SYNTHACE

SOFTWARE TO INCREASE THE USE OF AUTOMATION IN LIFE SCIENCES

Spring 2019 Allotrope™ Connect Meeting

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INTRODUCTION

People: 55

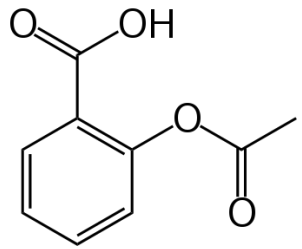
Location: Central London & USA (Q2 2019)

History:

Funding: $44m raised to date

CHALLENGE: EVER INCREASING BIOLOGICAL COMPLEXITY

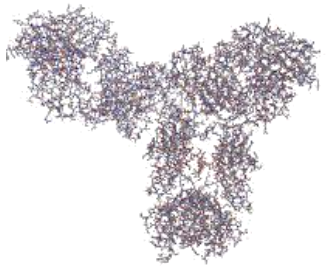
SMALL MOLECULES



Aspirin

21 atoms

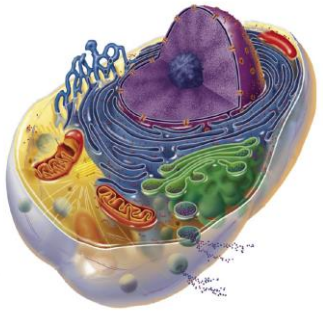
BIOLOGICS



Humira

20,067 atoms

CELL & GENE THERAPY



Human cell

10^{14} atoms

CHALLENGE: EVER INCREASING BIOLOGICAL COMPLEXITY

English Representation of Biological Processes

+

Manual Execution

+

Artisanal Insight

NOT FIT FOR PURPOSE

…. Eroom's Law….

