Olin College of Engineering

Event webpage: https://www.olin.edu/events/scope-summit-2025

Welcome to SCOPE Summit

SCHEDULE OF EVENTS
FRIDAY, MAY 9, 2025

12:30–1:00 PM	**Registration** Milas Hall Lobby
1:00–1:10 PM	**Welcome from Olin Leadership** Norden Auditorium, Milas Hall
1:10–2:15 PM	**Presentations by SCOPE Teams**
2:15–2:30 PM	**Break**
2:30–3:30 PM	**Presentations by SCOPE Teams**
3:30–4:30 PM	**Poster Session & Reception** Milas Hall

This event is being recorded and will be available on the SCOPE webpage.

Scan for today's program

SCOPE SUMMIT 2024-2025

SCOPE
Senior Capstone Projects

Accelerate Wind

Amazon Robotics

Blue Origin

Boston Scientific

Boston University (WISE)

LineVision

MA Dept of Early Education and Care

Microsoft NERD

Moderna

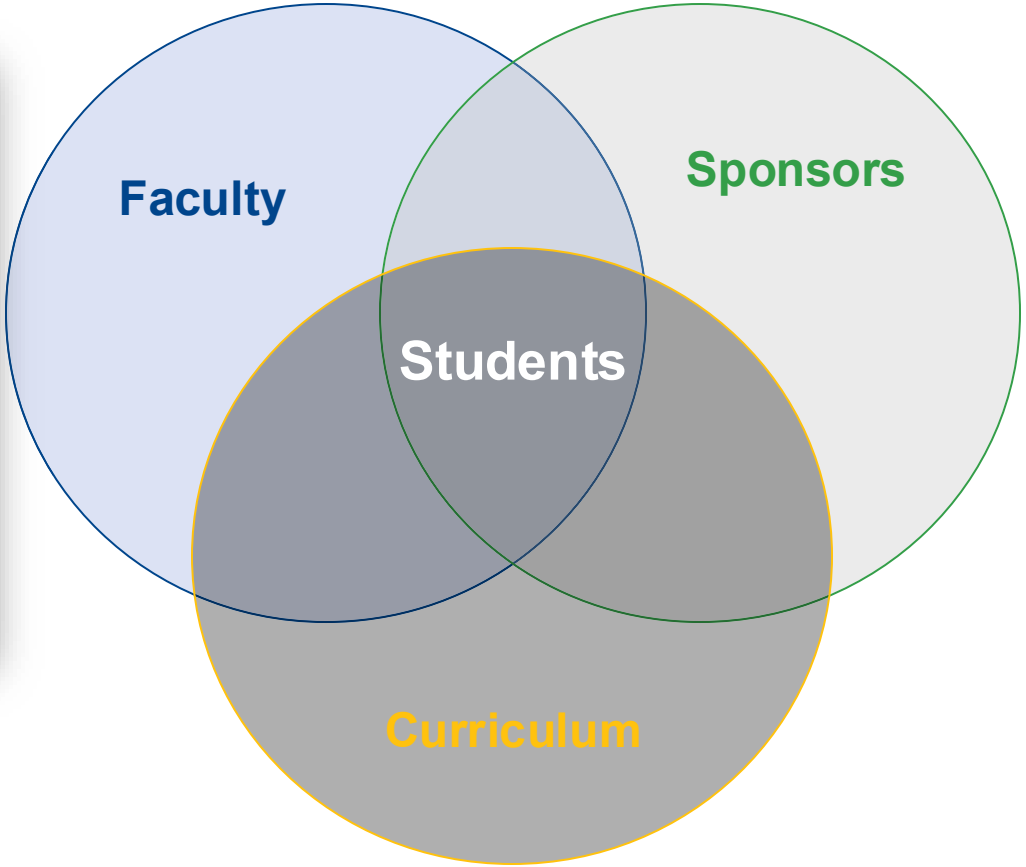
New Balance

Pfizer

Santos Family Foundation / Volpe Center

SCOPE: Senior Capstone Program in Engineering

Accelerate Wind



SCOPE serves both students and sponsors

Microsoft NERD/flok

Compelling and complex real-world projects executed in collaboration with external partners, both:

- Provide opportunities for the **personal and professional development** of our students
- **Create value** for sponsors and for the world

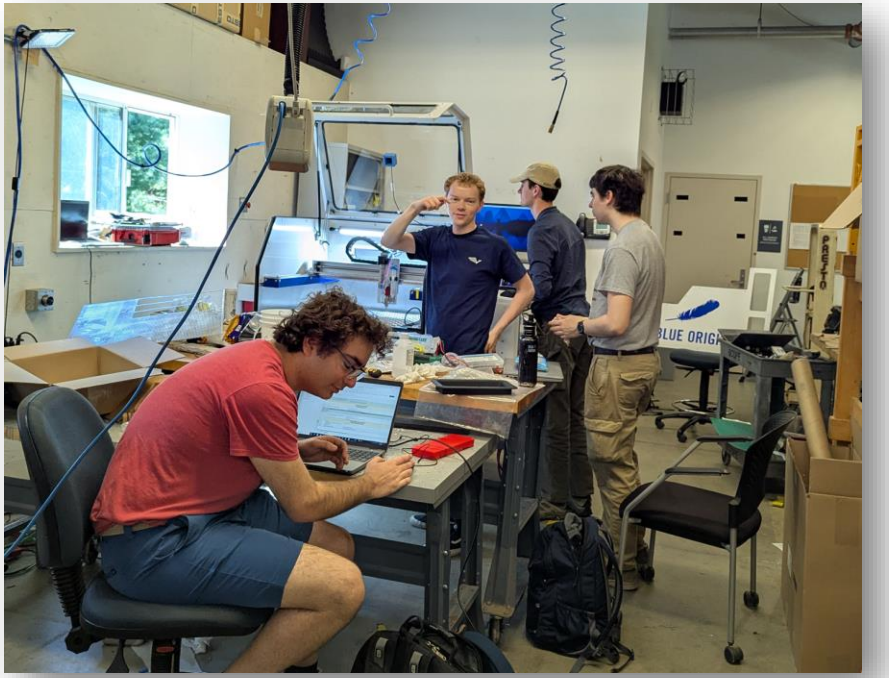
1 Mission critical projects

2 Projects with significant potential value

3 Topics which would be nice to explore

SCOPE projects take many forms

- Exploration of new product directions
- Product enhancements
- Manufacturing challenges
- Improved user experiences

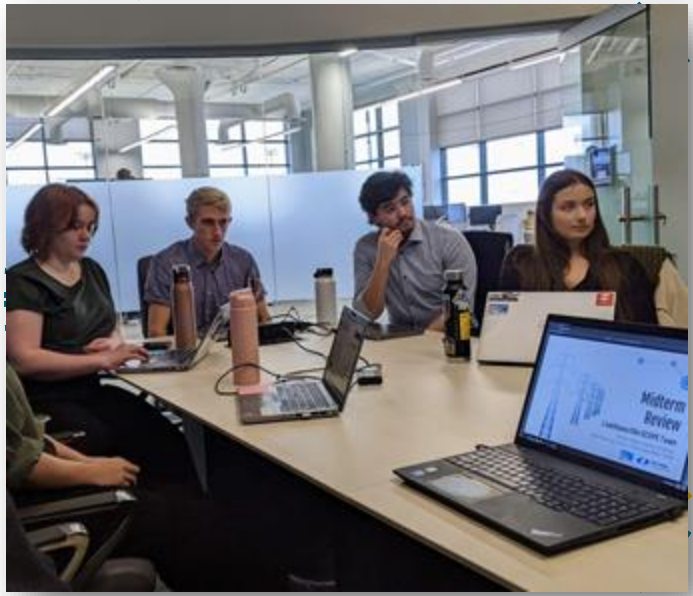


Blue Origin

SCOPE projects take many forms

Every project is very different:

- Disciplinary domain
- Social, technical, and ethical contexts
- Starting point and goal endpoints
- Confidentiality constraints and IP assignments



LineVision

Lawrence Neeley

Alessandra Ferzoco

Jessica McCarthy
Program Director
Lauren Palmer
Biz Dev Director

Sarah Bloomer

Jessica Townsend

Thank you SCOPE team!!

Thank you Subject Matter Experts (SMEs)

Steve Matsumoto

Ben Linder

Amon Millner

Caitrin Lynch

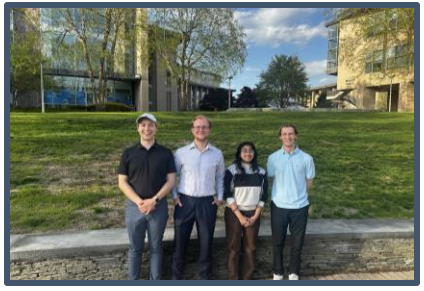
Format for this session

- 13 SCOPE team presentations
- 10-minute break half-way through
- Followed by poster session

Slides and program are available on Summit webpage:
https://www.olin.edu/events/scope-summit-2025

Scan for Program

The 2024-25 SCOPE Projects



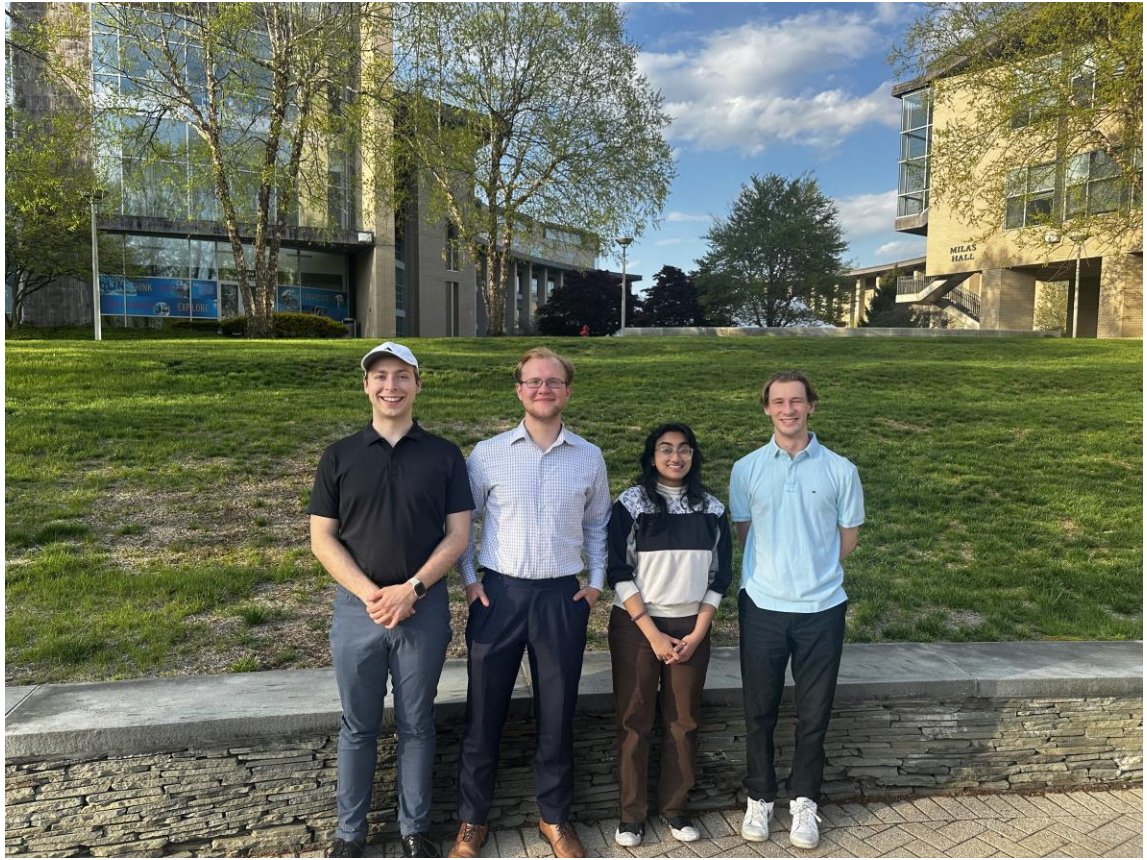
Olin College of Engineering

Accelerate Wind

Accelerate Wind – SCOPE Collaboration May 9, 2025

Installing the Future of Wind:

Enabling on-site deployment of rooftop wind turbines.



