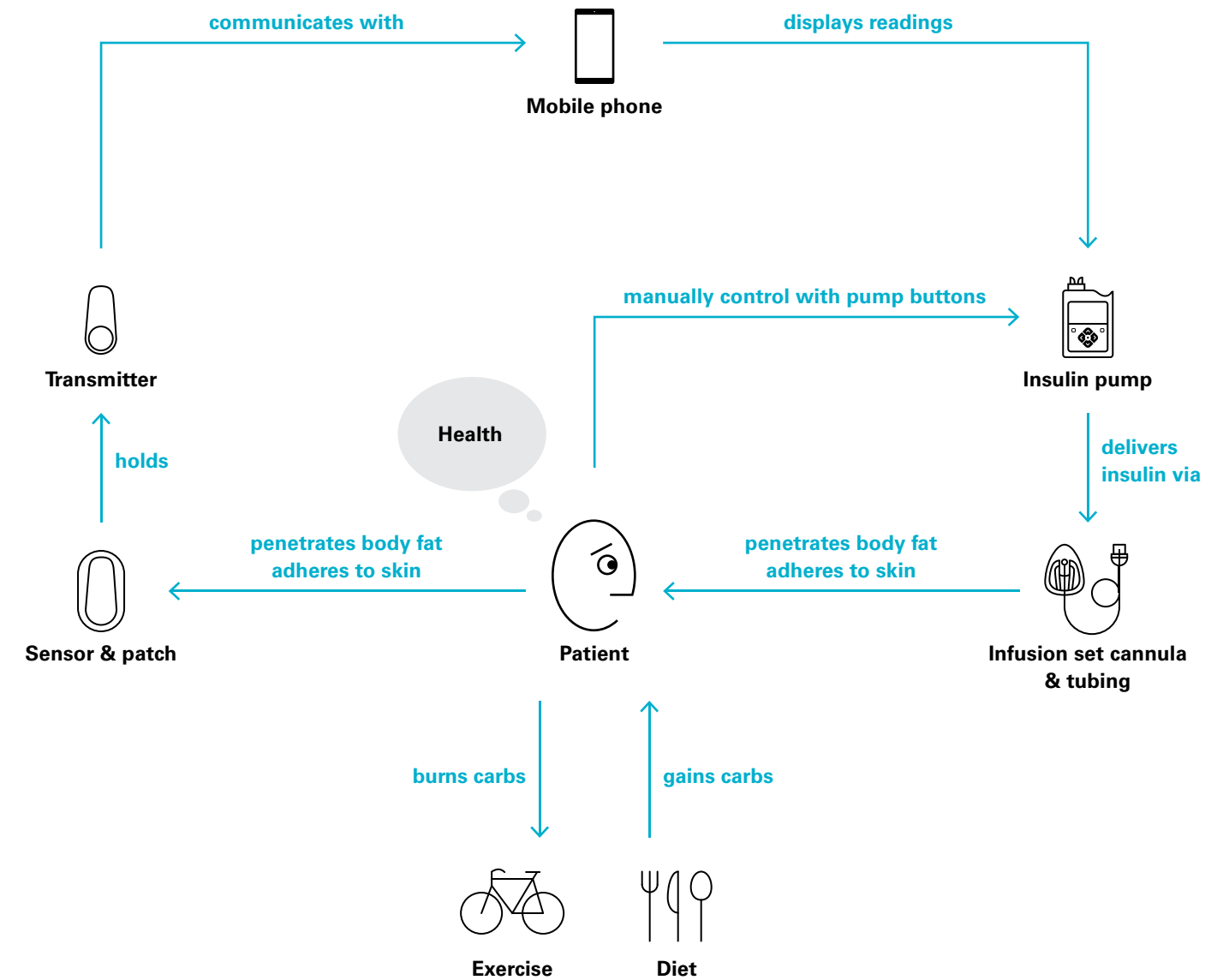
Model driven / data animated

Data driven

Data informed

Data aware

State of nature

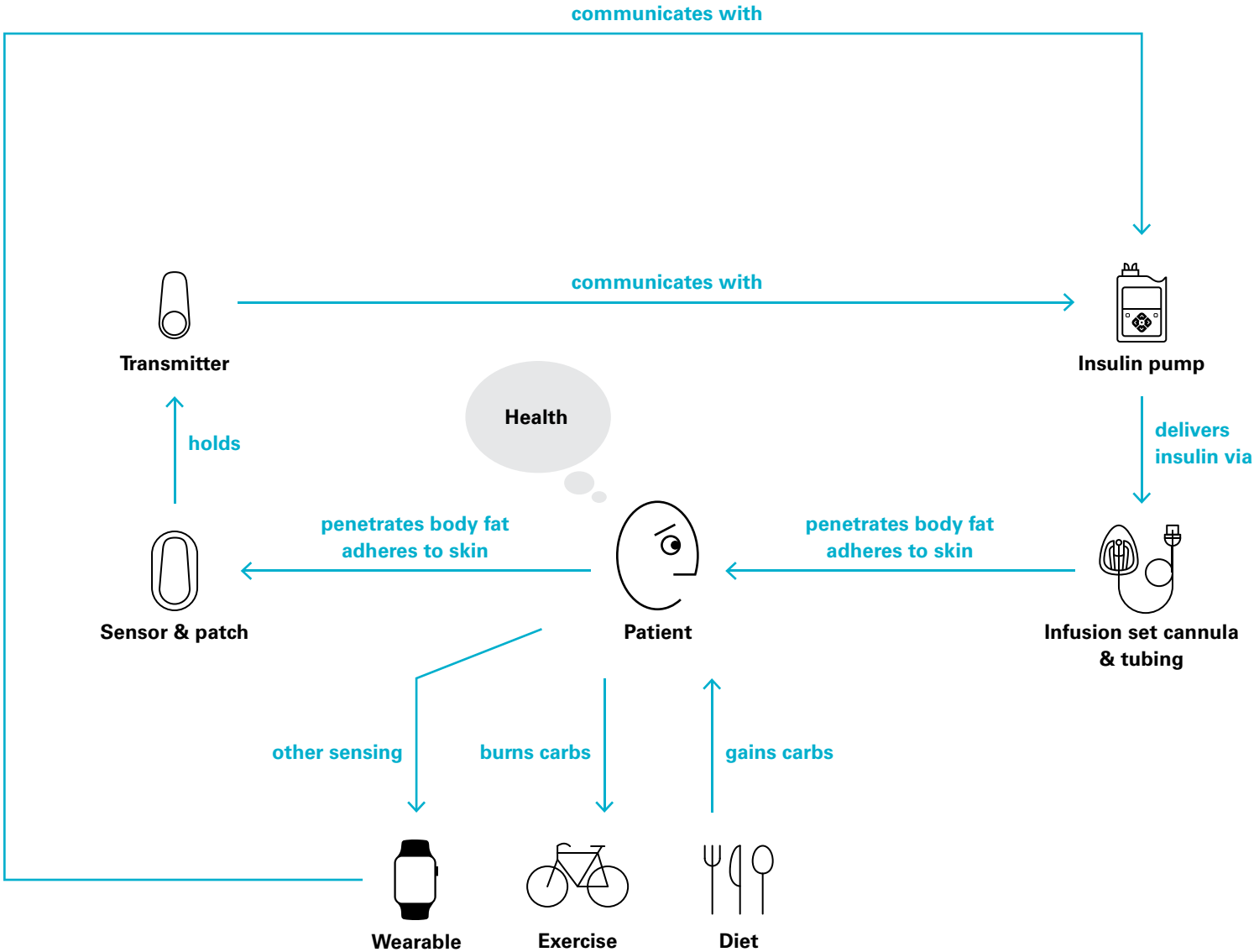


# Autonomous / self-driving

## A true “artificial pancreas”;

### the system measures carbs + exercise.

(We’re not here, yet.)



New Kind of Nature

Autonomous / self-driving — closed loop, no human input

Semi-autonomous