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A NEW WAY OF WORKING: COMPUTER AIDED BIOLOGY

A way of working, reliant upon Automation and Analytics

Digital Representation of Biological Processes

+

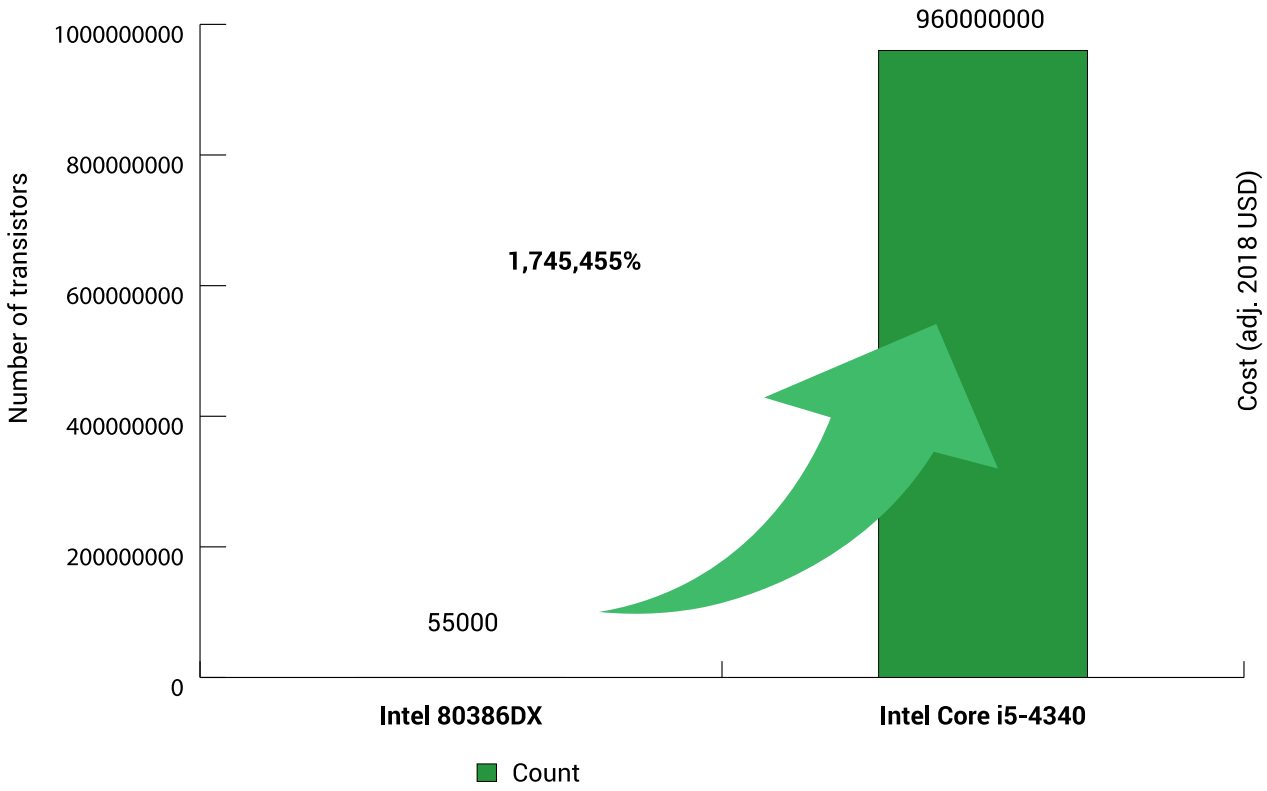
Connected Automation & Data Capture

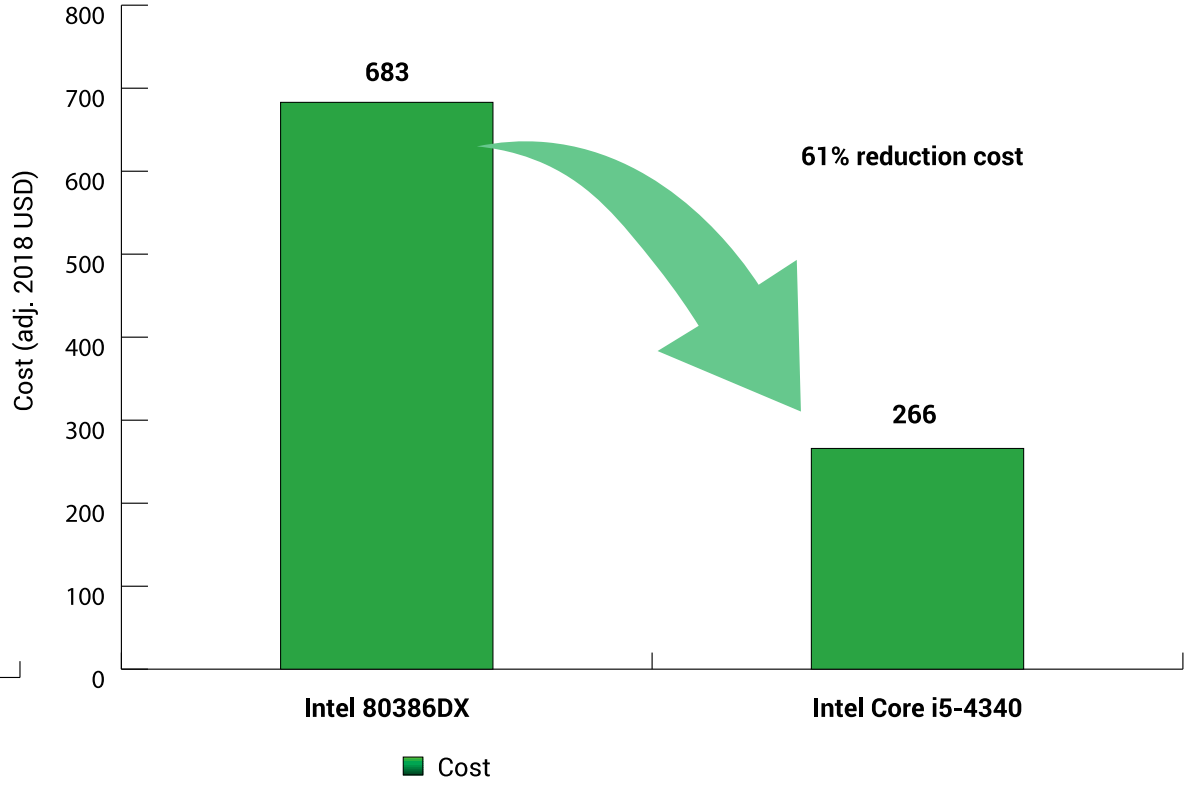
+

Active Learning

BASIC CONCEPT – MANUAL TO AUTOMATED

OTHER INDUSTRIES HAVE REDUCED COST WHILST DELIVERING AN INCREASINGLY COMPLEX PRODUCT





Electronic Design Automation tools comprised of abstracted design and simulation allowed for the rapid design, testing and production of increasingly complex integrated circuits; in part leading to Moore's Law

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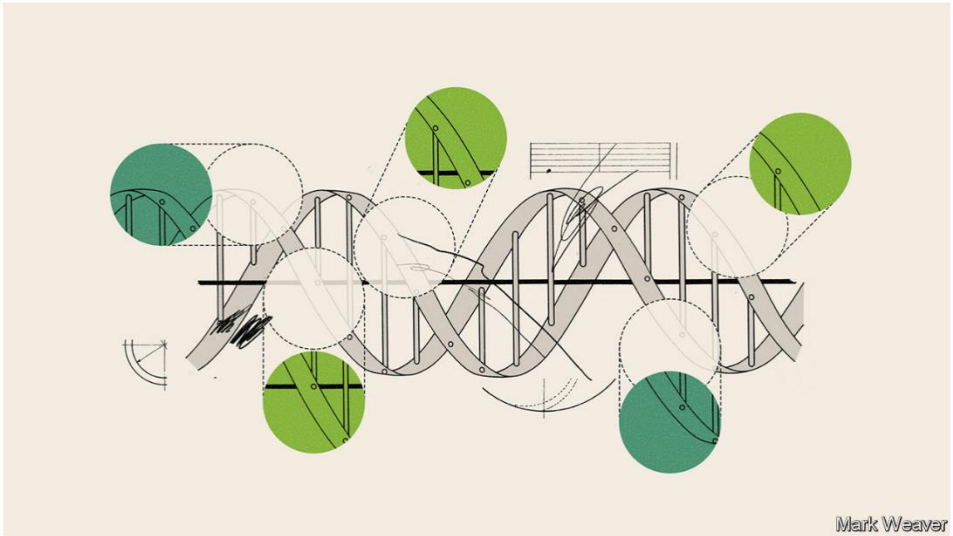
A GROWING INTEREST IN AUTOMATING BIOLOGY

The Economist Topics Current edition More

Automation

Remaking life means automating biology

Synthesised DNA enables doing biology on an industrial scale



Print edition | Technology Quarterly ›

Apr 4th 2019

Biotech + Add to myFT

Microsoft moves into biological computing with Station B

Tech giant rolls out new system to analyse vast volumes of biomedical data

A scientist at work in Oxford BioMedica's main facility in the UK © Jonathan Banks for Microsoft

Clive Cookson in London MARCH 12, 2019 5

Microsoft will make a big move into biotechnology on Tuesday with the launch of a new research system that enables scientists to engineer living cells using machine learning and data analysis.