Gabe Zak,
Mechanical Engineer

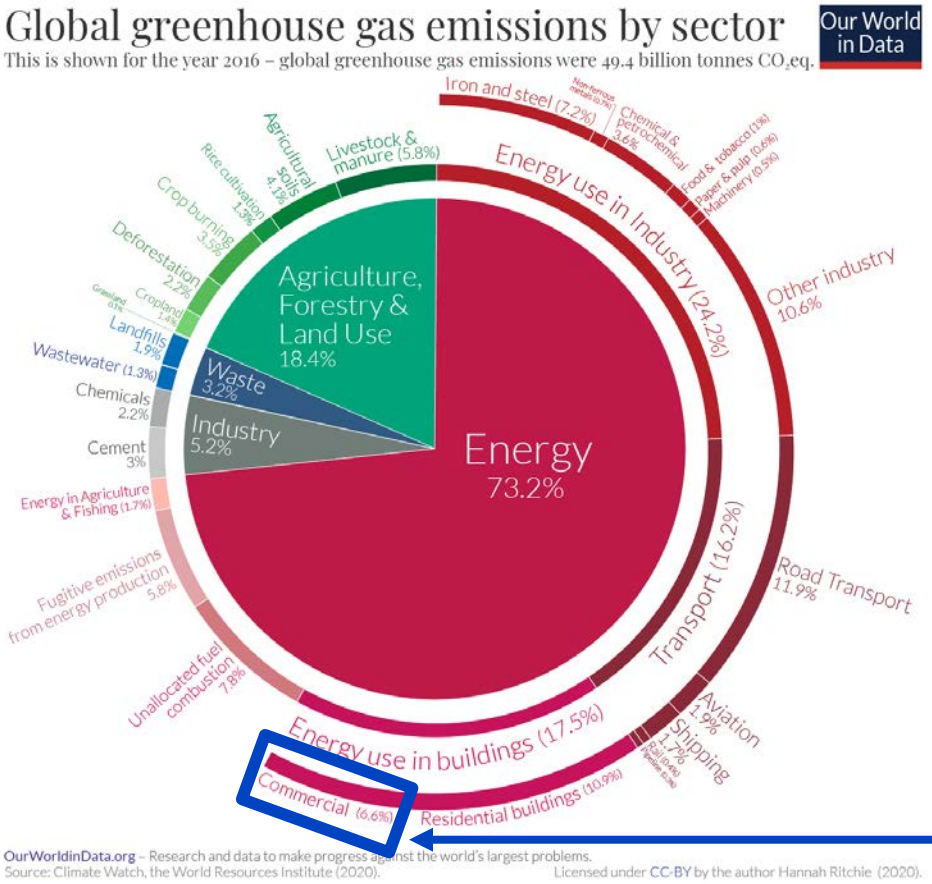
Phillip Post,
Electrical Engineer

Lauren Nalajala,
Mechanical Engineer

James Jagielski,
Electrical Engineer

Our Team

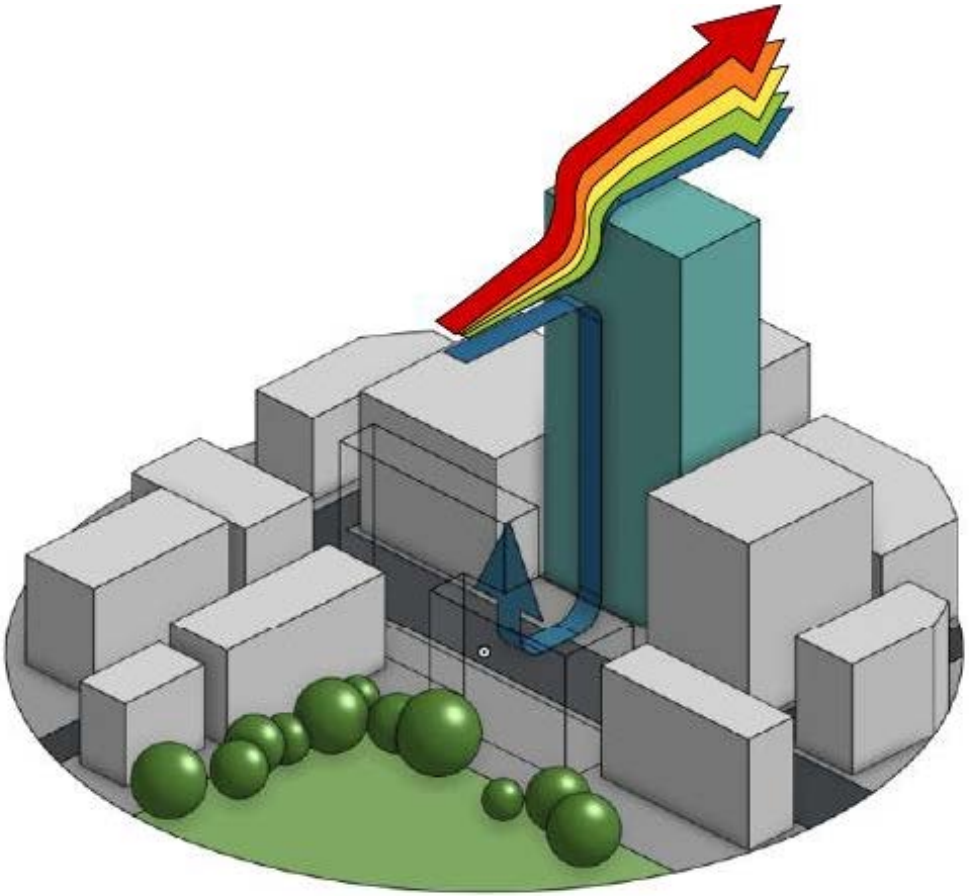
We emit
35 billion tons of CO_2
each year.



As we move towards decarbonizing the built environment, we must address the impact that commercial buildings have on global emissions.

Accelerate Wind's rooftop wind turbines can help decrease commercial building emissions.

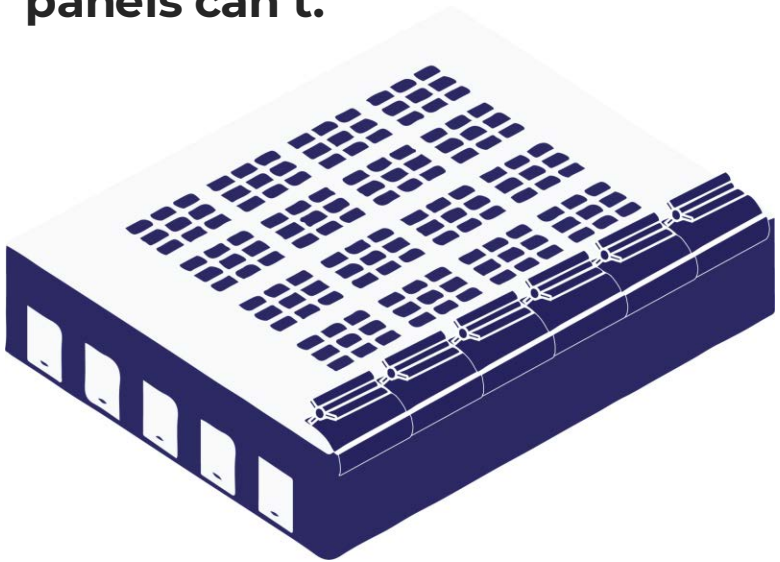
Why an edge-of-roof turbine?



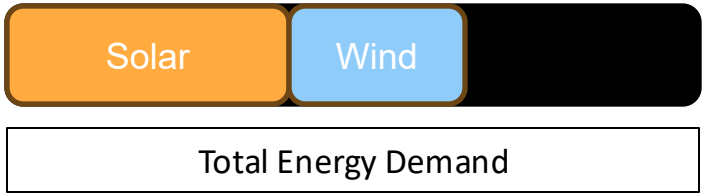
Wind Speeds Up As It Travels Over the Edge of a Building

Wind Complements Solar

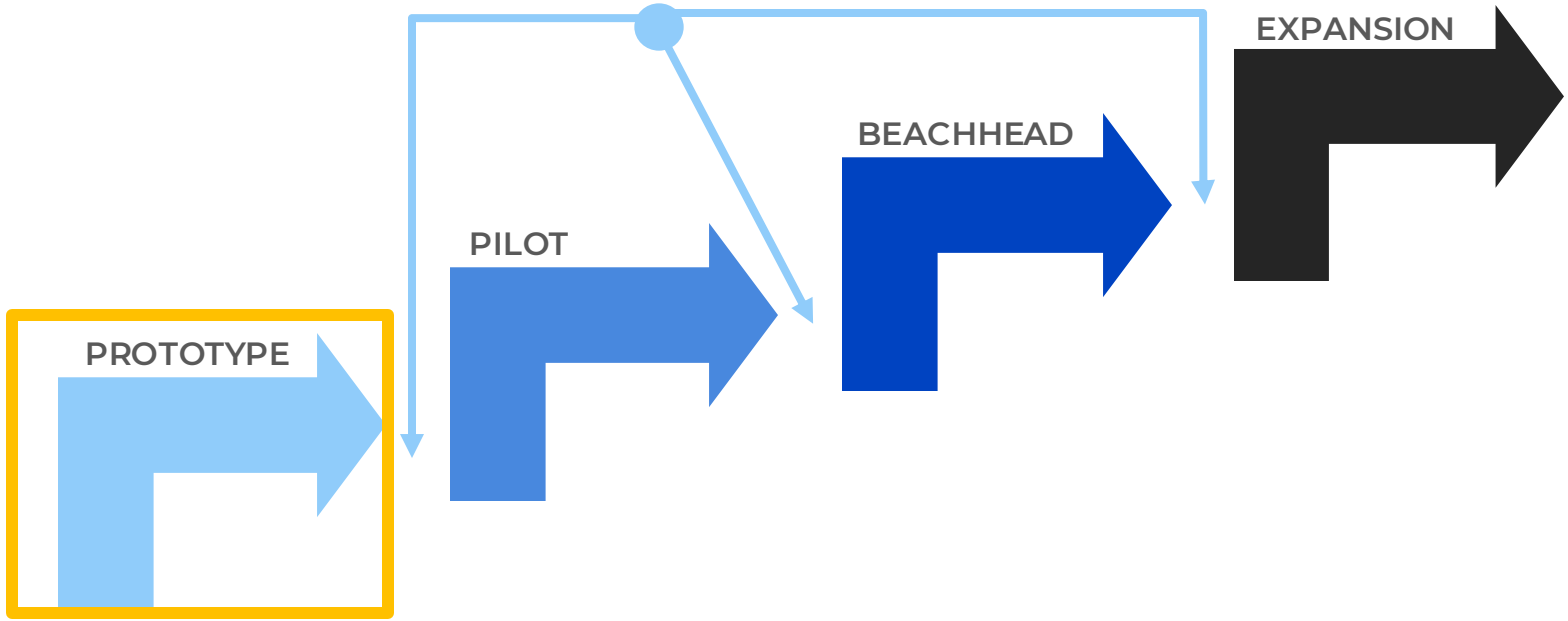
Accelerate Wind's turbines occupy space that solar panels can't.



Wind generates power when solar doesn't; together they can significantly reduce a building's carbon footprint.