Model driven / data animated

Data driven

Data informed

Data aware

State of nature

# New Kind of Nature

**Metabolism happens on its own.**

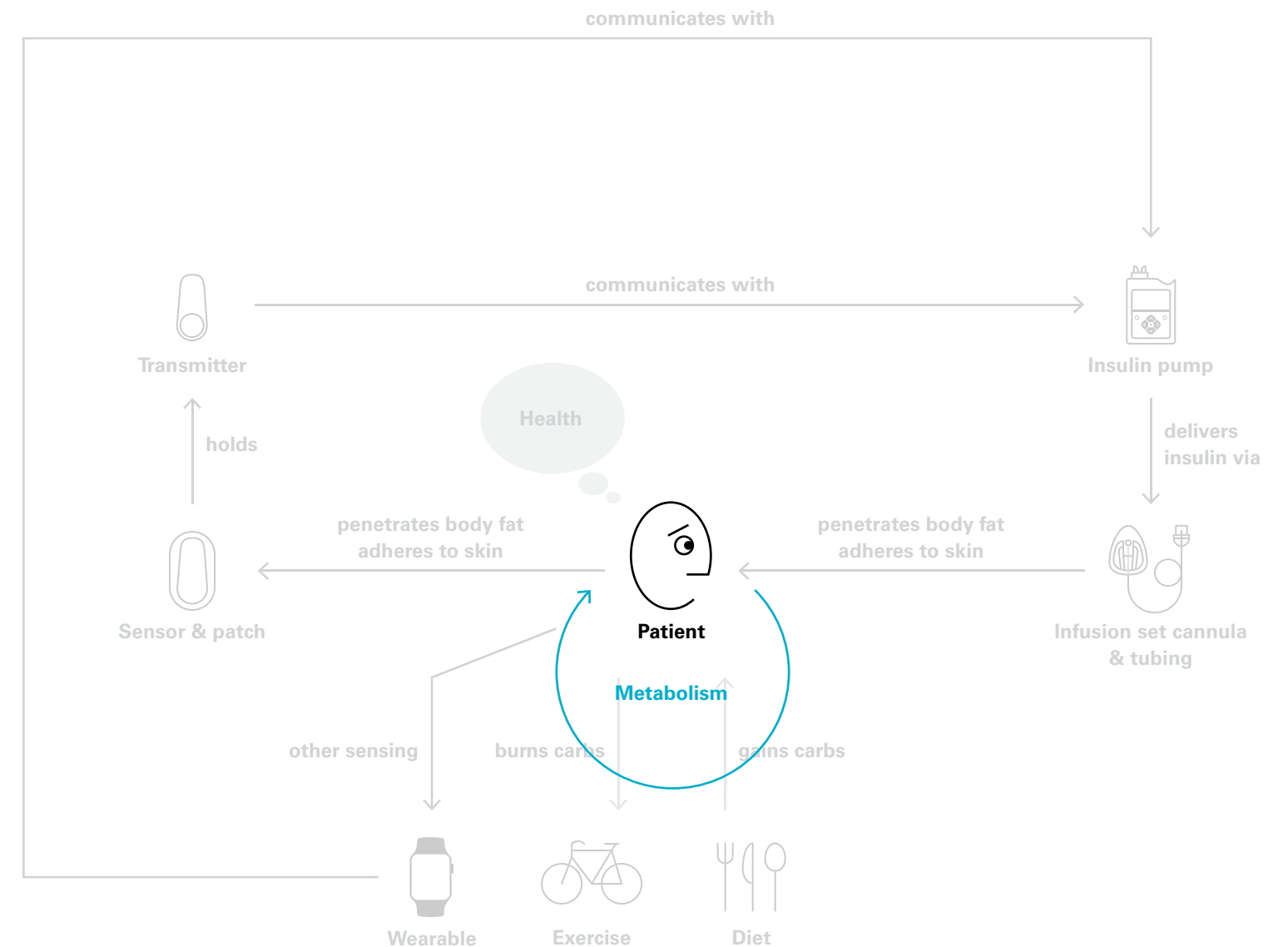
**The individual is unaware.**

**(But the system *is* “aware”.)**

## New Kind of Nature

Autonomous / self-driving  
Semi-autonomous  
Model driven / data animated  
Data driven  
Data informed  
Data aware