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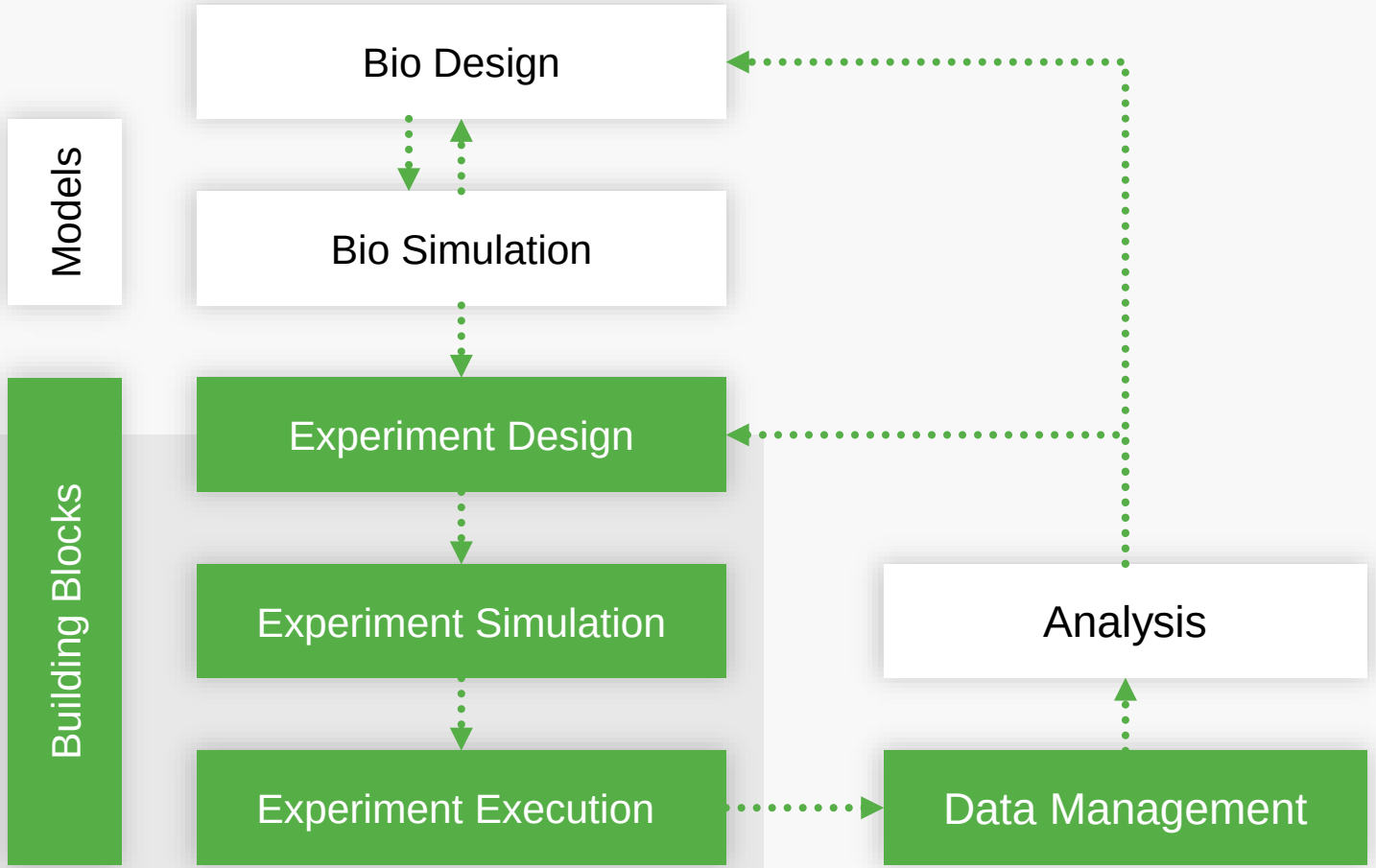
COMPUTER AIDED BIOLOGY: A NEW WAY OF WORKING

DIGITAL

Powered by AI

PHYSICAL

Powered by Automation



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COMPUTER AIDED BIOLOGY: AN EMERGING ECOSYSTEM

DIGITAL

Powered by AI

PHY

Powe
Auto

Synthace key differentiator

Interoperable methods across equipment

The prerequisite for a universal platform

Models

Building Blocks

Benchling | Asimov | Synthego

Bio Design

Autodesk | Teselagen

Arzeda | Cyrus Biotechnology | Silicolife

Bio Simulation

ATUM | Labgenius

Stat-Ease | SAS Institute

Experiment Design

Experiment Simulation

Experiment Execution

Internal efforts to close the loop

Zymergen

Ginkgo

Insitro

Recursion

~~Interoperability~~

Genedata | Aigenpulse

Exputec | Indigo Bioautomation

Analysis

TIBCO | Titian | Palantir

Bigfinite | Dassault Systèmes

Data Management

Riffyn | Tetrascience

Transcriptic | High Res Biosolutions | Elemental Machines | Core Informatics (Thermo)

PAA Automation | Emerald Cloud Labs | PerkinElmer | IBDS

Agilent | GE/Danaher | Camunda

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(a selection focused on Large Molecule/CGT vendors)

WE USE CAB TO TEST OUR OWN SOFTWARE

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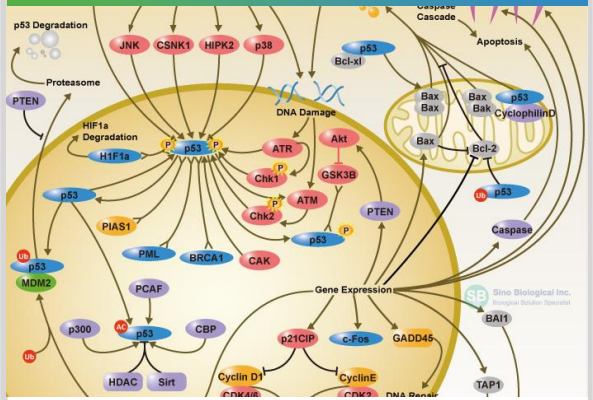
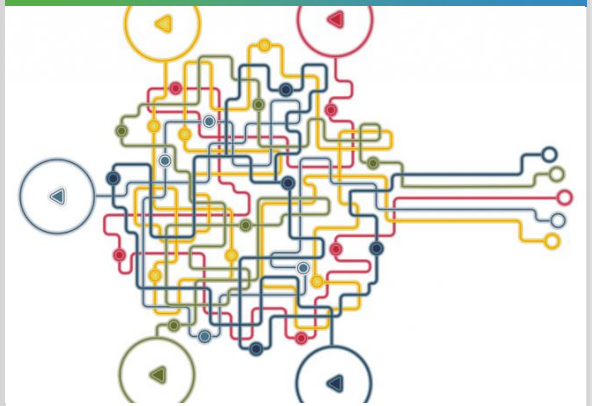
WHY THE DIGITAL TO PHYSICAL TRANSITION IN CAB IS KEY?

COMPLEXITY



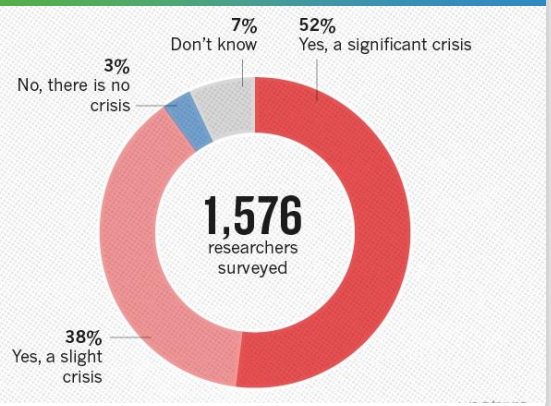
Complex biology leads to complex experimentation