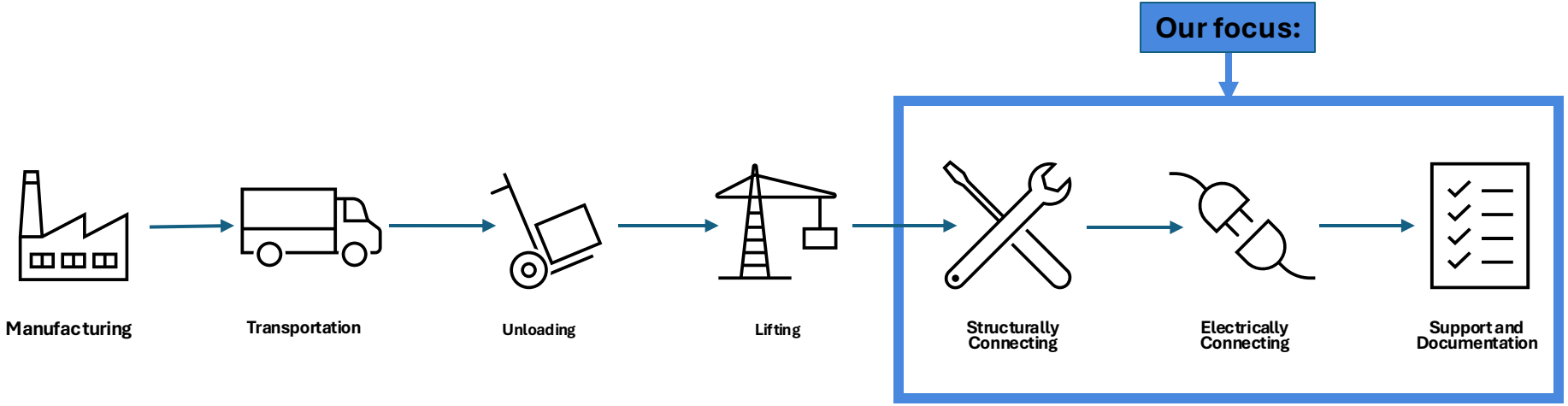


For Accelerate Wind to secure market acceptance, they must establish an installation process.



Project Objective:

to explore and clarify the installation process.



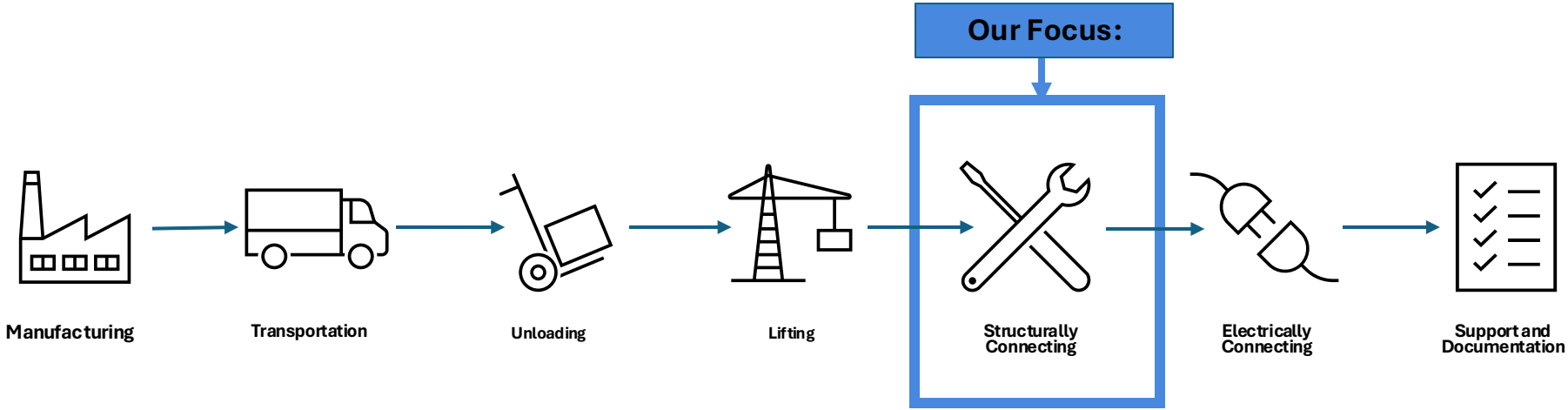
Turbine Mounting

Wireless Communication

Electrical Installation Guide

Project Objective:

to explore and clarify the installation process.



Turbine Mounting

Wireless Communication

Electrical Installation Guide

Above: Roof without parapets.

Below: Roof with parapets and corrugated metal decking.

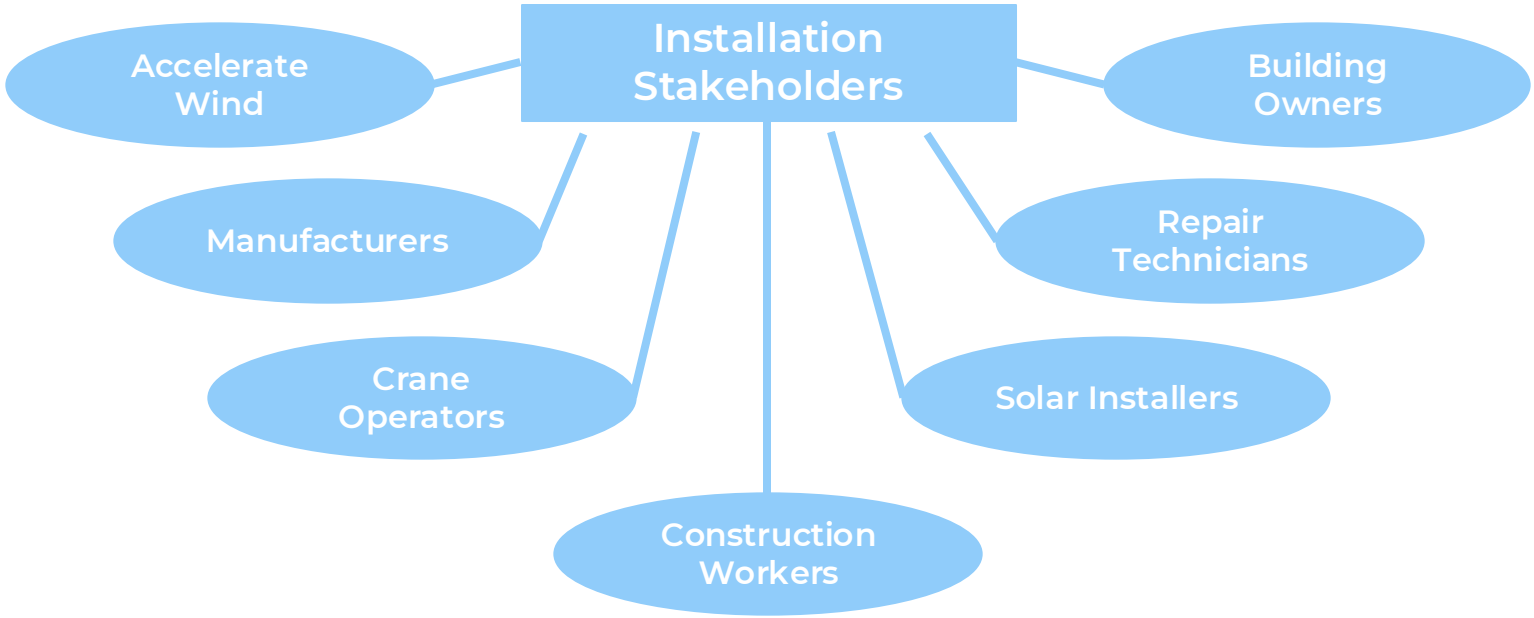
Above: Roof with corrugated metal decking and ledge.

Below: Concrete roof, no parapets.

Accelerate Wind will install their turbines on buildings with **variable roofs** across the United States.

Objective: to make it faster for Accelerate Wind to adapt their mounting design to a variety of roofs.

Approach 1: to create a requirements list to assess turbine mounting designs rapidly, using information from various stakeholders.



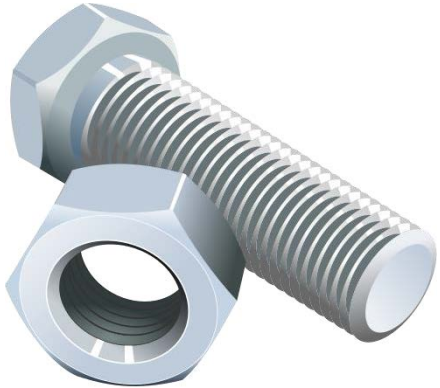
Objective: to make it faster for Accelerate Wind to adapt their mounting design to a variety of roofs.
Approach 2: to create a ¼-scale test bed model of the current turbine, spoiler, mounting system, and the roof of a potential building for install.

- Easy to manufacture and rapidly prototype
- Allows for assessment of design feasibility
- Enables simulation of installation processes at a human scale

We Identified Ways to Improve Design for Manufacturability and Assembly

Parts like these require **tight tolerances** to ensure proper fit. However, if they are being welded, there is **potential for human error**. There may also be confusion during installation, which could result in more **roof time**. All the above results in **increased cost**.

Assembly Considerations

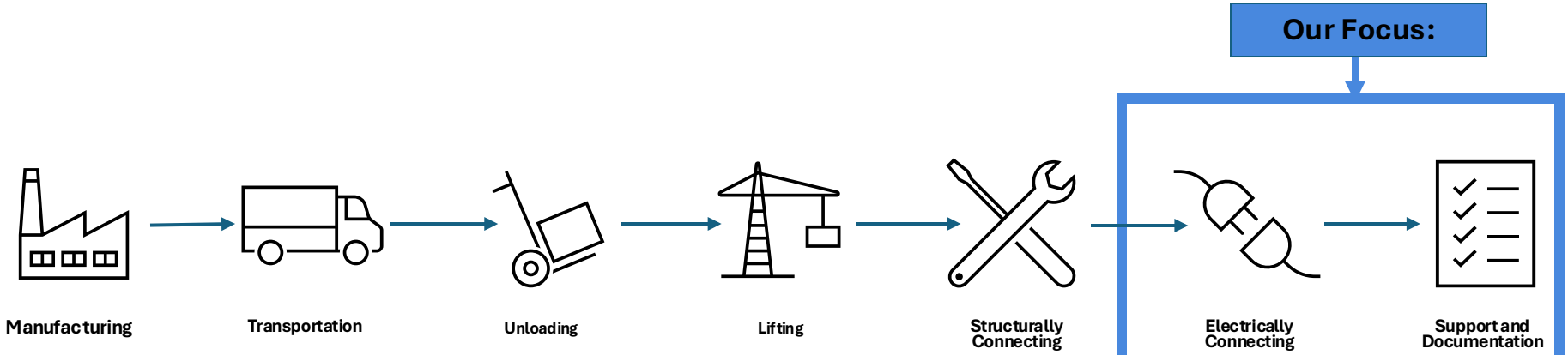


Rib assembly time is mostly fastening

Rib components can be misoriented

Project Objective:

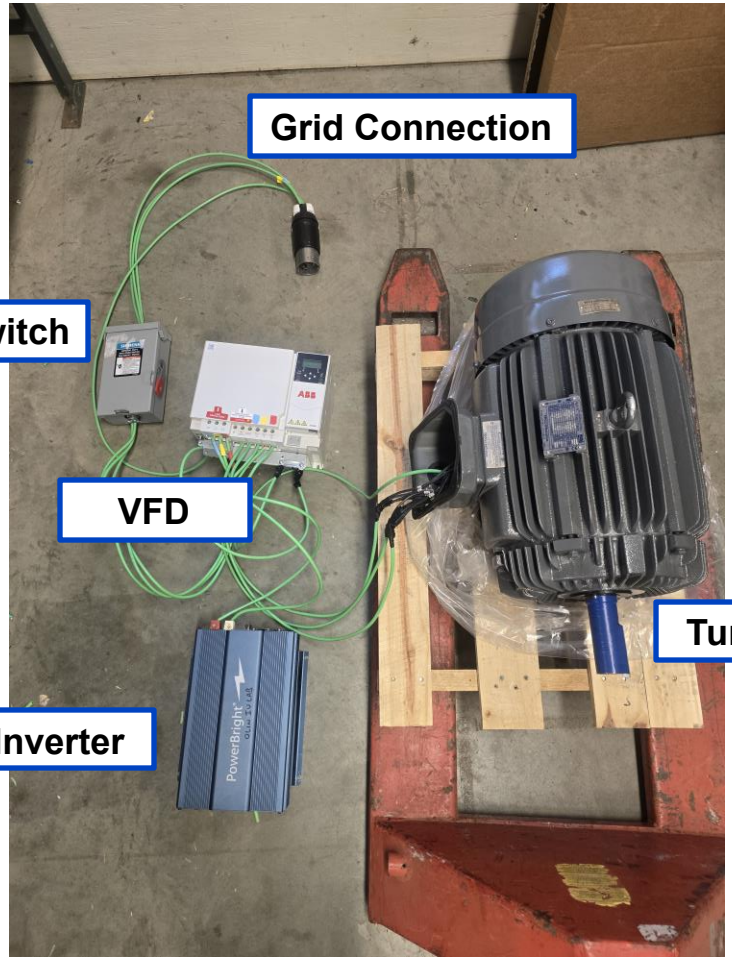
to explore and clarify the installation process.