State of nature





**Example:**  
**An organization managing  
a population of individuals  
with diabetes**

## State of nature

**Individuals are treated in isolation;  
no concept of “patient population”.**

New Kind of Nature

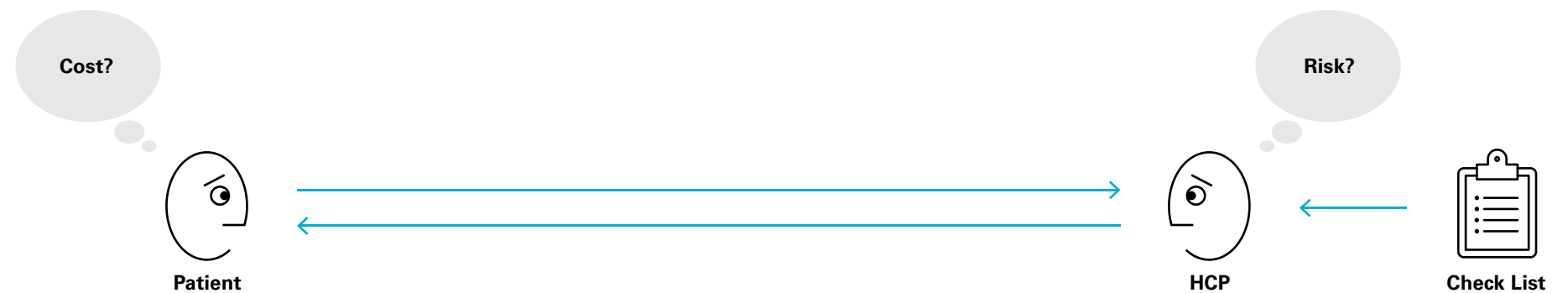
Autonomous / self-driving  
Semi-autonomous  
Model driven / data animated  
Data driven  
Data informed  
Data aware

