



BCG

THE BOSTON CONSULTING GROUP


AI & Automation in R&D

The Retreat 2018

Starting point (always): productivity

A  **More winners**
Better Science

Scientific talent, technologies and capabilities to generate and test intervention hypotheses for transformative therapies

B  **Lower cost of failure**
Better Decisions

Organizational and behavioral drivers of rapid unbiased decision making

C  **Lower cost / time**
Better Efficiency

Operational improvements to support more efficient execution of discovery and development activities

"R&D on a page"

A



Strategy



Scientific strategy: right investments in biology, modalities, models...

Portfolio choices (asset, DA/TA, pathway...)

B



Organization and culture



Talent, expertise and capabilities

Governance, decision-making

Structure

Culture, incentives

C



Operations



Agile processes, interfaces

Tools and platforms

Site footprint

External collaboration, variabilization

D



Supports others





Digital technologies



Digitization/ automation of processes

Analytical support of decisions

The big decisions

	Biology	Chemistry	Pre-clinical	Clinical
Hurdles	 <p><i>Is this the right biology?</i></p>	 <p><i>Is this the right way to modulate the biology?</i></p>	 <p><i>Will it work in humans?</i></p>	 <p><i>What are the right dose, endpoints, biomarkers & patients?</i></p>
Emerging solutions	<ul style="list-style-type: none"> • 'omics (P2G, G2P) for target ID • AI enabled discovery • Connectivity maps • Gene editing 	<ul style="list-style-type: none"> • Cell therapy • Gene editing • Epigenetic modulation • Microbiome • Personalized vaccines • Regenerative medicine • RNAi • Predictive DMPK • Structure based design 	<ul style="list-style-type: none"> • In silico predictive model (eg, ADMET, hormone, nervous system simulation) • Mouse models (eg, Replicon system) • Organoid systems • iPSCs models • Tissue explants • Organ on a chip • 3D printed tissues 	<ul style="list-style-type: none"> • Analytics for patient pop. segmentation • Genomics to ID patients (eg MSI high) • Circulating disease markers (eg, ctDNA) • Data-driven endpoint design (eg EHRs) • Digital endpoints • In silico trial design • AI on clinical trial data • RWE

Non-exhaustive list

Breakthroughs happen when all the "hurdles" comes down

Example: HCV



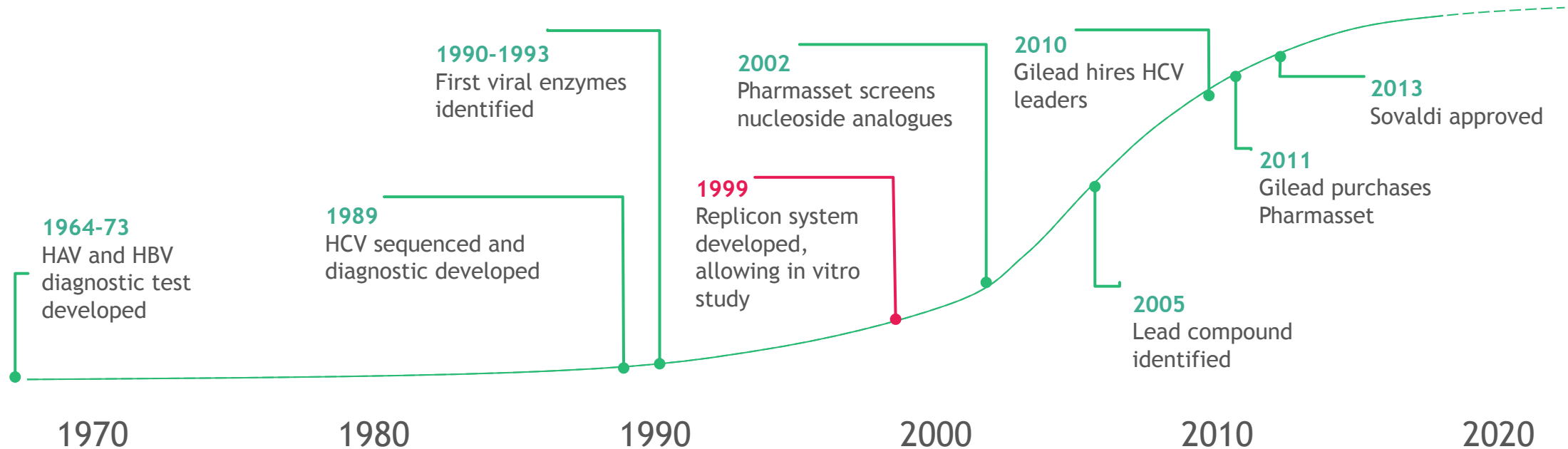
Biology, chemistry and clinical in place... but no translational model