Turbine Mounting

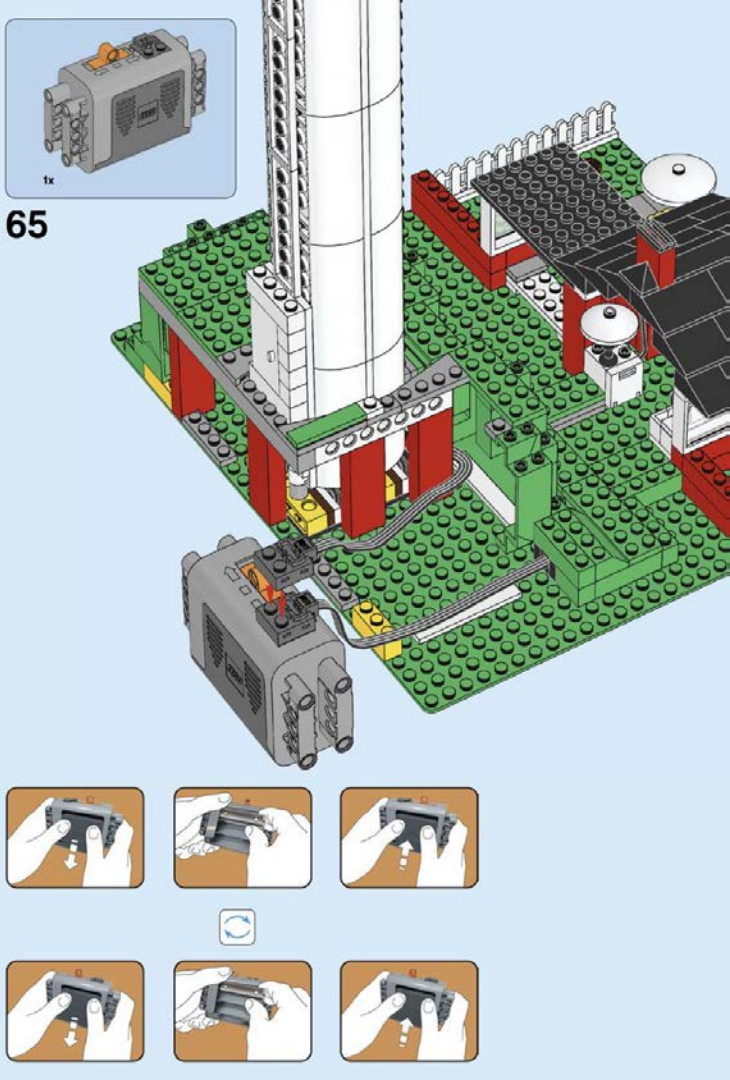
Wireless Communication

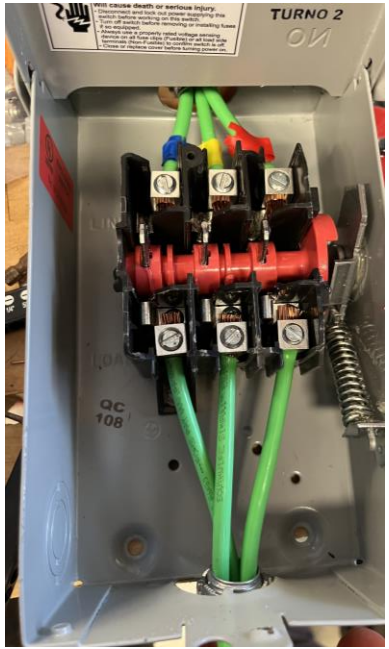
Electrical Installation Guide

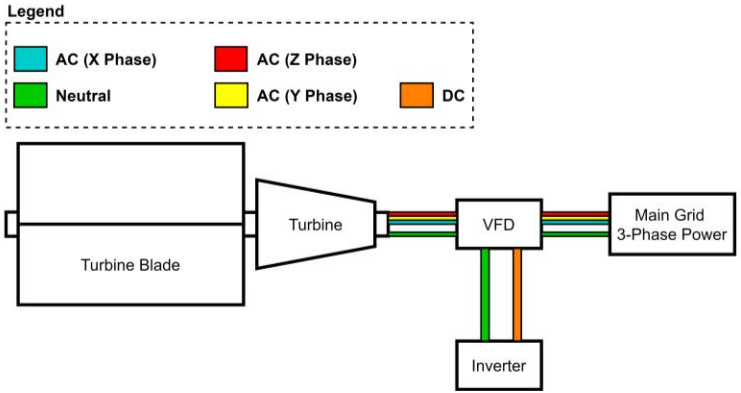

Grid Connection
Safety Switch
VFD
Turbine
Inverter
PowerBright

Accelerate Wind has the electrical schematics & final vision.

We made a practical step-by-step electrical installation guide.



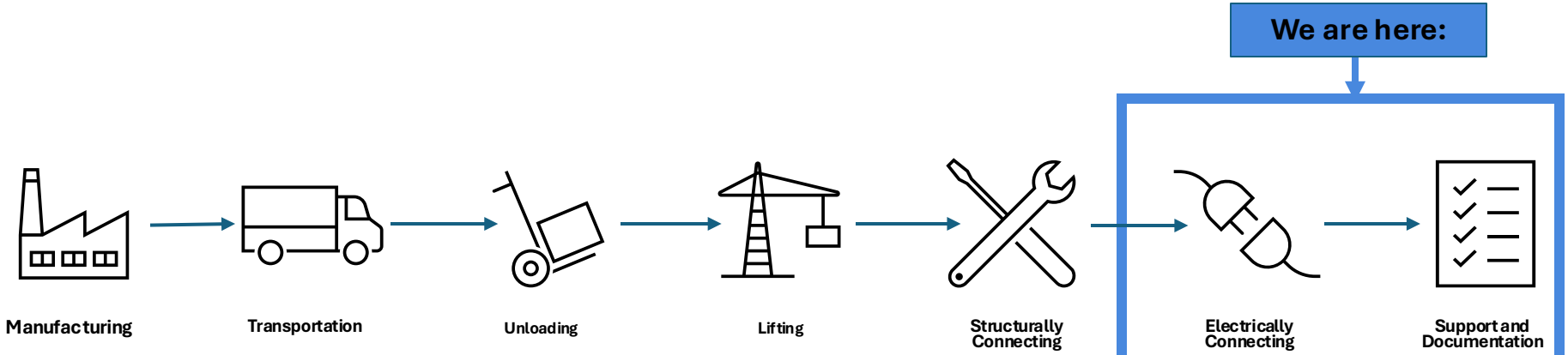




Support and Documentation

Project Objective:

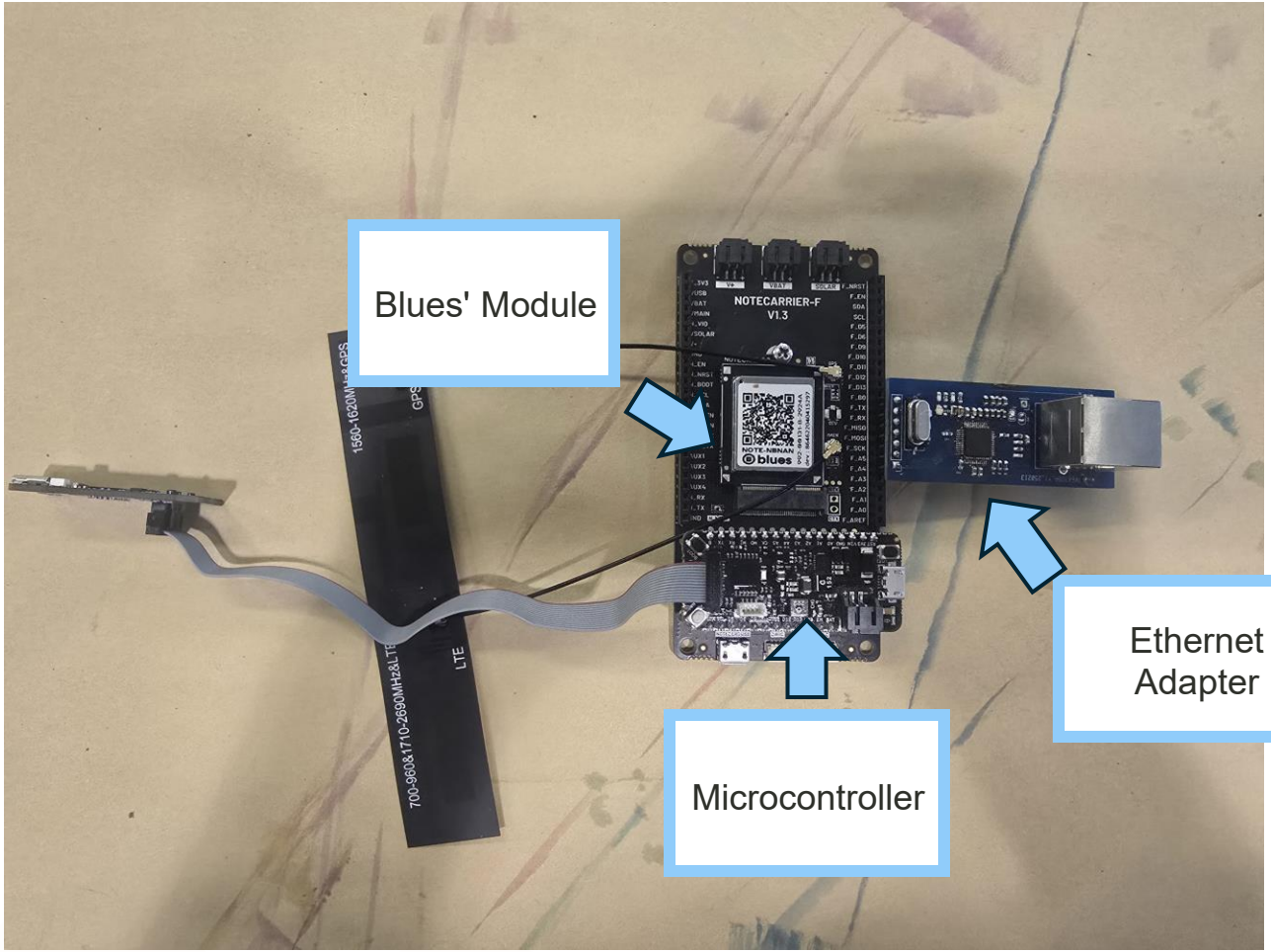
to explore and clarify the installation process.