State of nature



## Data aware

**HCPs establish standards of care; fees paid for services.  
Managing risks and costs become a concern.**



New Kind of Nature

Autonomous / self-driving

Semi-autonomous

Model driven / data animated

Data driven

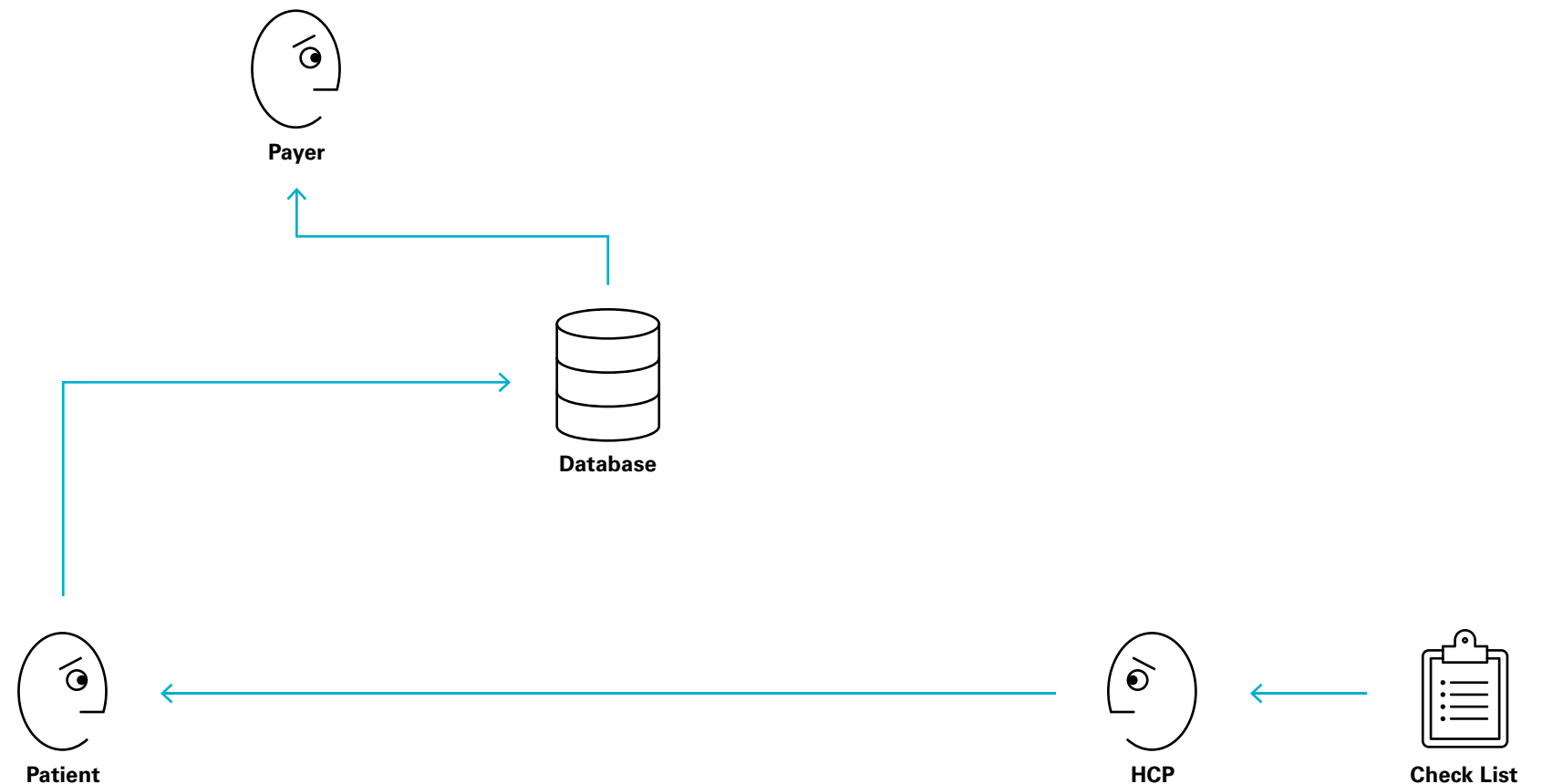
Data informed

**Data aware — reflecting, possible sensing**

State of nature

# Data informed

**Systematic measurement of outcomes begins;  
payers compare organizational performance.**



New Kind of Nature

Autonomous / self-driving

Semi-autonomous

Model driven / data animated

Data driven

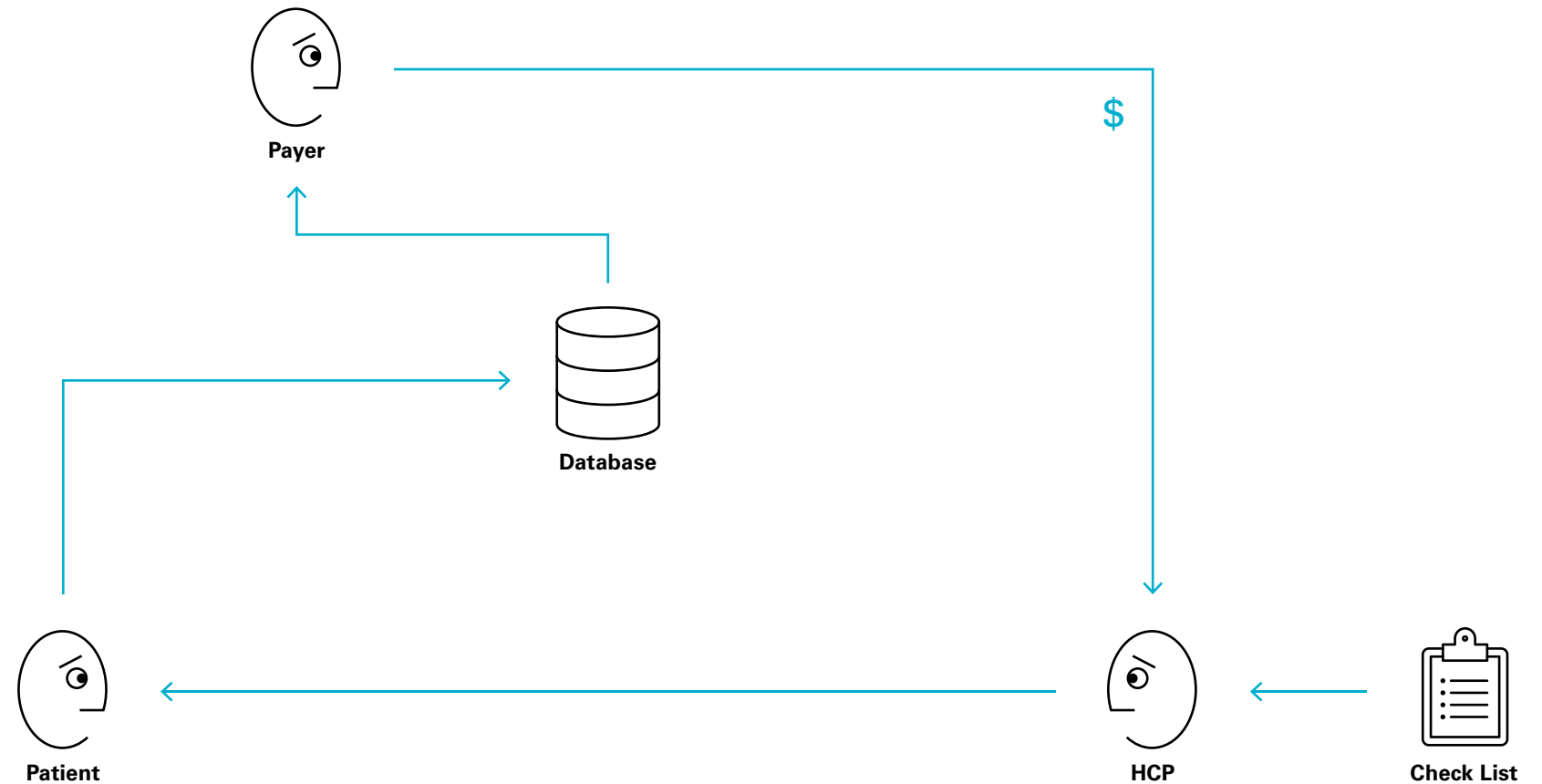
Data informed — sensing, reflecting, possible acting, “open loop”

Data aware

State of nature

# Data driven

**“Pay-for-performance” begins (feedback);  
“outcomes” begin to drive HCP actions.**



New Kind of Nature

Autonomous / self-driving

Semi-autonomous

Model driven / data animated

Data driven — sensing, reflecting, acting on feedback (human closes the loop)