Replicon model enabled HCV screening

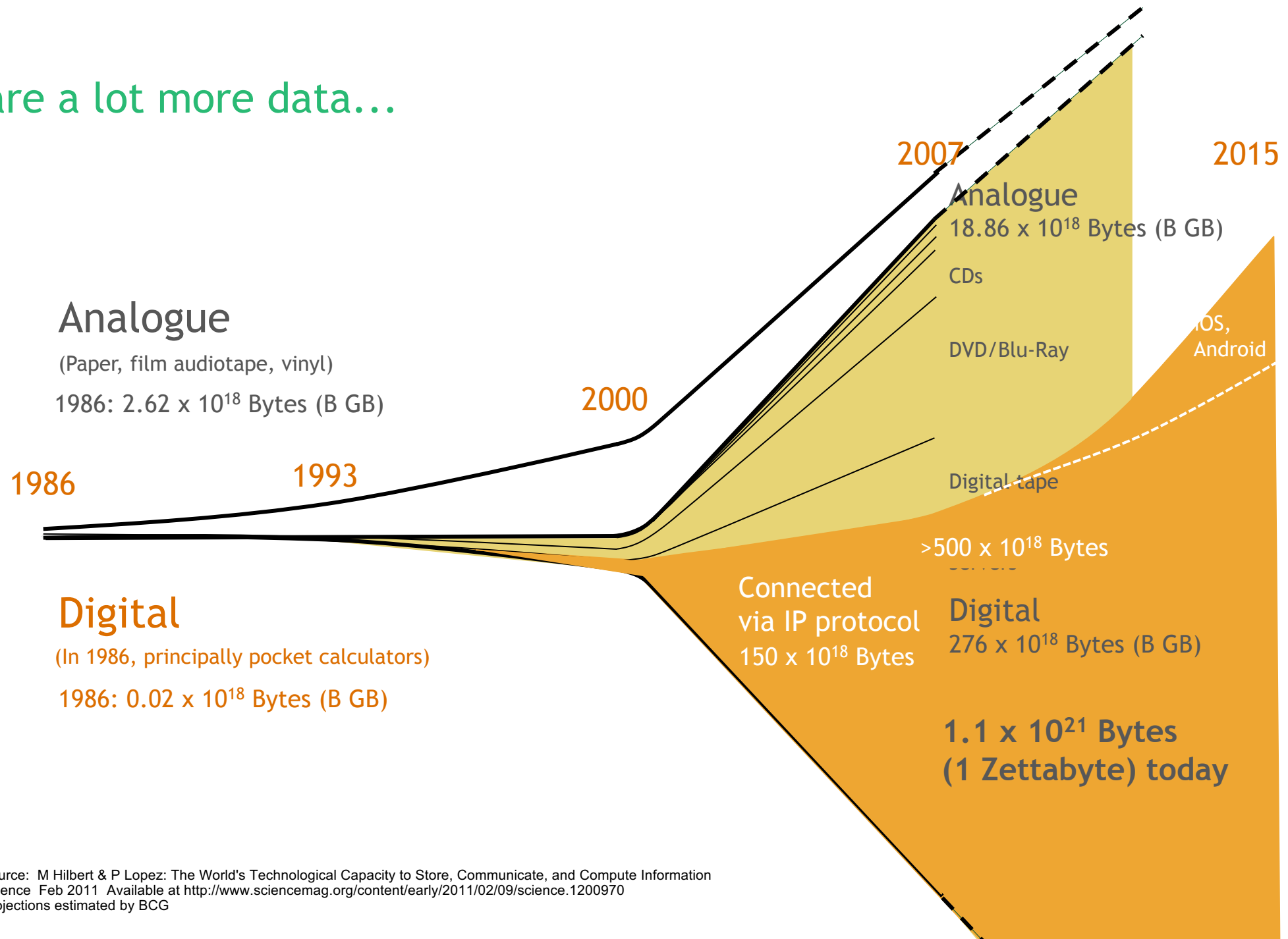


Rapid screening to approval of Sovaldi



Is digital going to bring down multiple hurdles across multiple DAs?