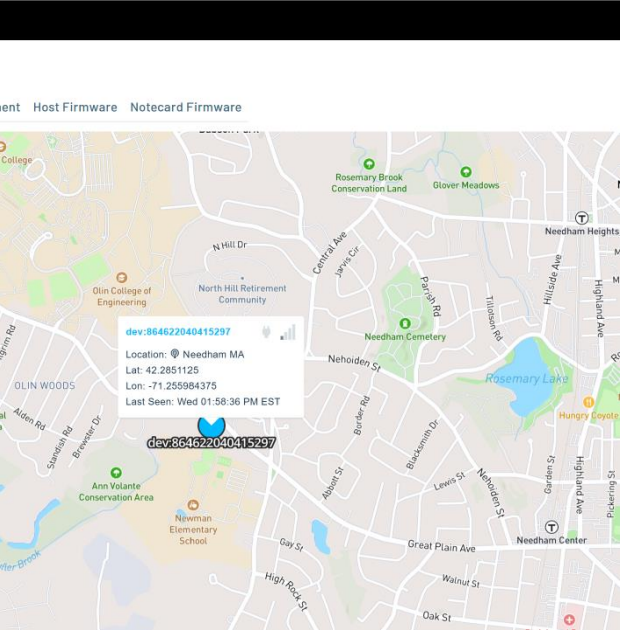


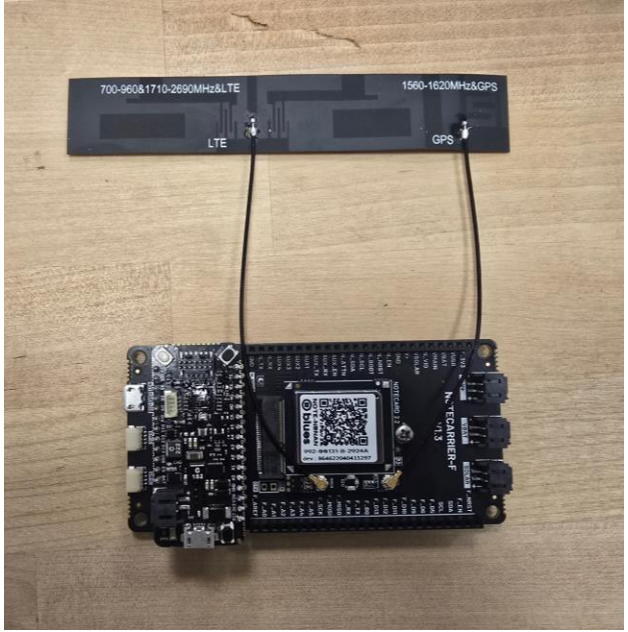
Turbine Mounting

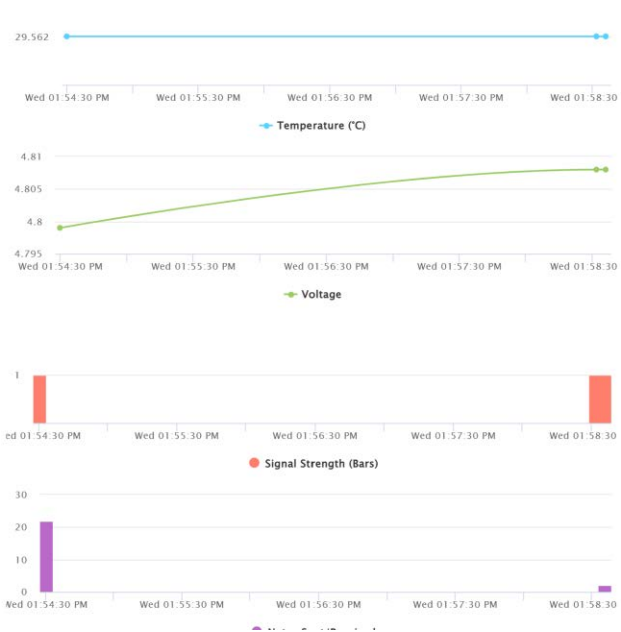
Wireless Communication

Electrical Installation Guide


Blues' Module
NOTECARRIER-F
V1.3
Ethernet
Adapter
Microcontroller







Cellular Communications Device

- Successfully performed encrypted cellular transmission of data
- Conducted a remote firmware update of the device
- Established a link from the device to a cloud monitoring dashboard

Project Impact

Turbine Mounting

- We developed a model to quickly assess turbine installation processes at a human scale.
- We identified ways to increase the resiliency of our sponsor's mechanical design in manufacturing and assembly.
- We proposed methods to streamline future design work.

Electrical Documentation

- We validated the foundational electrical system.
- We created an informed instructional manual for Accelerate Wind containing wiring, safety procedures, general electricity information, and step-by-step guides for each of the components.

Wireless Communication

- We developed a communication module that allows Accelerate Wind to receive performance data remotely after the turbine is installed.

Thank you!

Olin College of Engineering

Amazon Robotics

Olin College of Engineering
SCOPE

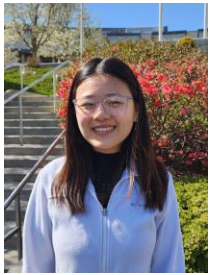
Robotic Manipulation using Tactile Feedback

SCOPE Summit 2025

amazon robotics

Our Team!

Stephanie Cho
Mechanical

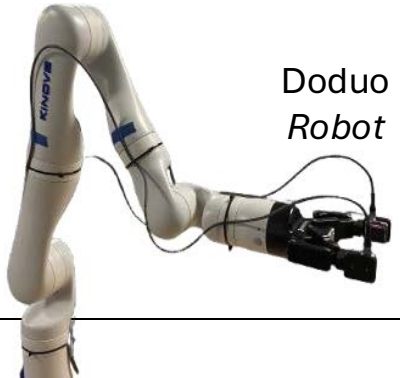


Miranda Pietraski
Electrical & Computing

Arturo Joya
Electrical & Computing

Evan Lockwood
Robotics

Jessica Brown
Robotics



Doduo
Robot

Special thanks to:

Our Advisor
Alessandra Ferzoco

Our Liaisons
Mikell Taylor
Sparsh Bansal
Chris Fitzhugh
Alex MacLean
Fred Heger
Yichen Jiang
Sophie Li

Amazon Shipping

9 billion packages were delivered to customers the same or next day in 2024

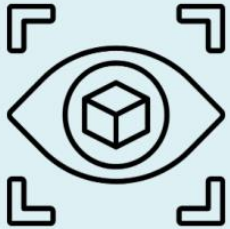
750,000 mobile robots are being used at Amazon fulfillment centers worldwide

In 2022, **1 billion packages** (1/8 of all orders), were sorted by Robin, a robotic handling system

https://www.amazon.science/latest-news/robin-deals-with-a-world-where-things-are-changing-all-around-it

Amazon's Current Manipulation Strategy

Vision identifies package



Pick up with suction

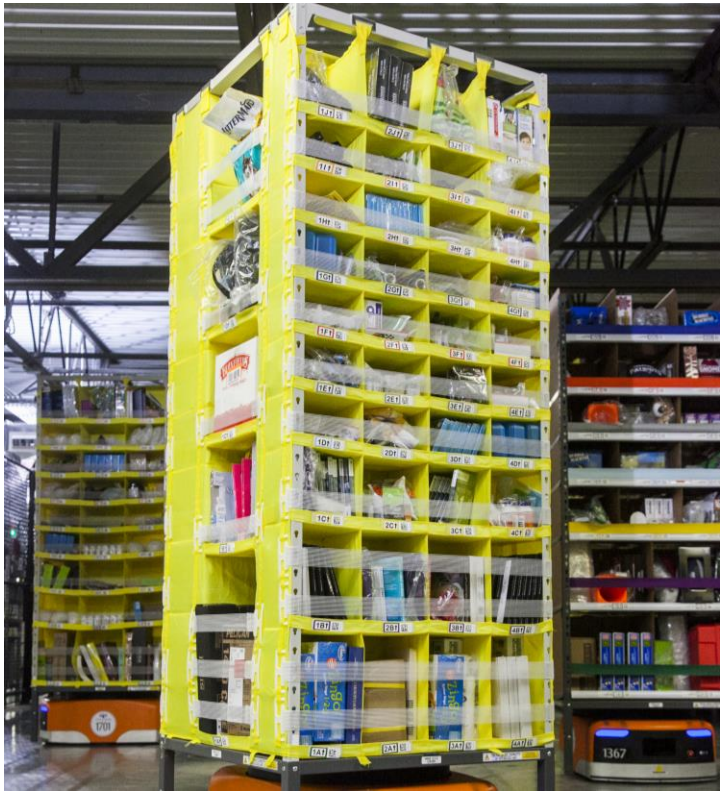
Handle with suction

https://www.aboutamazon.com/news/operations/amazon-robotics-robots-fulfillment-center

Some tasks don't fit the current strategy

Vision is not always available

Suction is not always the best option



https://www.allaboutlean.com/amazon-fulfillment-1/amazon-kiva-with-pod/

Grasping is a more secure and adaptable way to hold a variety of objects

Tactile sensing provides valuable feedback for manipulation

https://www.automate.org/products/grippers https://raslabs.com/

Our Goal:

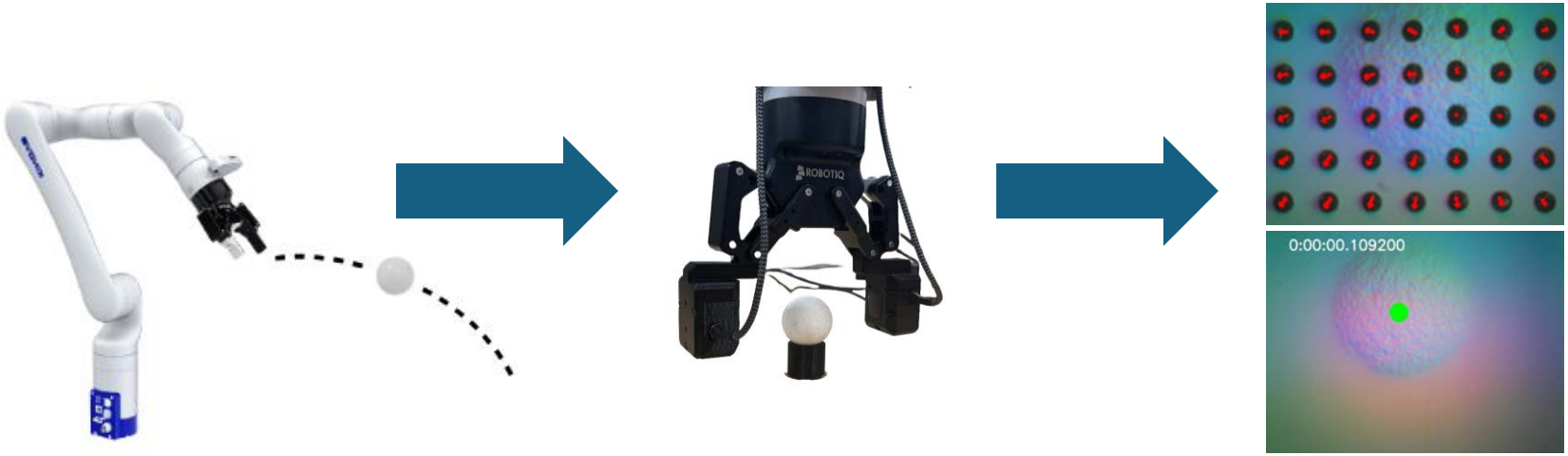
Investigate the role of tactile sensing in object manipulation

Our Task:

Perform throwing experiments using tactile sensors

Why Throwing?

Throwing, and measuring throwing accuracy, gives us a means of analyzing the value of tactile sensing



Two Main Questions:

What is the best type of tactile sensor to use in this setting?