TRACEABILITY



Tracing and provenance is necessary for hundreds of experiments

REPRODUCIBILITY



Digitally encoded protocols means better reproducibility

TRANSFERABILITY

Digitally encoded protocols reduces learning time

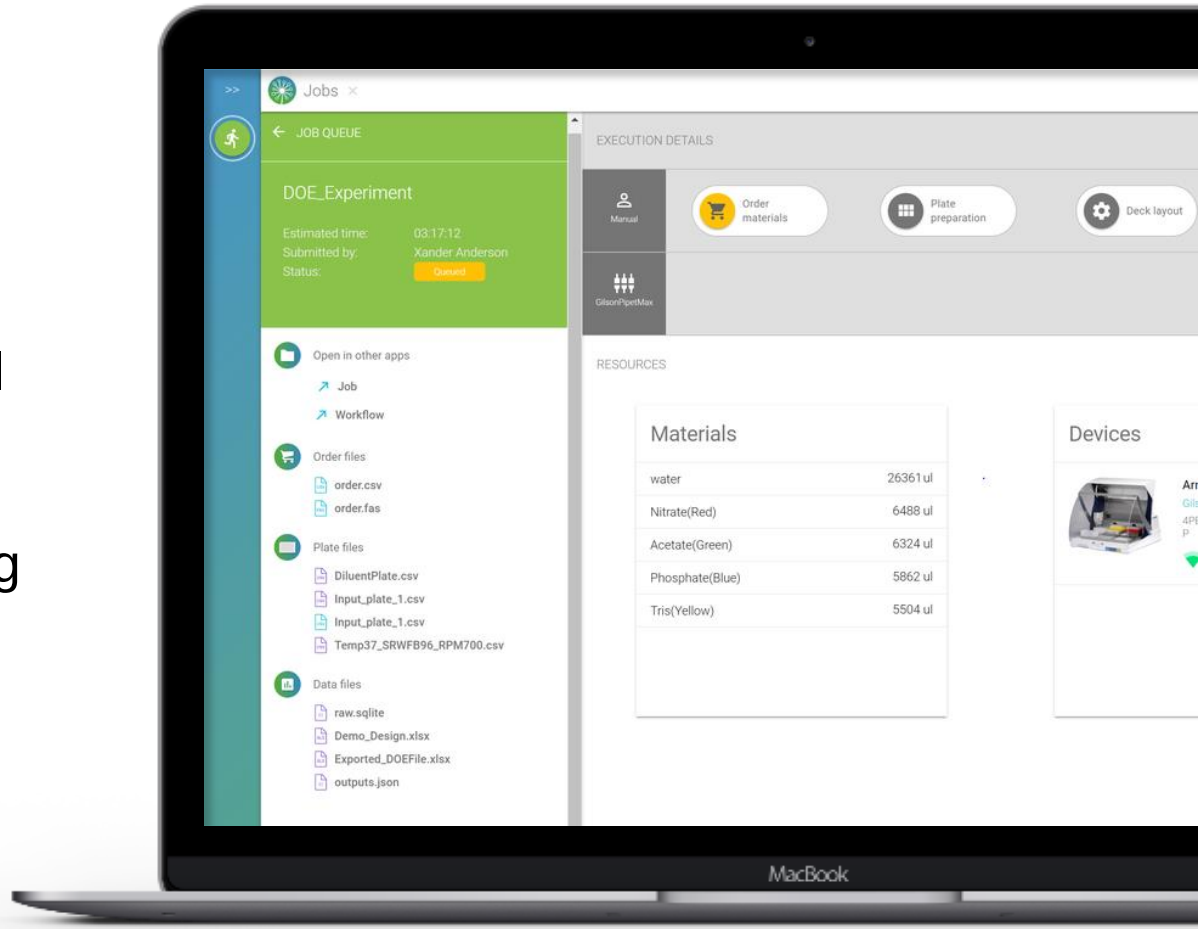
Case studies…

OUR PLATFORM

antha

A software platform for interoperable experimental execution and data integration.

Built with a high-level language for biology, making it easy to rapidly compose and execute reproducible workflows using individually testable and reusable Antha Elements