There are a lot more data...



...and a lot more computing power

Performance (GFlop/s)

1,000,000,000

800,000,000

600,000,000

400,000,000

200,000,000

0

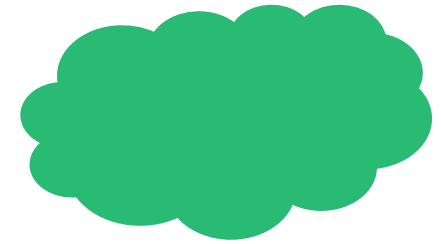
1995

2000

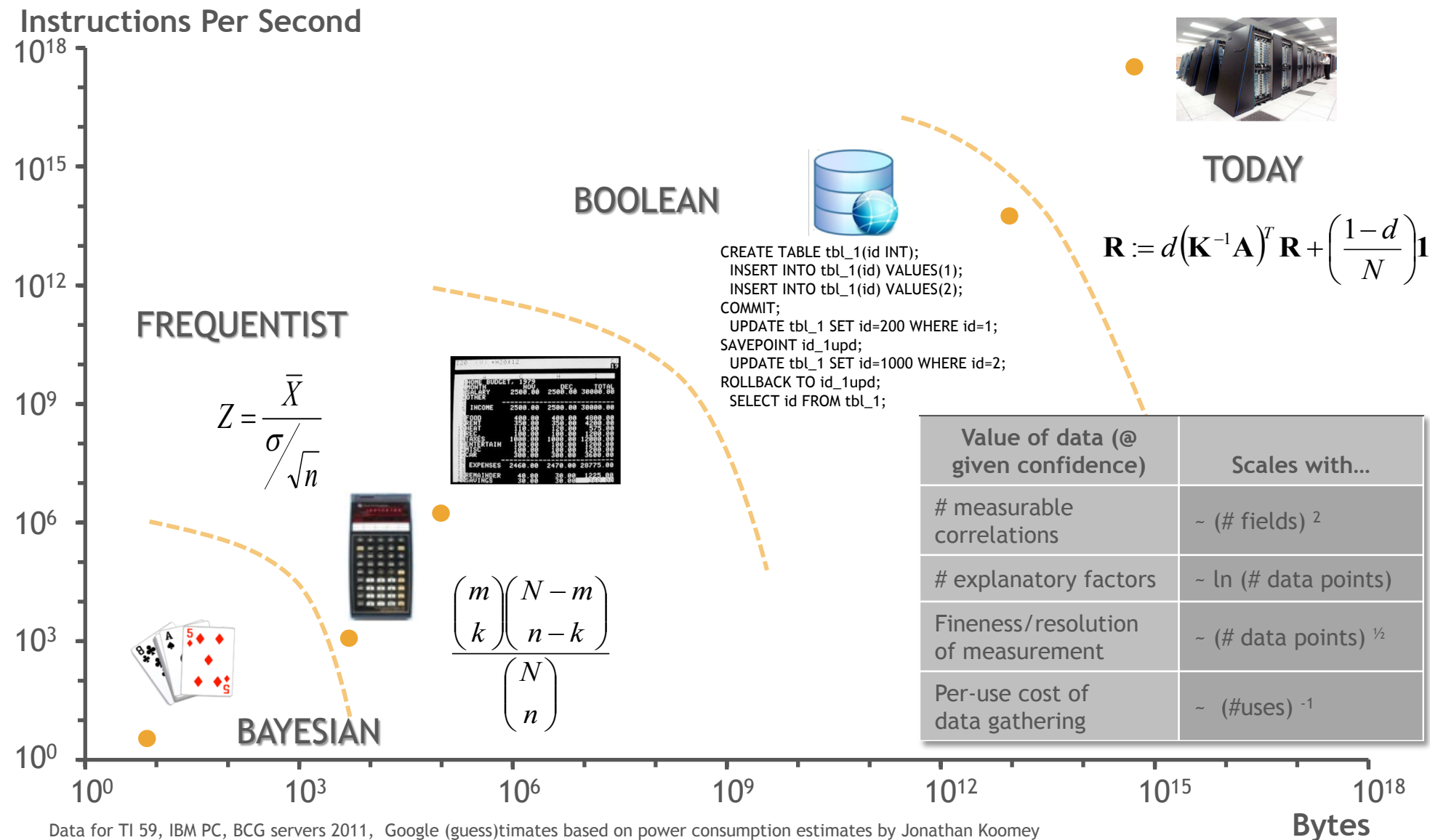
2005

2010

2015

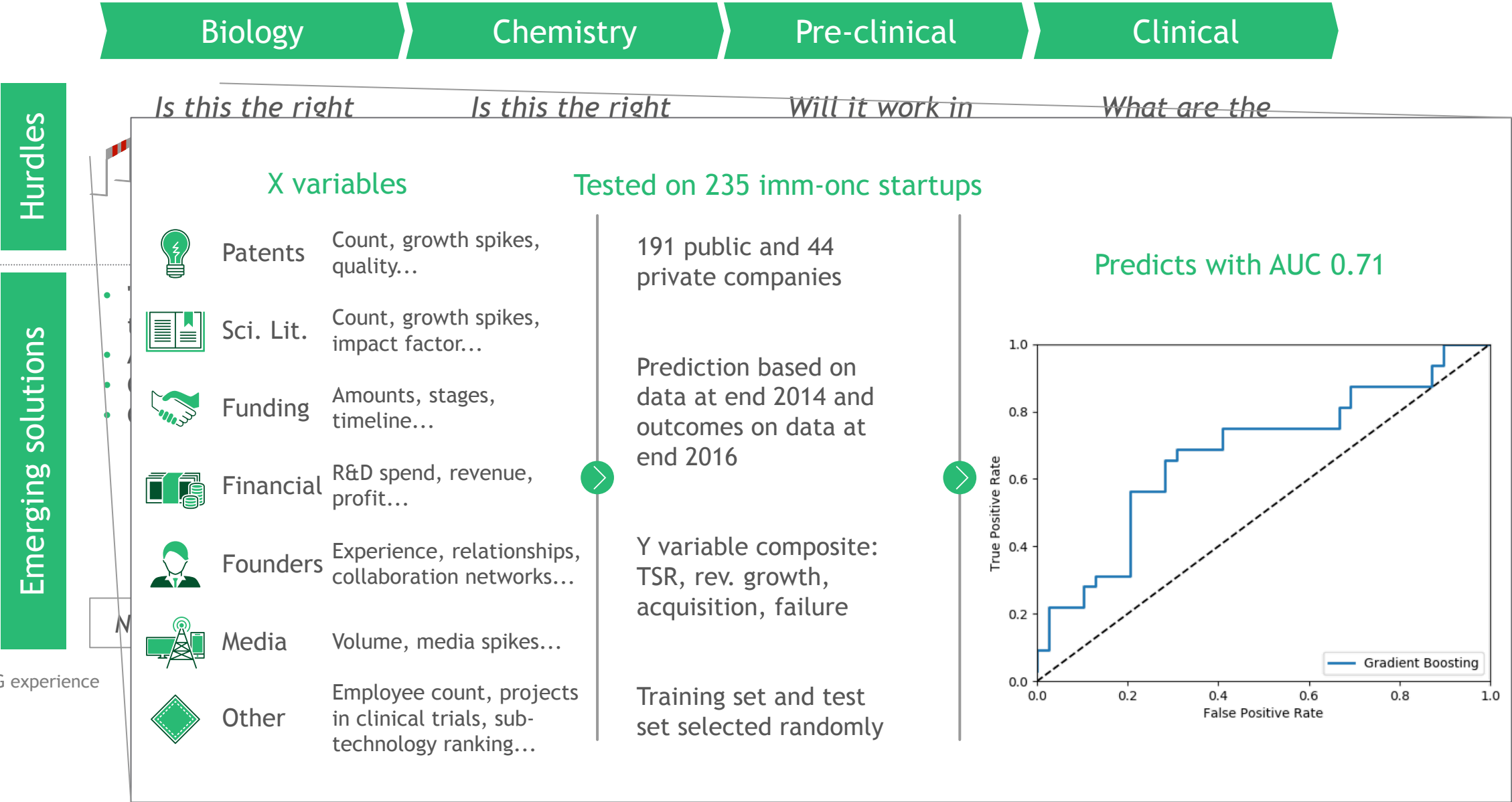


Putting those together



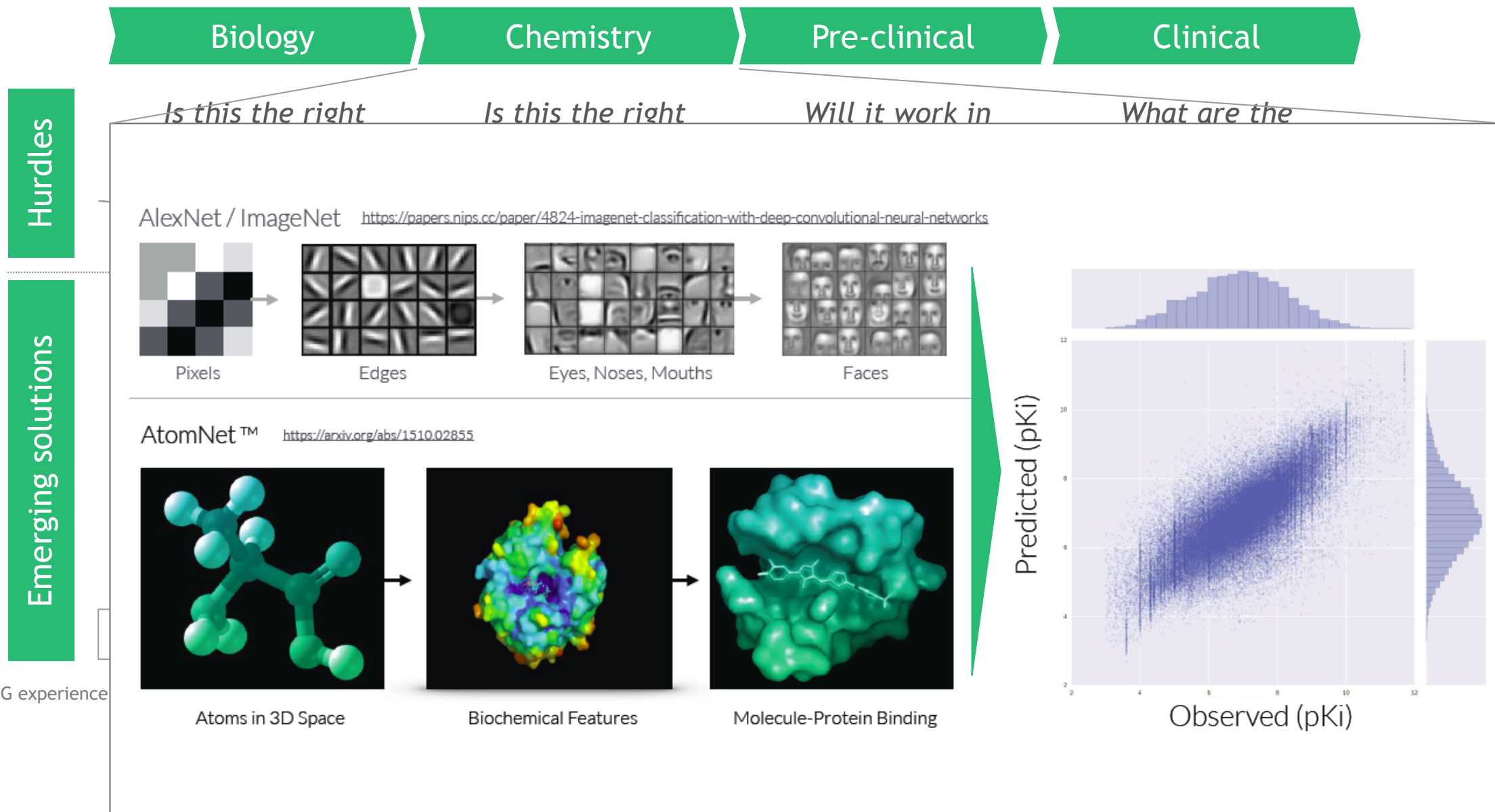
Data for TI 59, IBM PC, BCG servers 2011, Google (guess)timates based on power consumption estimates by Jonathan Koomey
<http://iopscience.iop.org/1748-9326/3/3/034008>. BCG analysis