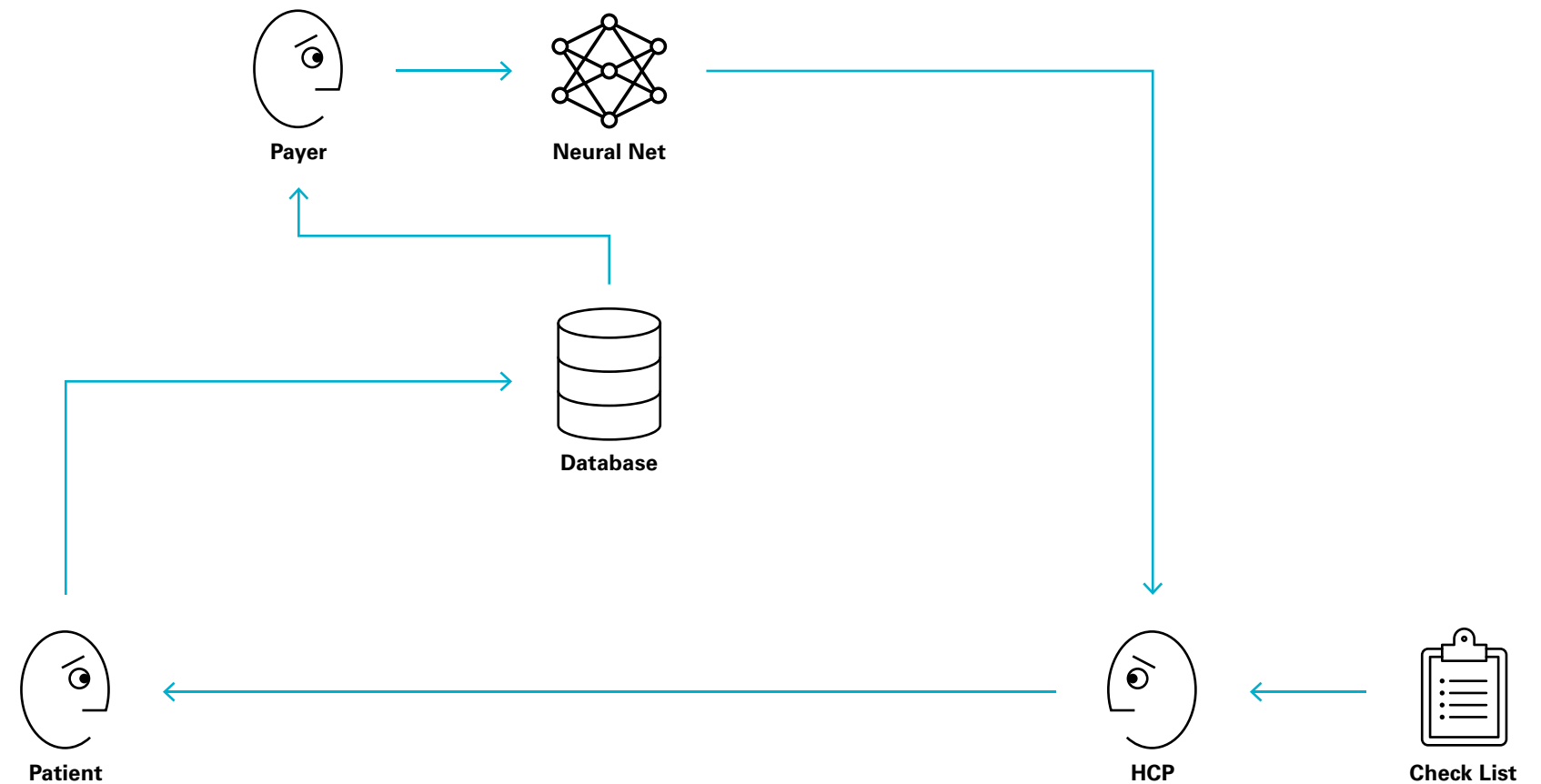
Data informed

Data aware

State of nature

# Model driven / data animated

## Historical data creates risk models; system refers “high risk” folks to HCPs.



New Kind of Nature

Autonomous / self-driving

Semi-autonomous

Model driven / data animated — collecting data history, recognizing patterns, predicting outcomes