What is the best way to apply tactile information?

https://www.gelsight.com/product/gelsight-mini-system/ https://www.automate.org/products/grippers

Question 1:

What is the ideal type of sensor?

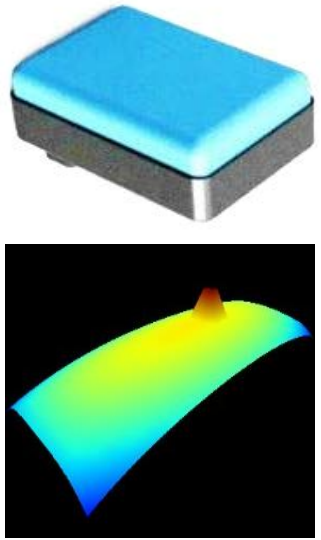
Our Tactile Sensors

Used to measure forces, textures, shapes, or contact locations

Displacement
Contactile

Optical
GelSight

Electroactive
Ras Labs



https://contactile.com/novel-optical-sensing-technology/ https://www.gelsight.com/product/gelsight-mini-system/ https://raslabs.com/

Testing and Comparing Sensors

Object Properties

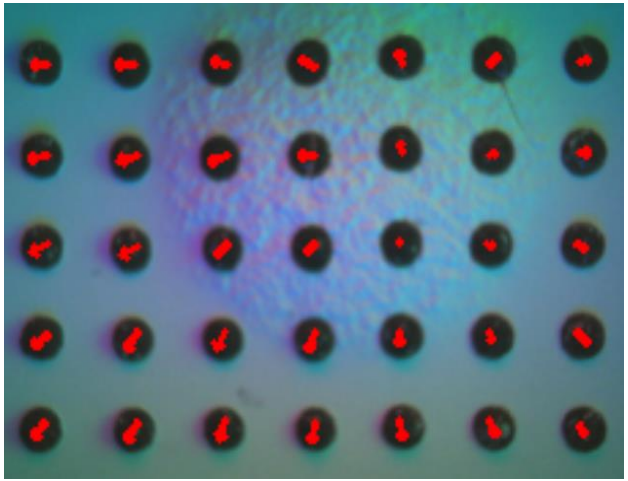
Grip Location

Recommendation: **Optical Gel**

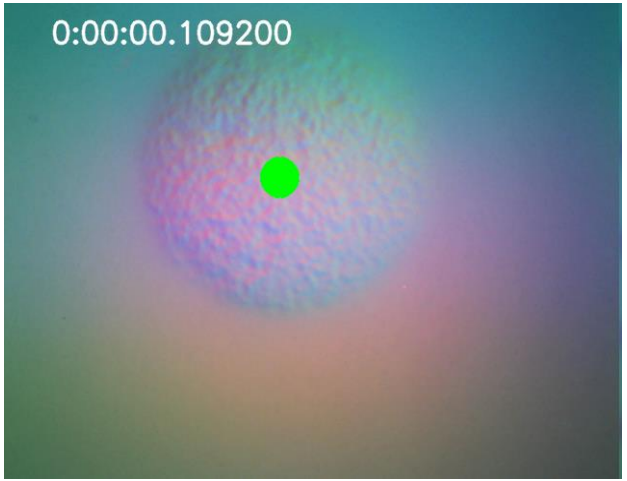
GelSight can act as either a **flow/displacement** sensor or a **camera**

Using both gel types detects **object properties** and **location**

Flow Sensor



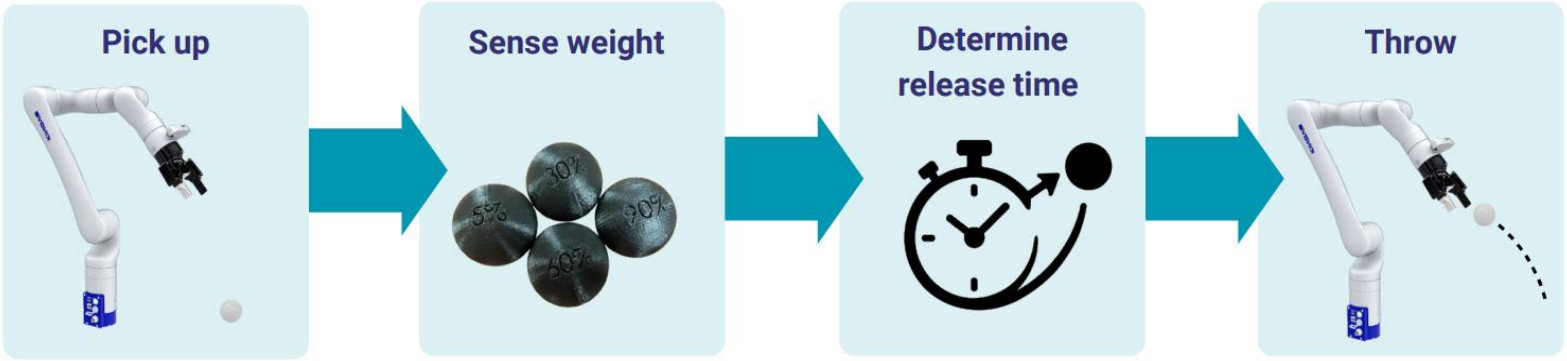
RGB Camera



Question 2:

What is the Best Way to Apply Tactile Information?

Throw Control



Grip Control

https://vention.io/parts/kinova-gen3-6-axis-robot-arm-with-gripper-2086

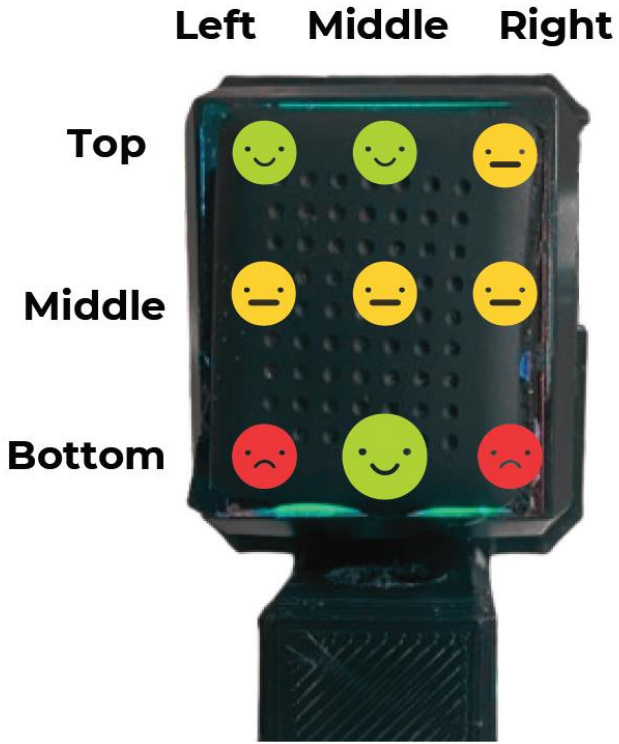
Recommendation:
Grip Control

- Changes in grip location had the biggest impact on throw accuracy

85% - 90% accuracy

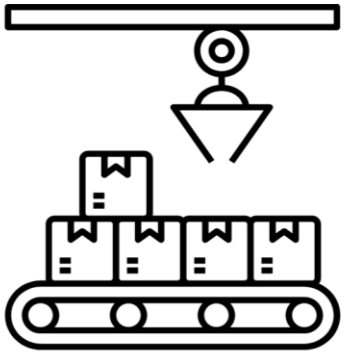
65% - 75% accuracy

55% - 60% accuracy

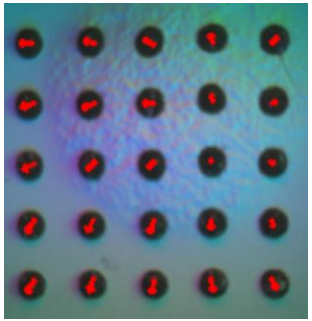


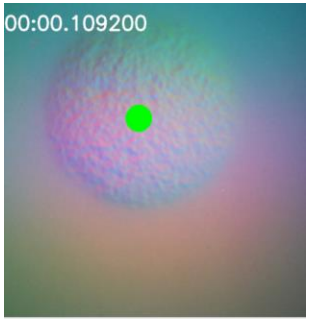
Overall Recommendations

Tactile sensors **are** worth exploring in warehouse package manipulation



A combination of **displacement** and **optical** sensing is ideal for understanding **grip** and **object properties**





Sensing can be used to **correct** for a **good grip**

Impact

Proof of concept for Amazon Robotics

Increase the efficiency of warehouses

Fill in gaps where suction fails

What's Next?

Exploring asymmetrical, deformable, and obstructed objects

https://cdn.geekwire.com/wp-content/uploads/2023/09/amazonrobots-cropped.png

Thank you!

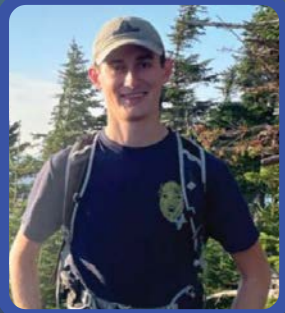
Blue Origin

CNC Conformal Coating Machine

Blue Origin Team

Olin College of Engineering SCOPE | SCOPE Summit 2025 | BLUE ORIGIN

OUR TEAM



Danny Burns

Jacob Prisament

Joseph Gilbert

Rowan Jansens

William Skelly

Alan Tate

David Llapitan

Federico Diamante

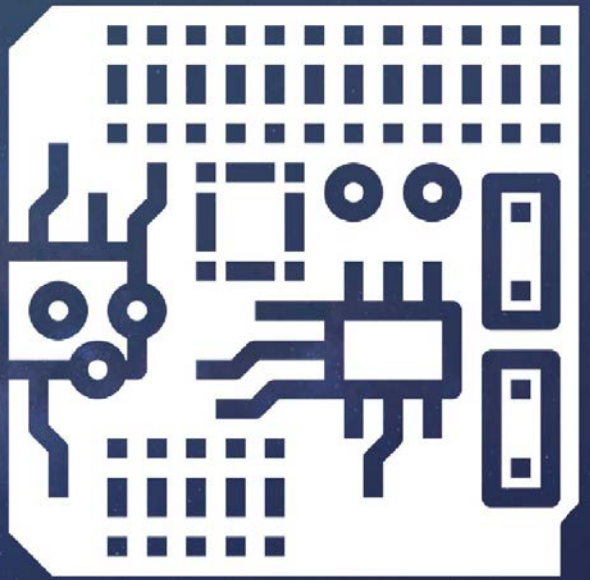
Sara Olson

Lawerence Neeley

Conformal Coating Rework Machine

A semi-automatic robotic spray-coating machine for simplifying and accelerating Blue Origin’s current in-house PCB rework process.