BCG machine learning model predicts company success



Source: BCG experience

Chemistry treated like computer vision



Source: BCG experience

For discussion:

What is real and what is over-hyped?

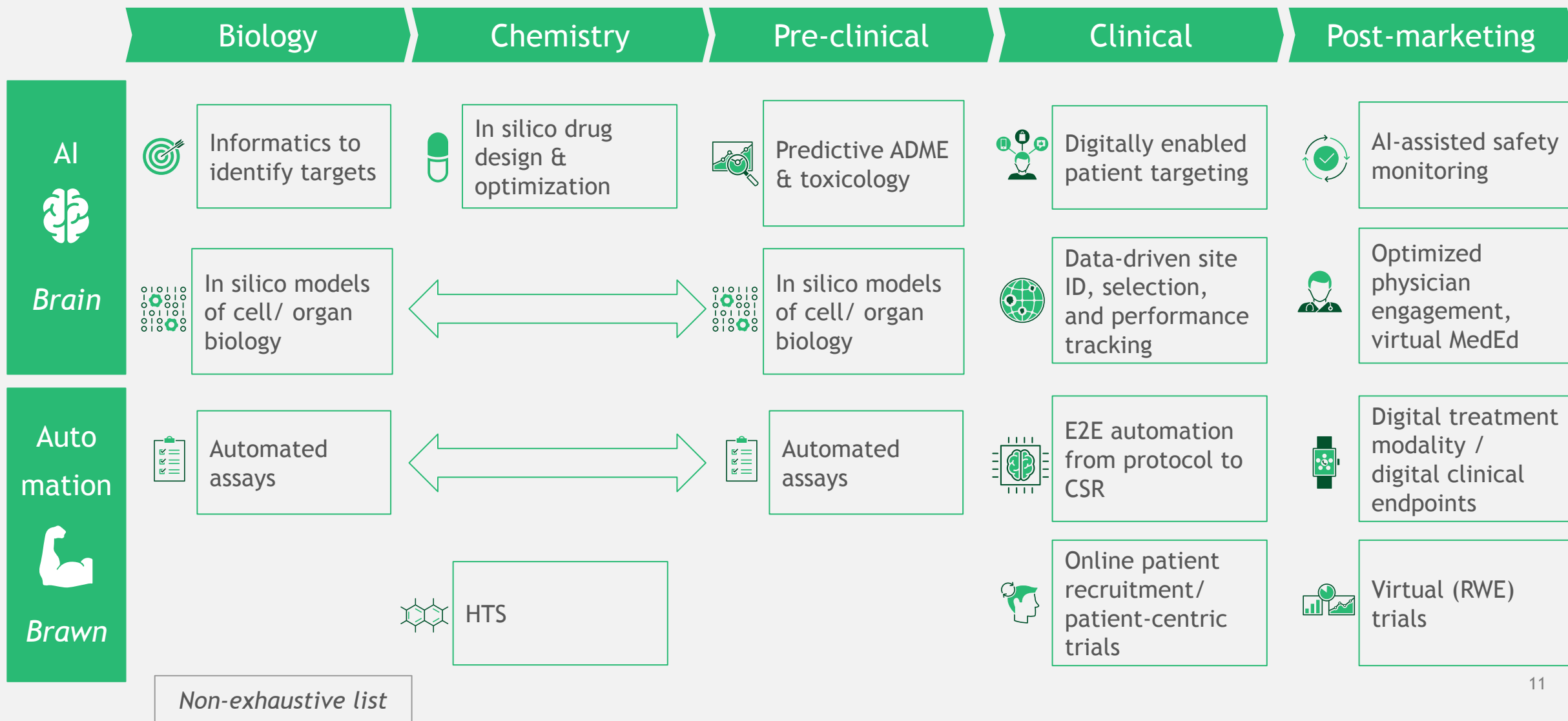
What has the most potential for long-term impact?