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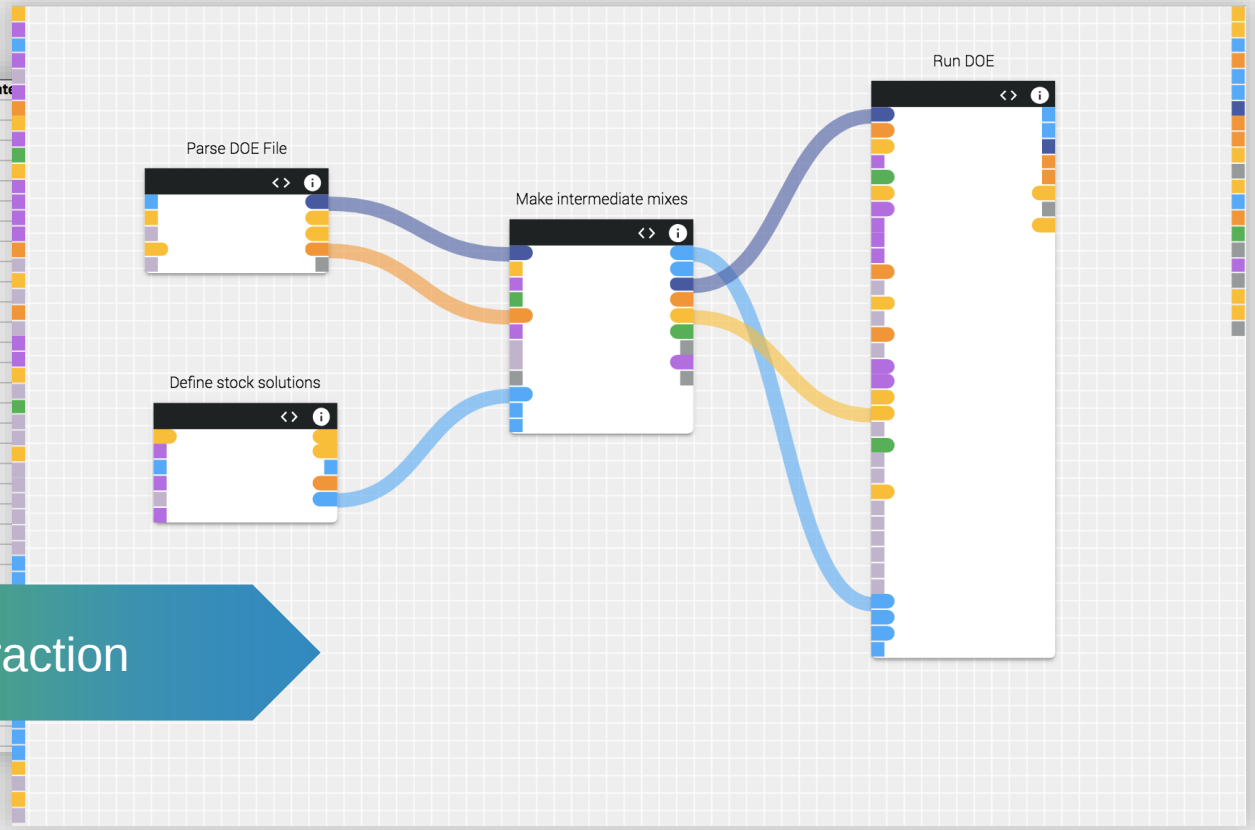
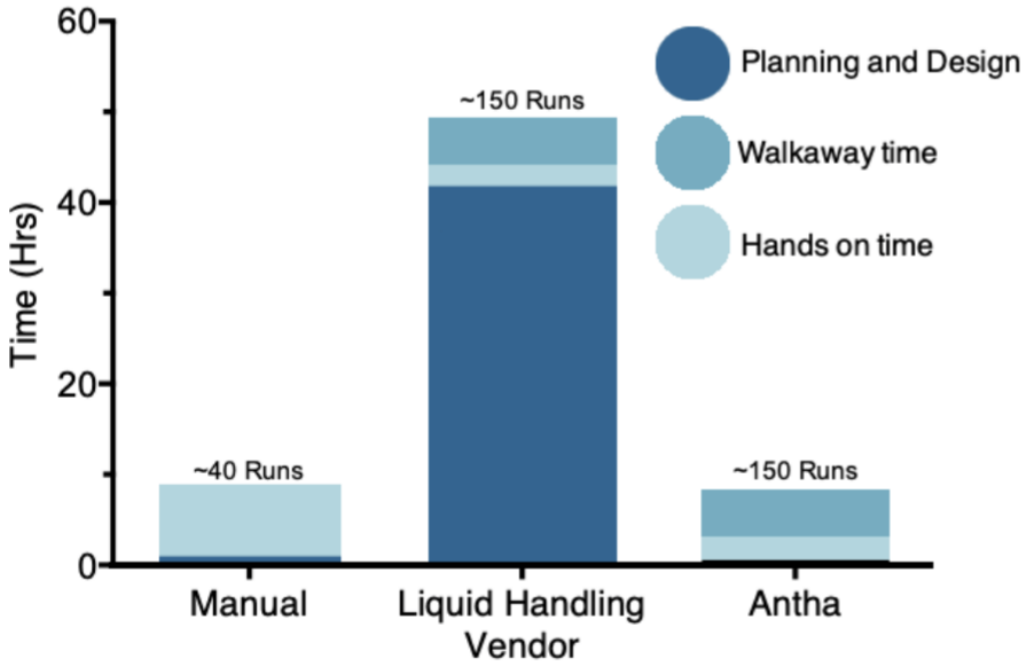
CASE STUDY: ABSTRACTED DESIGN OF EXPERIMENTS AUTOMATION

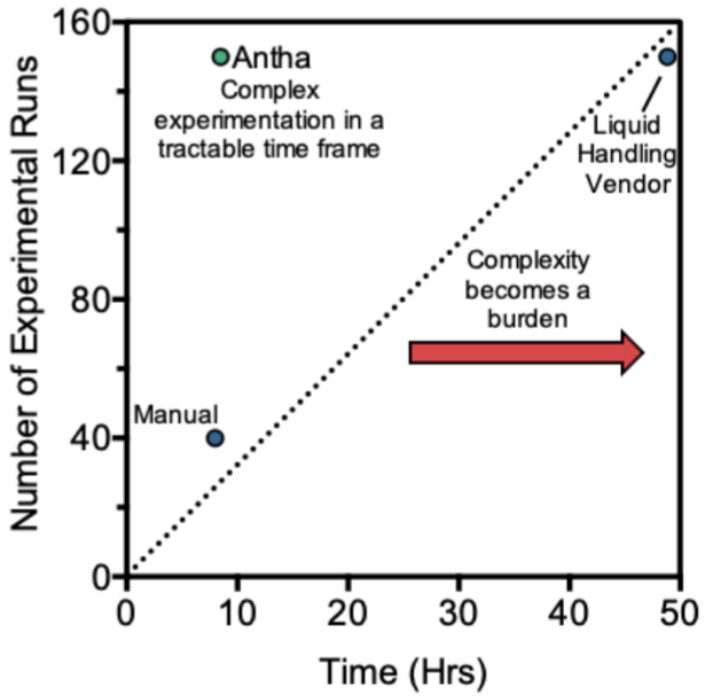
1 MOPS pH 7 (mM)	Glucose (g/L)	Magnesium Sulphate (mM)	Ferric Chloride (uM)	ACE METALS (mM) (1e6X Tim	ino Acid Supp (mM) (50X Tim	Ammonium Sulphat
55	5	1	100	0.1	0.1	
55	10	1	100	0.1	1	
110	10	5	10	0.1	0.1	
55	10	5	10	1	1	
55	5	1	10	0.1	1	
55	5	1	10	1	0.1	
55	10	5	10	0.1	0.1	
55	5	5	100	1	0.1	
110	10	5	10	0.1	1	
55	10	1	100	0.1	1	
110	5	1	10	1	1	
110	10	1	100	0.1	1	
110	10	1	100	1	0.1	
110	10	5	10	1	0.1	
55	10	1	100	0.1	1	
110	5	1	100	1	0.1	
110	10	1	10	0.1	0.1	
110	5	1	10	0.1	1	
110	5	1	10	0.1	1	
110	5	1	10	0.1	1	
110	10	1	10	0.1	0.1	
110	10	5	100	0.1	0.1	
55	5	1	10	1	0.1	
110	5	5	10	0.1	0.1	
110	10	5	100	1		
55	5	5	10	1		
110	5	1	10	1		
110	5	1	100	0.1		
55	10	1	10	0.1		
110	10	1	100	0.1		
110	10	1	10	1		
55	5	1	100	0.1	1	

abstraction



SCIENTIFIC & OPERATIONAL BENEFITS IN DOE WORKFLOWS





Antha enabled the optimization of transfection conditions to give 3-10 fold increase in viral titre, whilst providing 83% time and 32% resource savings.