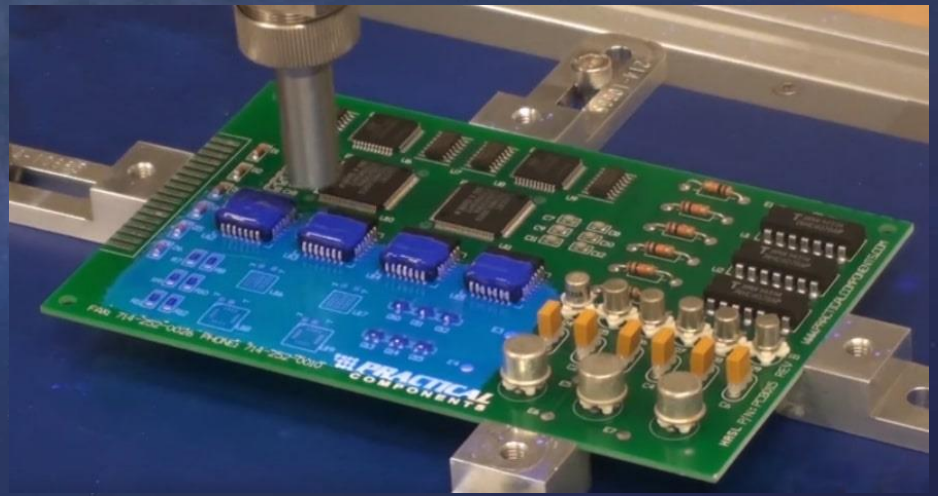
Printed Circuit Boards (PCBs) are the heart of the modern world



PCBs can be damaged by many environmental hazards

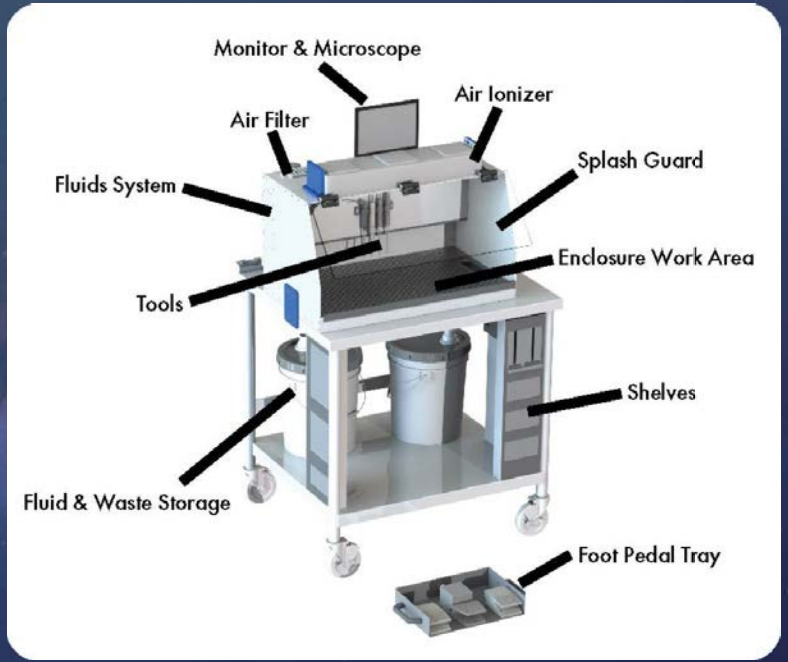
The Solution: Conformal Coatings

Protective coatings that seal off electrical components from outside factors



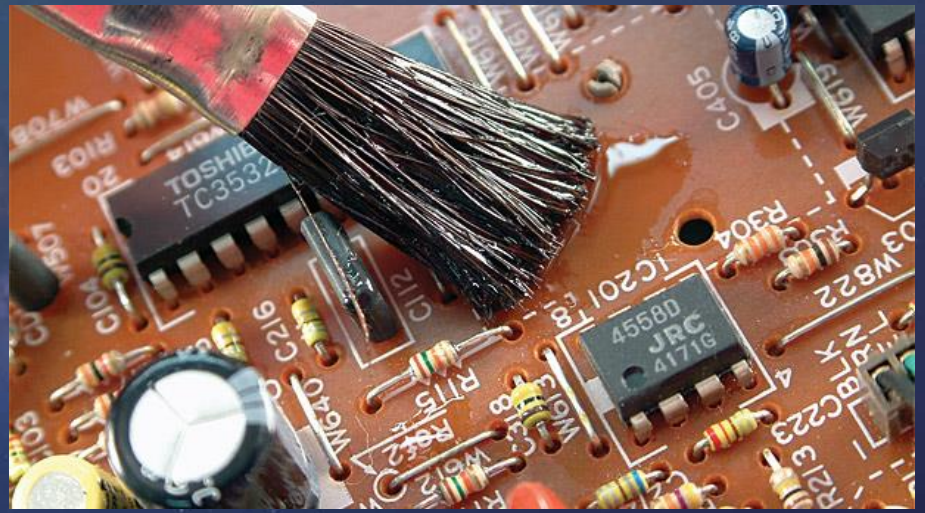
Removal

Sometimes Conformal coat must be removed. Last year's Blue Origin project made a workstation for this



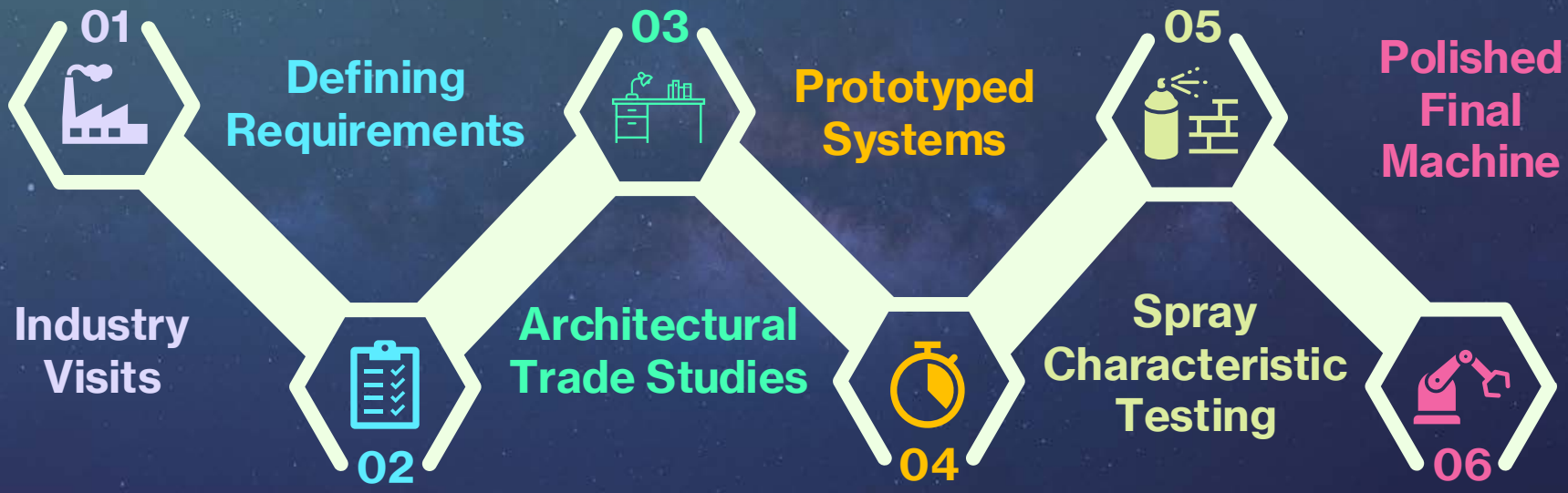
Difficult Reapplication

Rework at Blue Origin is done by manual brushing which is time consuming and has poor control over thickness



So, how will Blue Origin improve their conformal coating rework procedure?

Our Process


01
Industry Visits
02
Defining Requirements
03
Architectural Trade Studies
04
Prototyped Systems
05
Spray Characteristic Testing
06
Polished Final Machine

Inspiration: Industry Visits

Spec Coat

TTM Technologies

Existing Coating Machines

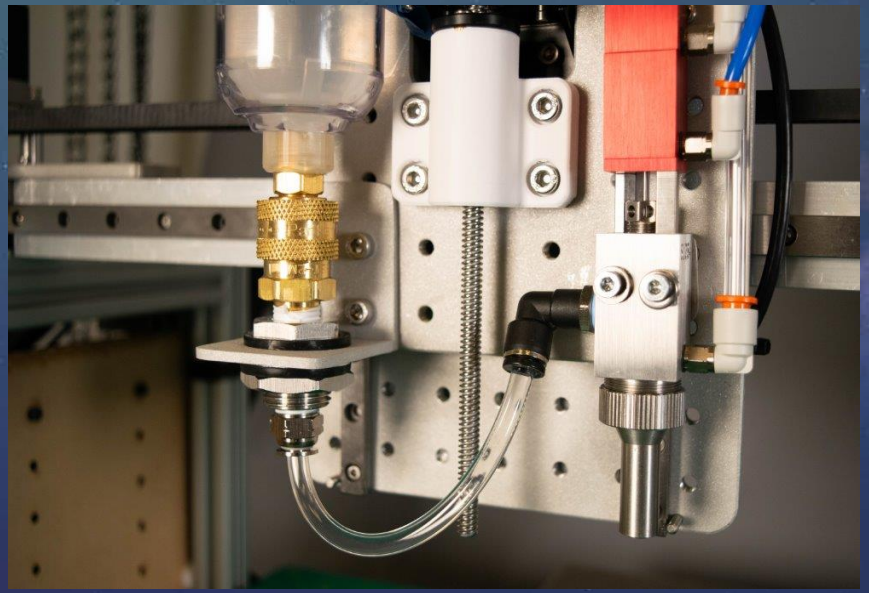
- $40,000 to $100,000 dollars
- Designed for large volume production