What are the best near-term opportunities?

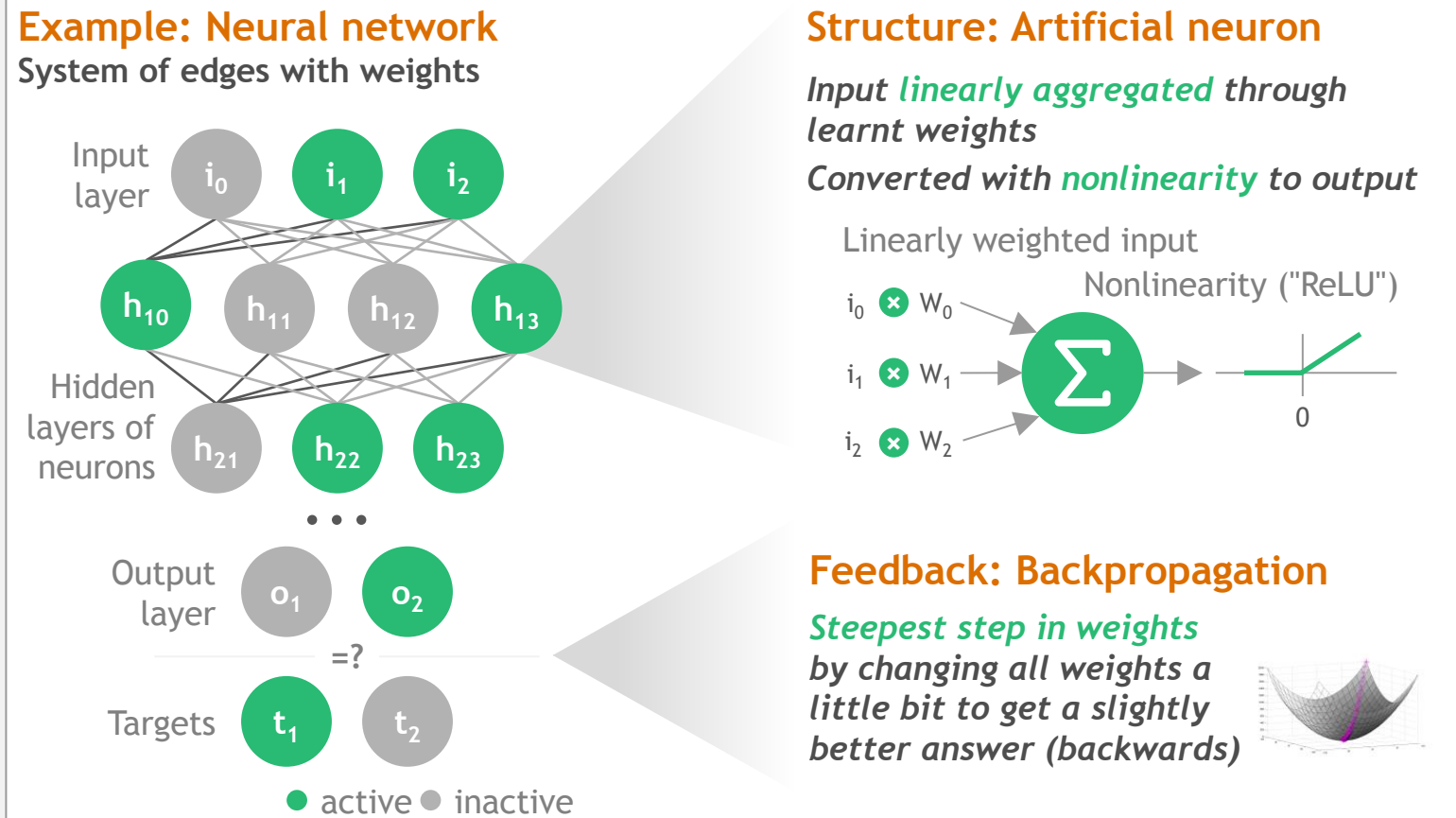
What are the constraints (data availability, privacy, etc.) and how should they be addressed?