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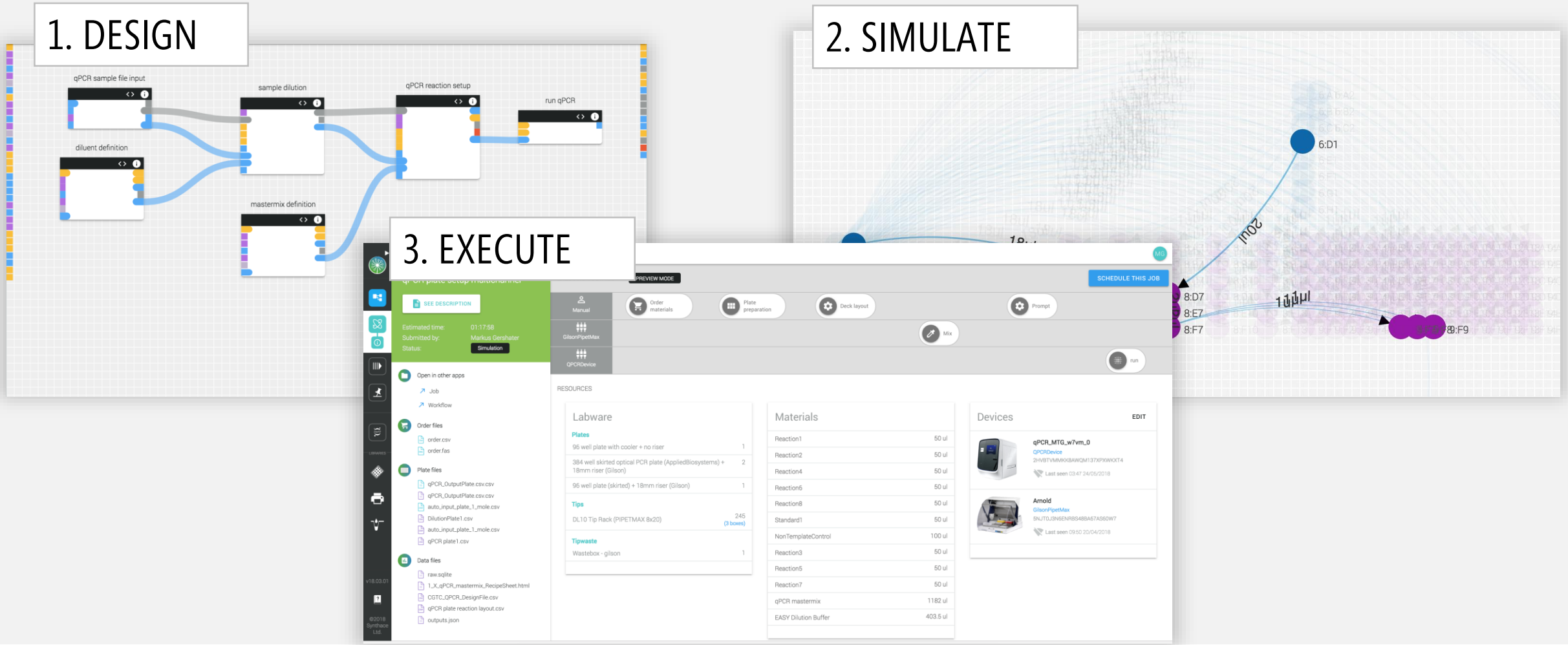
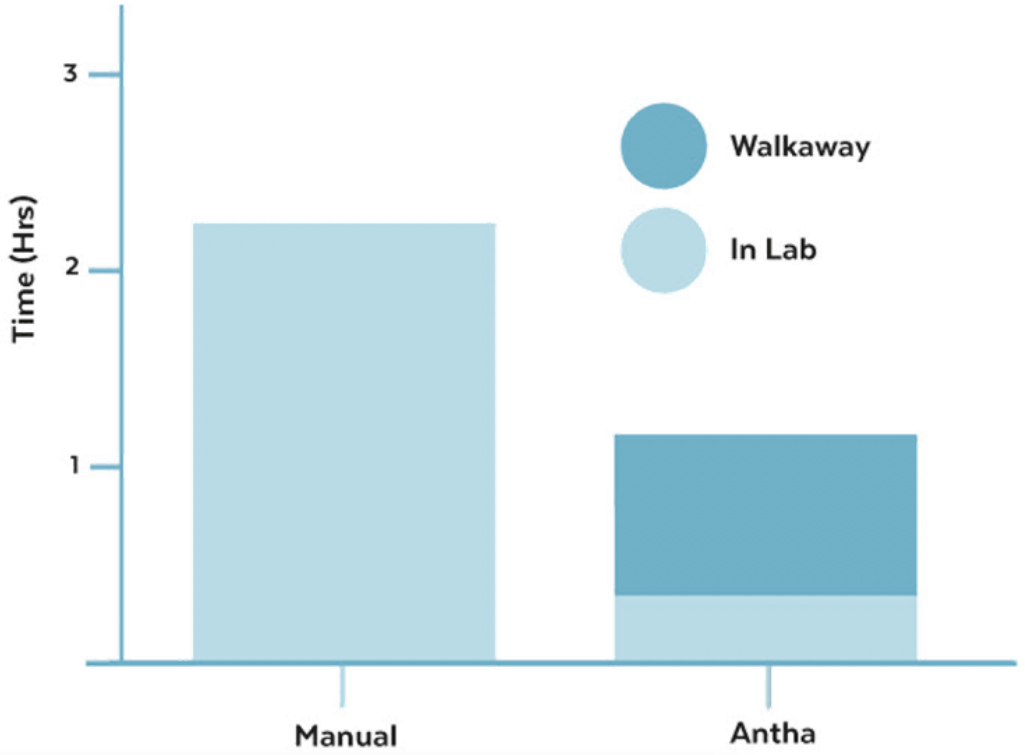
CASE STUDY: QPCR ANALYTICS AUTOMATION



ANALYTICS AUTOMATION EMPOWERS USERS

Set up time per 384 well plate (mins)				
	Manual Process		Antha Automated Process	
Workflow Step	In Lab	Walk Away	In Lab	Walk Away
qPCR master mix preperation	10	-	10	-
Set up robotdeck	-	-	5	-
Robot tip refill	-	-	5	-
Liquid Handling	120	-	-	45
Set up qPCR thermocycling	5	-	5	-
qPCR thermocycling	-	50	-	50
Total Time	135	50	25	95
Total Time to Data Output	185		120	



This workflow is now scalable to allow extensive testing in realistic timelines, increasing throughput by 50%. The resulting data generated is highly reliable and reproducible whilst improving cross contamination control.