Data driven

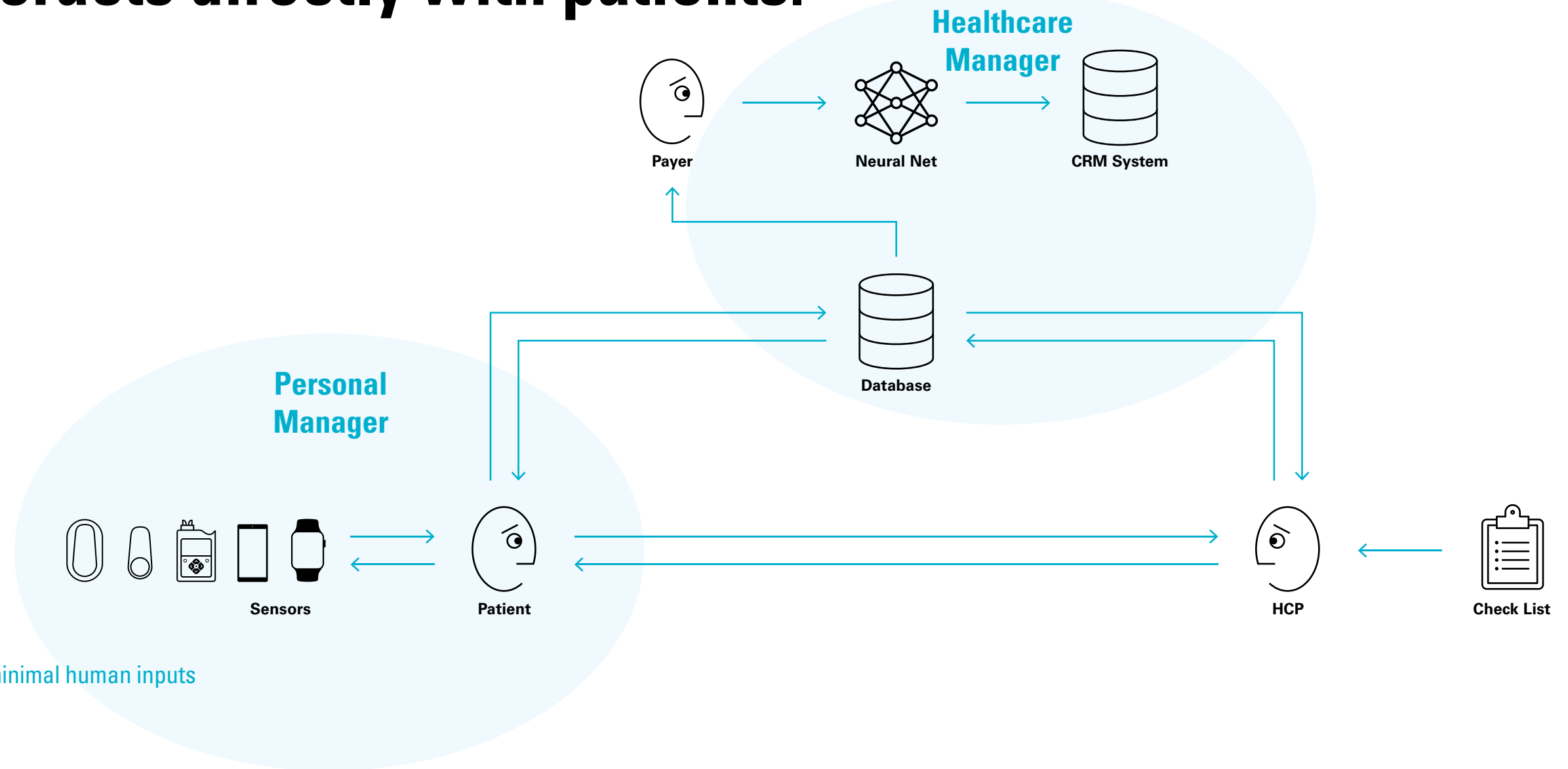
Data informed

Data aware

State of nature

# Semi-autonomous

## Healthcare embraces sensors and CRM; the system interacts directly with patients.



New Kind of Nature

Autonomous / self-driving

**Semi-autonomous** — closed loop with minimal human inputs

Model driven / data animated

Data driven

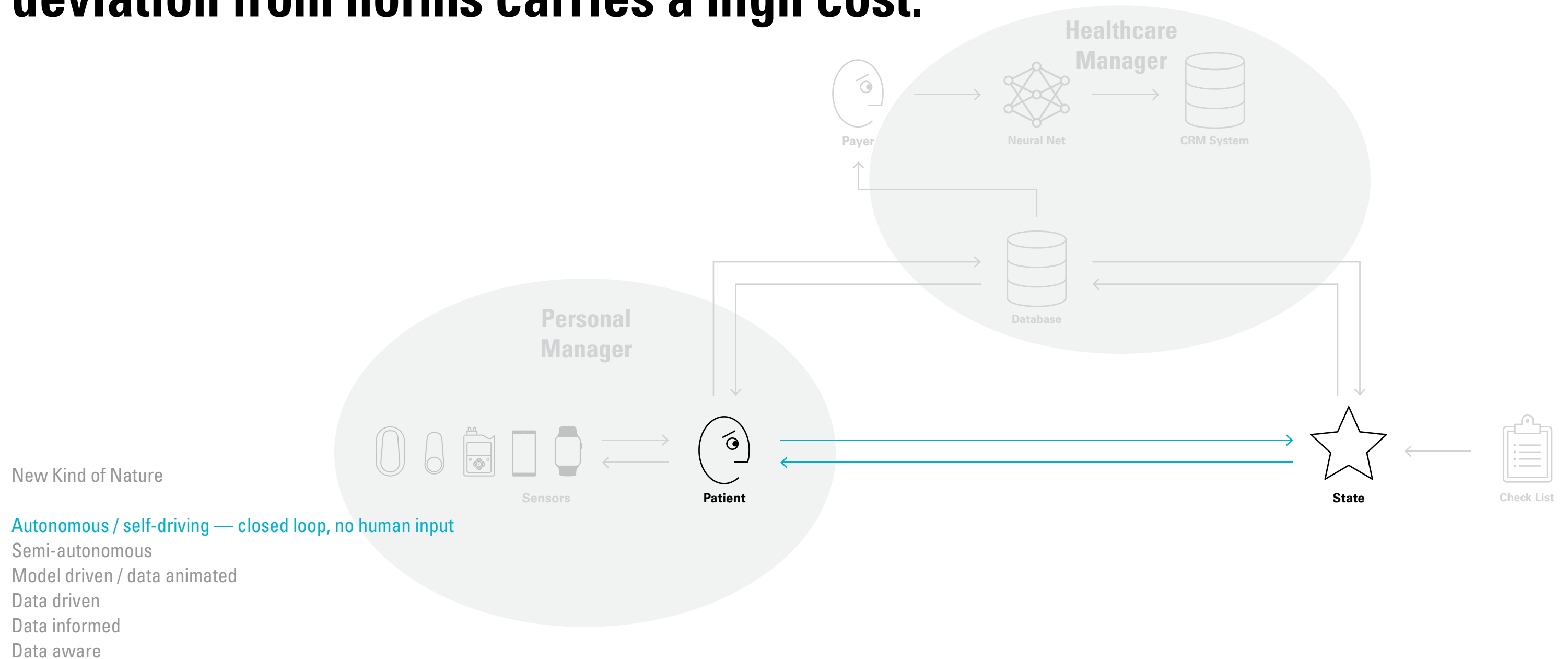
Data informed

Data aware

State of nature

# Autonomous / self-driving

## State (or payers) measure behavior; deviation from norms carries a high cost.



New Kind of Nature