What are the risks (cost, reputation, error, etc.) and how should they be managed?

Thought-starters for potential R&D opportunities

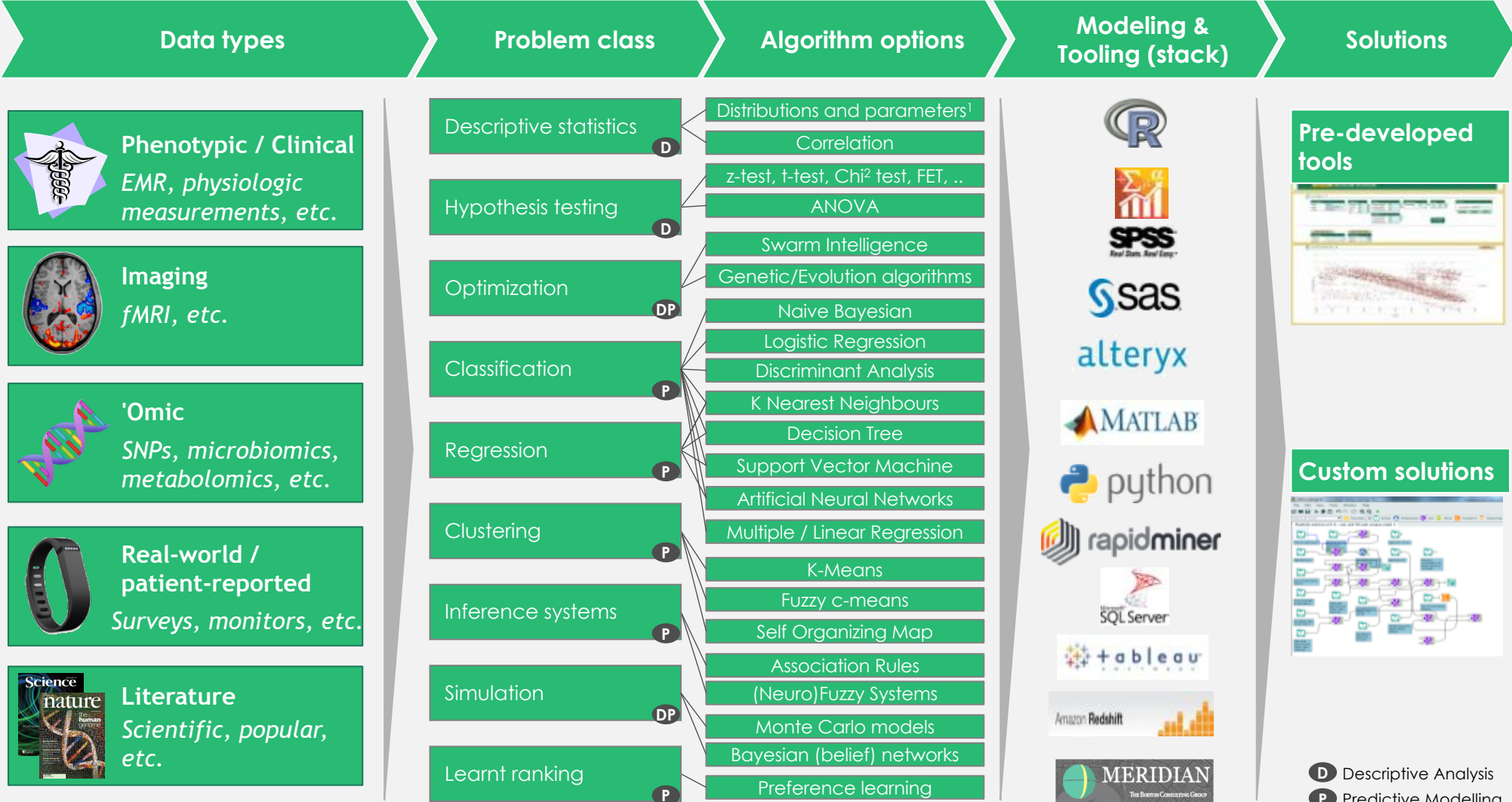


Just a big nonlinear regression...



Value heavily dependent on the training set

...with a lot of variants



Note: Lists of methodologies and tools are not exhaustive