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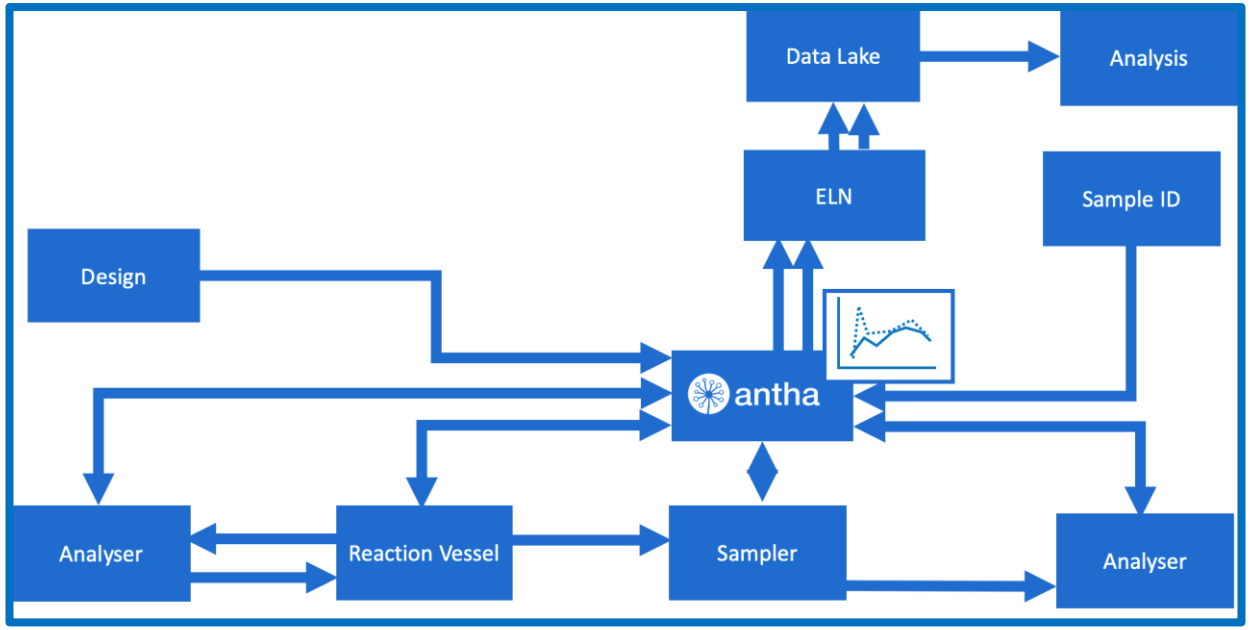
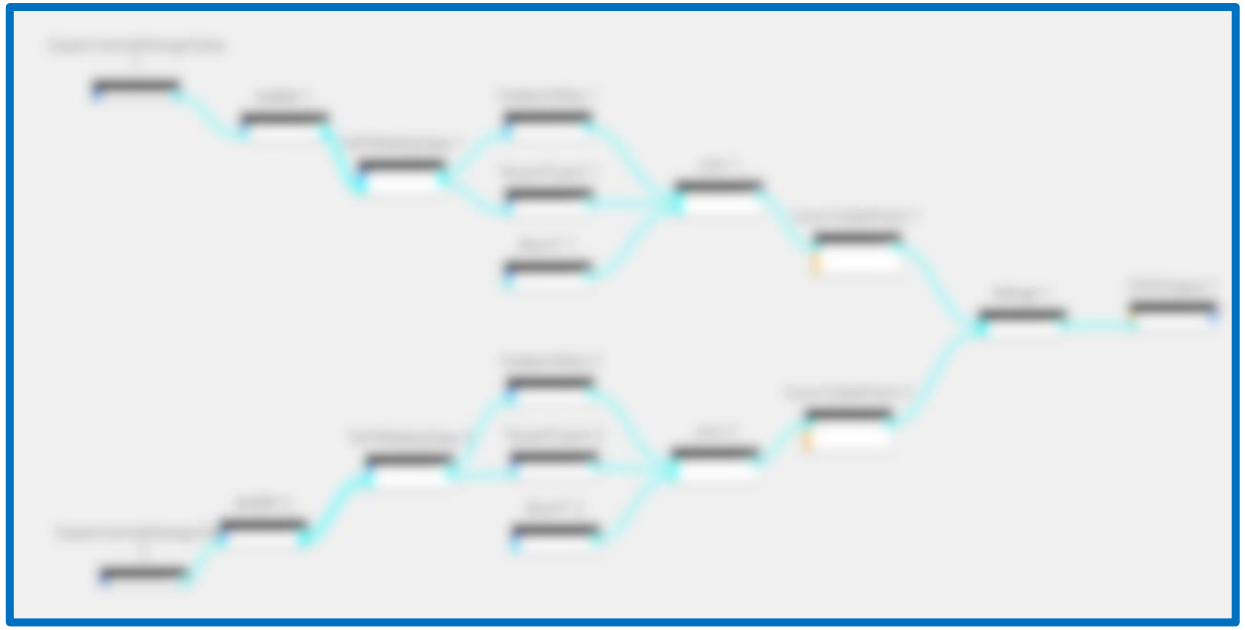
FROM UNIT OPERATIONS TO END TO END MODULAR AUTOMATION





Conclusions..