Autonomous / self-driving — closed loop, no human input

Semi-autonomous

Model driven / data animated

Data driven

Data informed

Data aware

State of nature



# New Kind of Nature

**A new balance between freedom and responsibility;  
Privacy is dead for all but the very wealthy.**

## New Kind of Nature

Autonomous / self-driving  
Semi-autonomous  
Model driven / data animated  
Data driven  
Data informed  
Data aware

State of nature



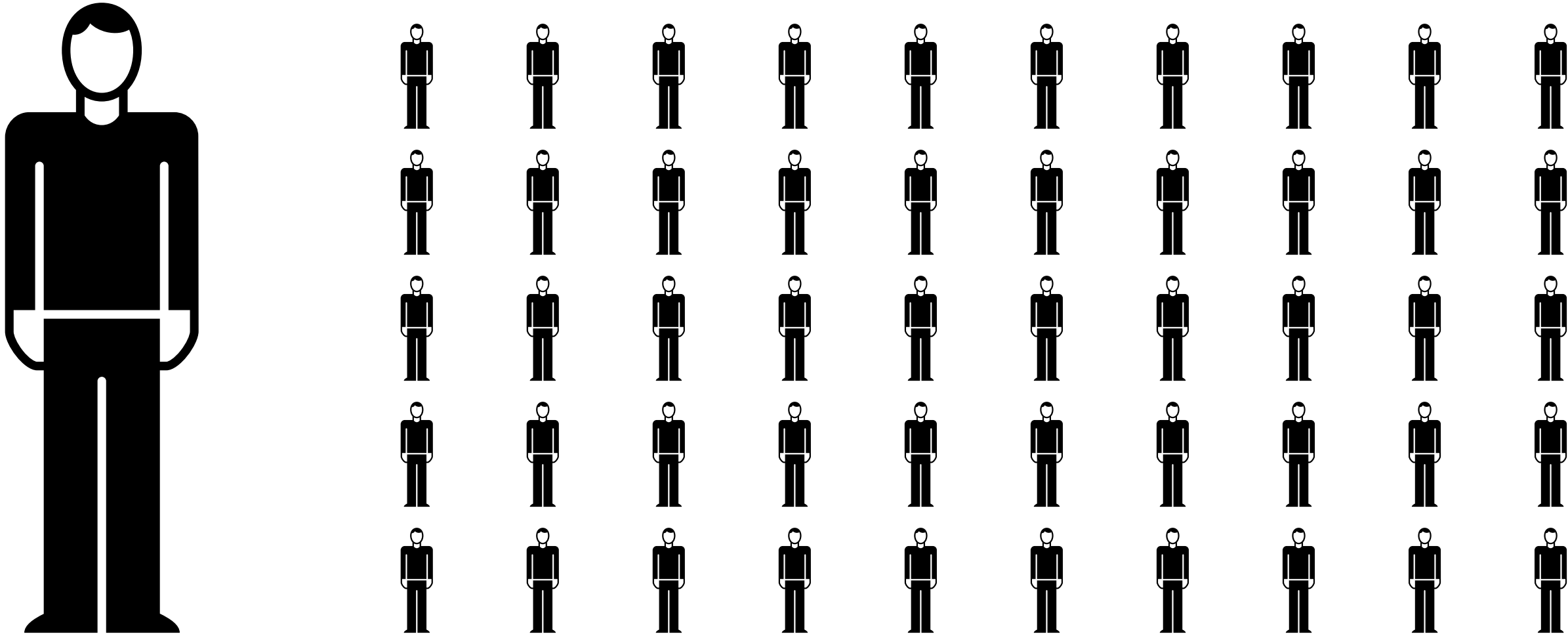
Max Schrems and his 1,200 page Facebook profile.

# This model describes organizations and individuals; it serves in the large and the small.

New Kind of Nature

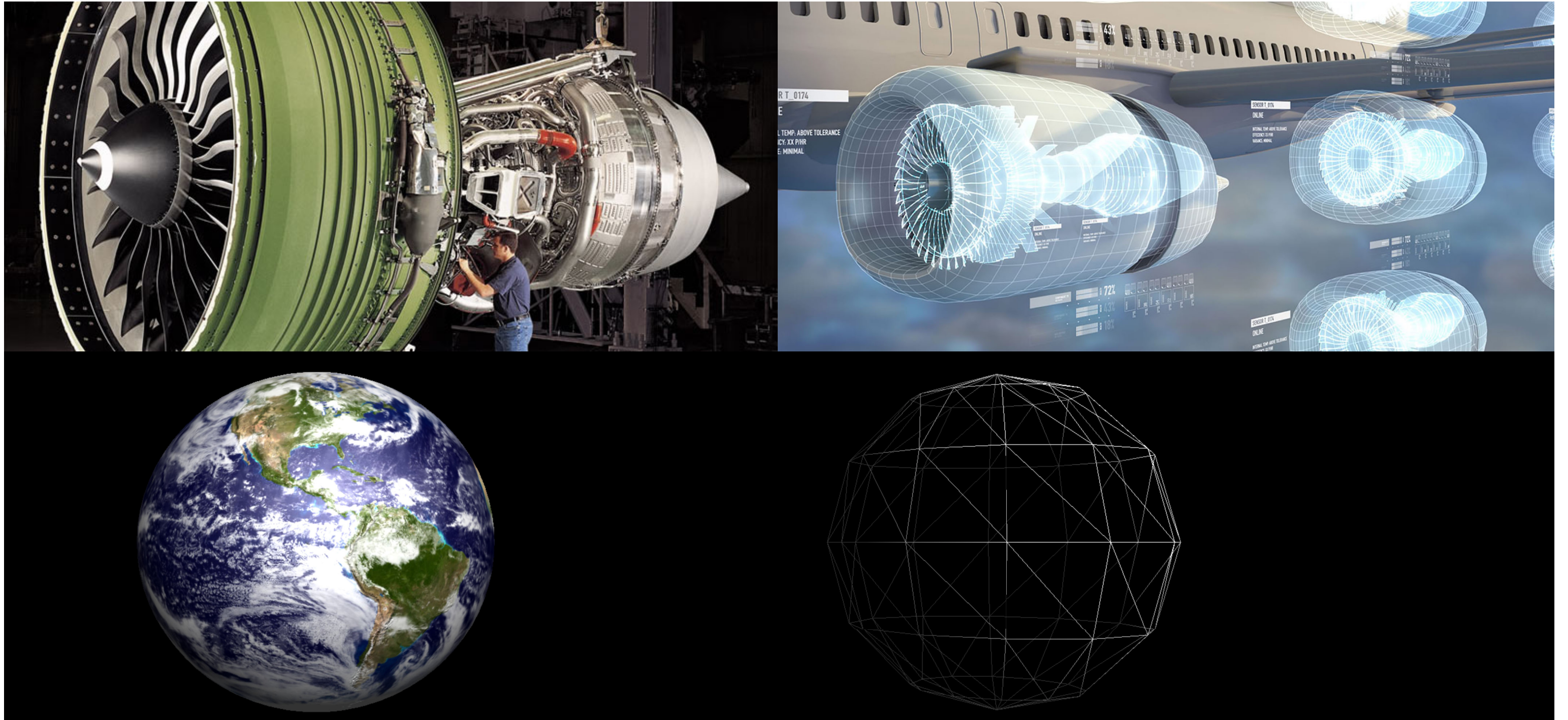
- Autonomous / self-driving
- Semi-autonomous
- Model driven / data animated
- Data driven
- Data informed
- Data aware

State of nature





**In other words, we are beginning to create “digital twins” — of machines, of people, of organizations, and the whole earth.**



# Conclusion

# Product-service ecologies change what designers design:

## Business models:

e.g., better outcomes, lower costs

## Infrastructure:

e.g., distribution systems, payment systems

## Patient journeys:

e.g., on-boarding, ordering, training, support, monitoring

## Cloud services:

e.g., patient portal, HCP portal; payer integration

## Human-machine interactions:

i.e., physical + virtual UIs

## Communications:

e.g., Packaging, documentation

## Foundation products:

e.g., CGM, phone, pump, supplies

# Product-service ecologies depend on a series of platforms:

**Services:**

e.g., CRM

**Data refineries:**

e.g., Predix, Descartes

**Data storage systems:**

e.g., RDBMS, Hadoop, Bigtable

**File systems:**

e.g., HFS, Descartes Festivus

**Routing systems:**

e.g., DNS

**Operating systems:**

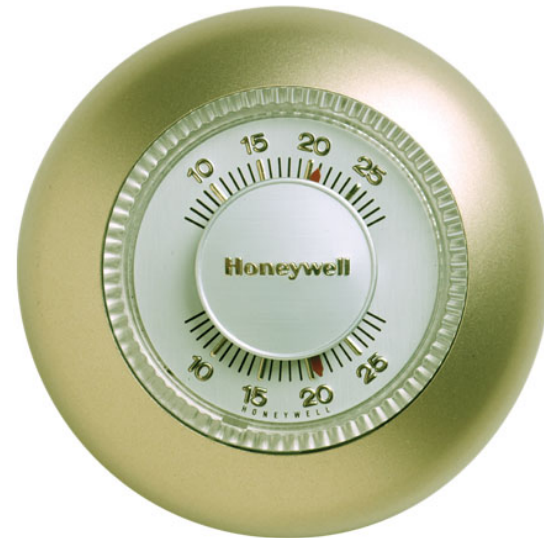
e.g., Windows

**Micro-processors:**

e.g., 8086, 80286, 80386, etc.



# Self-driving cars are very nearly real. Are self-driving organizations next?



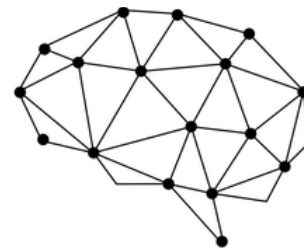
# The first semi-autonomous organizations are already here.

**amazon**

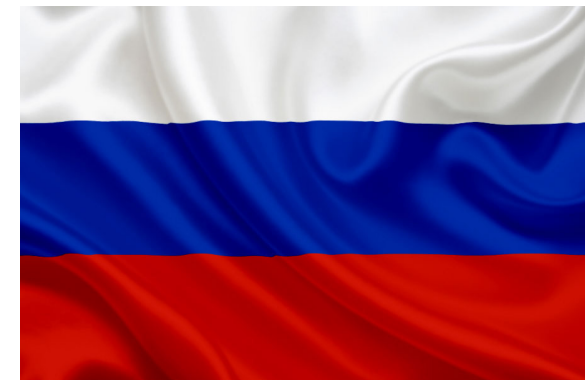
**Google**

**NETFLIX**

**facebook**



Cambridge  
Analytica



Internet Research Agency



**Special thanks to**  
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