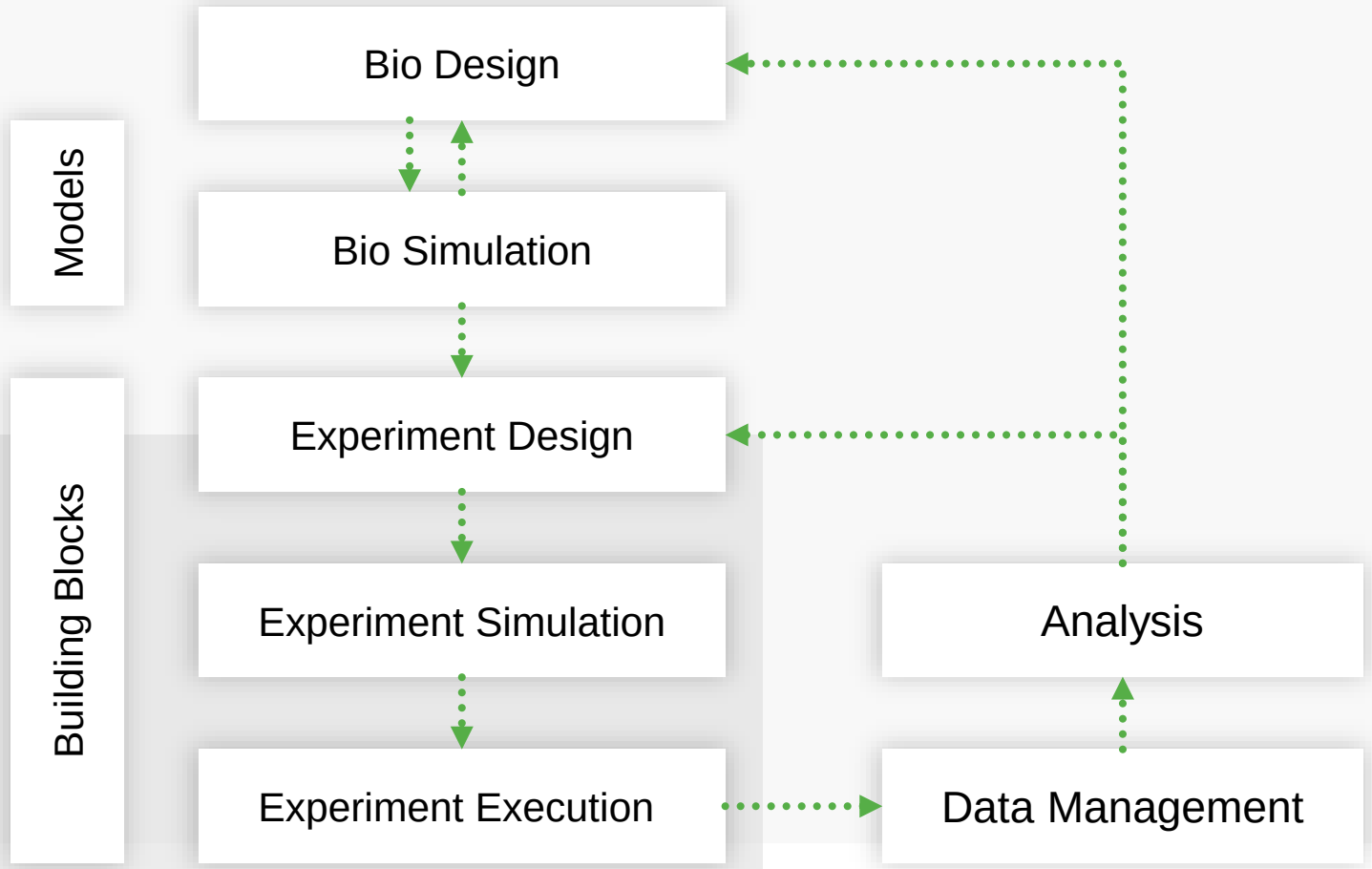
AN ECOSYSTEM OF PLAYERS…. COLLABORATION IS KEY

DIGITAL

Powered by AI

PHYSICAL

Powered by Automation



WE WORK WITH PARTNERS ACROSS THE LIFE-SCIENCES ECOSYSTEM

Life science R&D customers

Consultants, **foundations** & integrators

Cloud providers

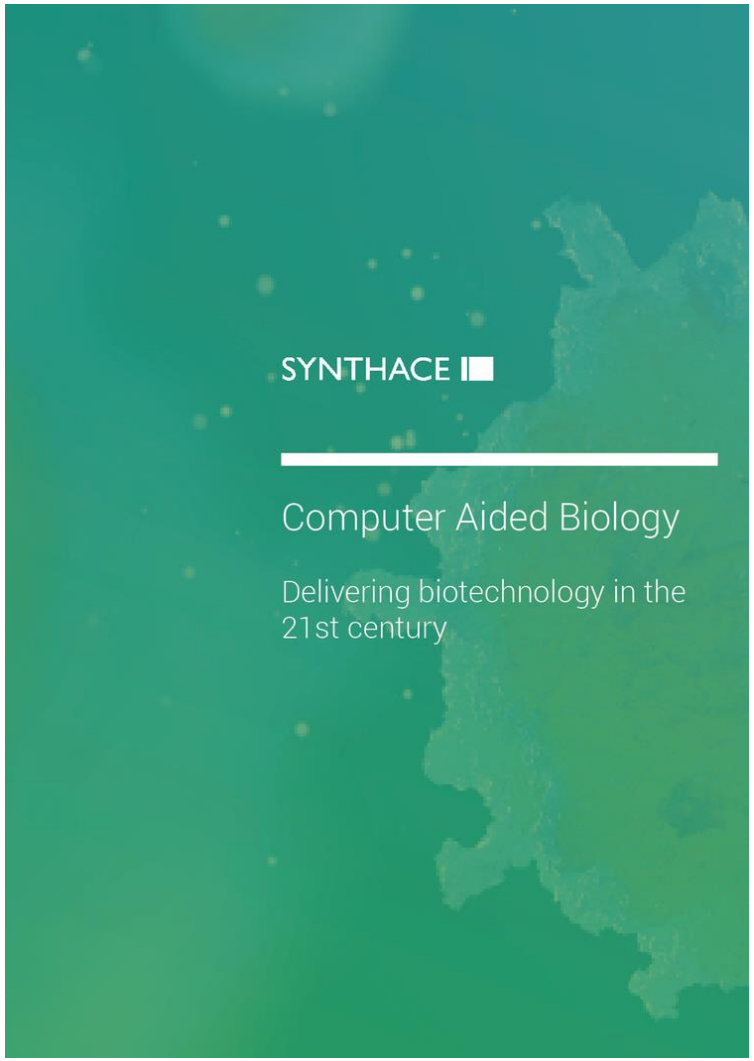
Equipment manufactures

Reagent & consumable suppliers

Design & analysis software providers

WE ARE LOOKING FORWARD TO WORKING WITH YOU ALL..

- **Focus on Digital to Physical Transition**
- White Paper on CAB >>> see website
- Office Hours/Drinks events in our London Office/LOTF (Biology, Bytes and Beers)
- US Office Q2 2019 (Boston)
- Learning more about standards & networks to see how we can add value to community (Allotrope and Pistoia Members)
- Rapidly expanding internal resource so open to collaboration across ecosystem



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https://synthace.com/computer-aided-biology-whitepaper

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