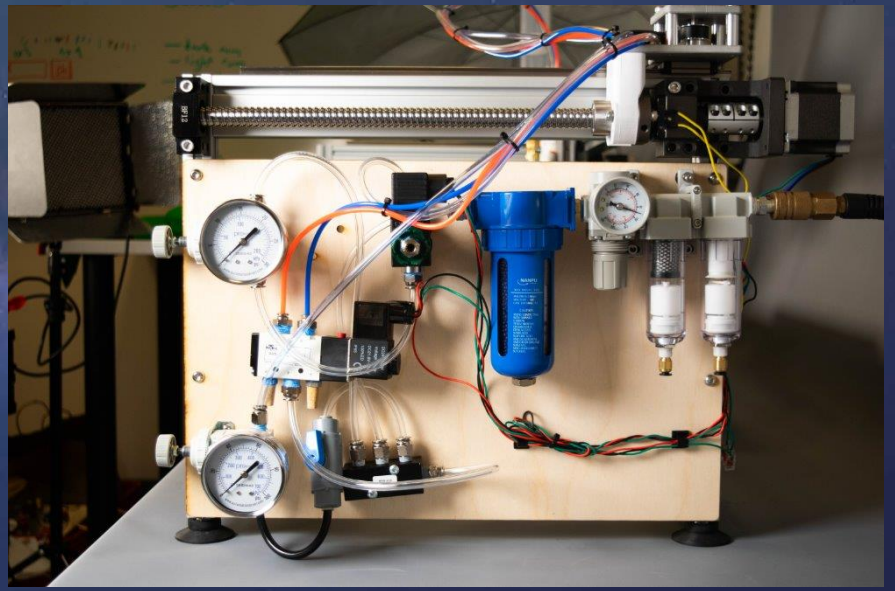
Top Level Design Trades and Testing

Precision Valve Automation

Venture Electronics

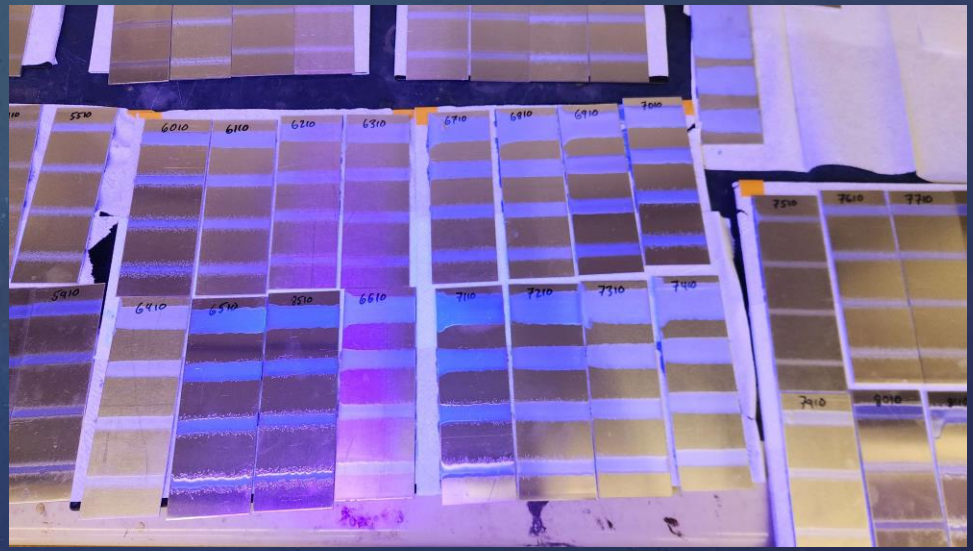
First Semester: Functional Prototype





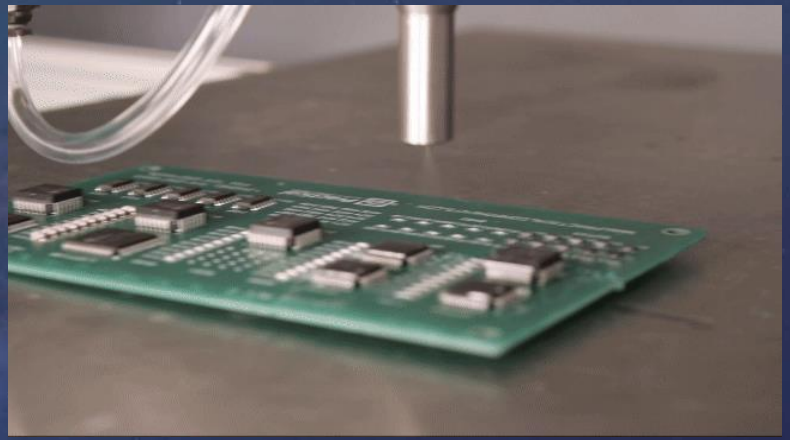
Spray Testing

Sprayed 300 coupons to determine valve characteristic and validate performance



Second Semester: Final Product

- Design, CAD, Fabricate the final, refined system
- Create comprehensive documentation package
- Ship completed system to Kent, WA



Our Machine


FLUID
AIR
STOP
BLUE ORIGIN

Integrated Fume Extraction
allows the machine to run safely in any lab space, without additional air filtration infrastructure

Quick-change Toolhead
enables rapid cartridge swapping, with dedicated solvent hookup for semi-automatic purge routines

Spray Mapping Software
facilitates quick and intuitive path planning and generation using augmented reality with a UV image of the board

24" x 24" Spray Area
gives capacity to coat the largest PCBs or multiple small boards at the same time

Access Covers
allow for quick service and testing of the critical hardware systems

Ergonomic Door
uses a gas spring for low-force action and an adjustable stay for operator comfort

Analog Control
creates a direct connection with the spray and motion system hardware, giving the operator greater machine awareness and control

Quick-Swap Filters
simplify machine maintenance

Interface Panel
consolidates power, air, and fluid hookups, simplifying machine setup

Modular PCB Fixturing
accelerates the setup process for boards of all shapes and sizes

Solvent Workstation
houses equipment for purging the spray valve without encroaching on the usable spray area

Built-in Storage Drawer
for storing mounting fixtures and coating consumables

40"x 60" Footprint
allows the machine to operate as a compact desktop device

Project Impact:

- 50% cost reduction
- 15% schedule reduction
- Improved coating consistency
- Streamlined UX (time-to-first-spray -> 15min)

Thank You!

Olin College of Engineering

Boston Scientific

Sustainable Design for Biopsy Forceps' Lifecycle

2024-2025 Boston Scientific Scope Team

Lillian Shoemaker, KD Vo, Madeline Robertson, Kai Scott, Miriam Rich, Cassandre Roos

Boston Scientific

Olin College of Engineering

The Team

Lillian Shoemaker

Mechanical Engineer ‘25

KD Vo

Mechanical Engineer ‘25

Madeline Robertson

Mechanical Engineer ‘25

Kai Scott

Mechanical Engineer ‘25

Miriam Rich

Mechanical Engineer ‘25

Cassandre Roos

Mechanical Engineer ‘25

Endoscopy Waste

2.1 kg[1] of waste **PER procedure**

Millions of endoscopies performed **annually** in the U.S.

1. S. Namburar, D. von Renteln, J. Damianos, L. Bradish, J. Barrett, A. Aguilera-Fish, B. Cushnie-Roisin, and F. Pohl, "Estimating the environmental impact of disposable endoscopic equipment and endoscopes," Gut, vol. 71, no. 7, pp. 1326-1333, Jul. 2022, doi: 10.1136/gutjnl-2021-324729.

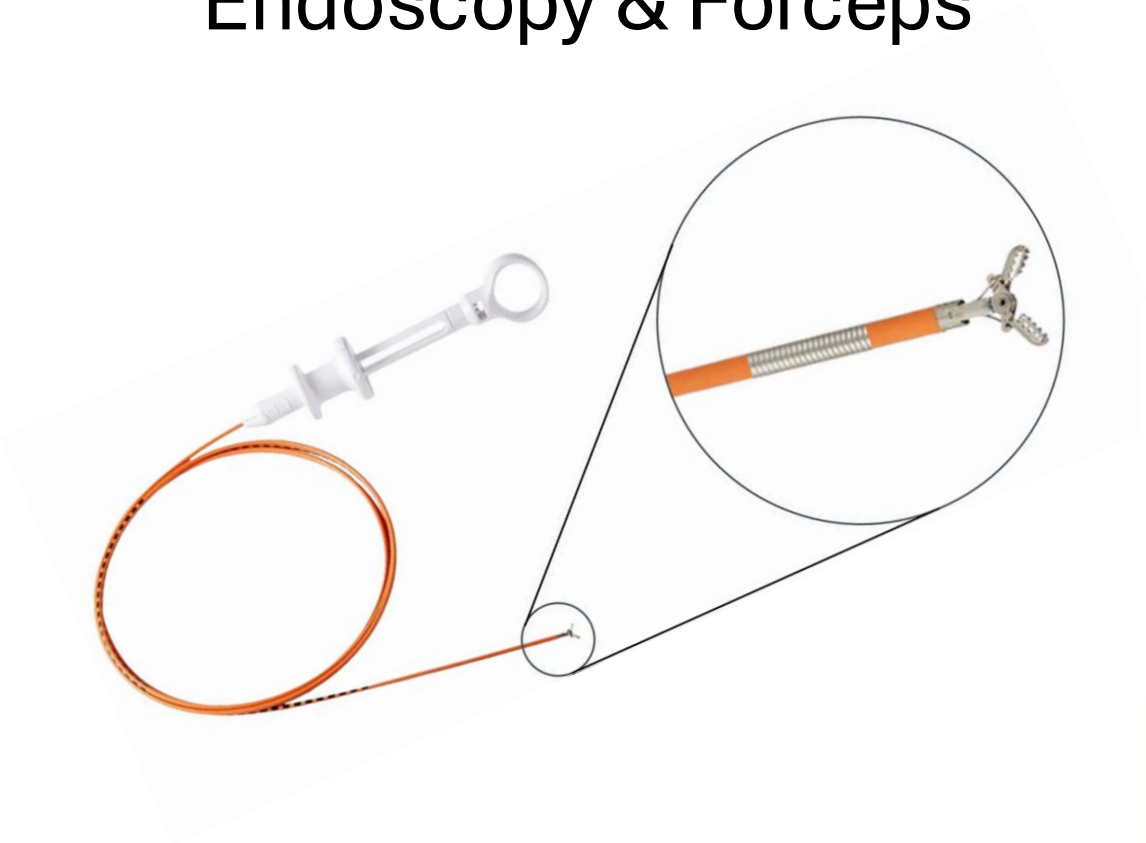
Goal

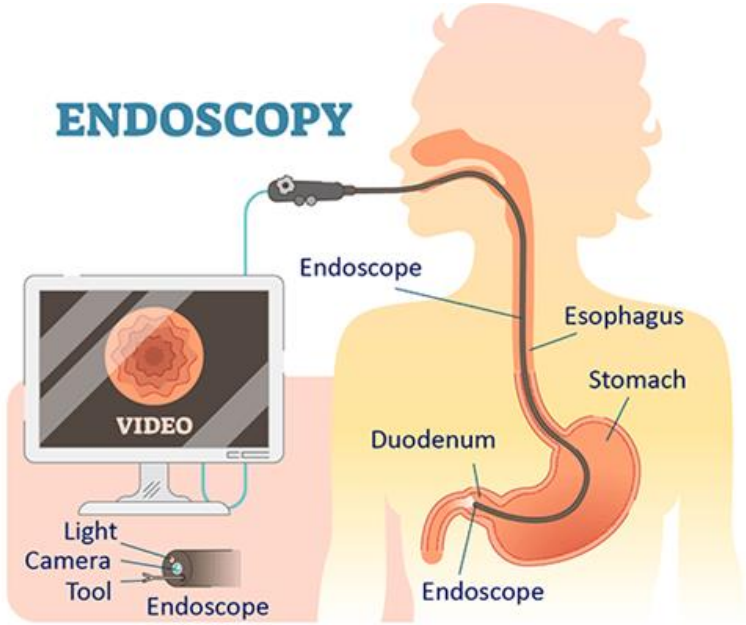
By **2050** Boston Scientific plans on being **carbon neutral**

<u>Our Job:</u>

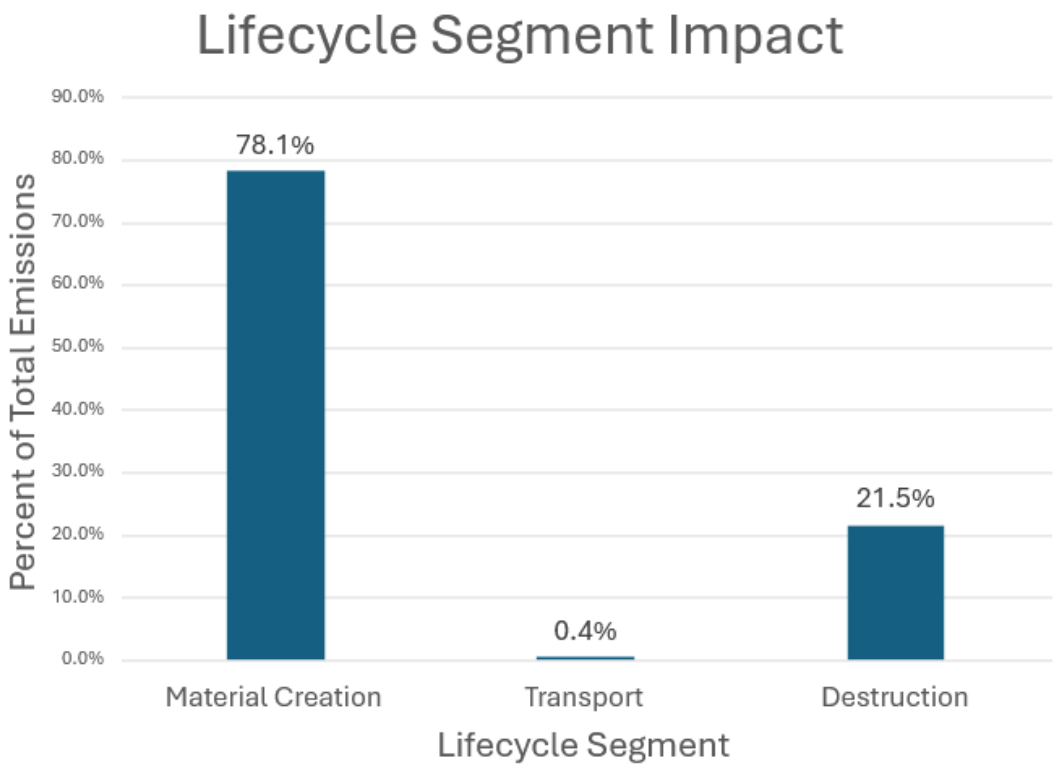
Focus on **increasing** the **sustainability** of the forceps product line while maintaining forceps **functionality**

Endoscopy & Forceps

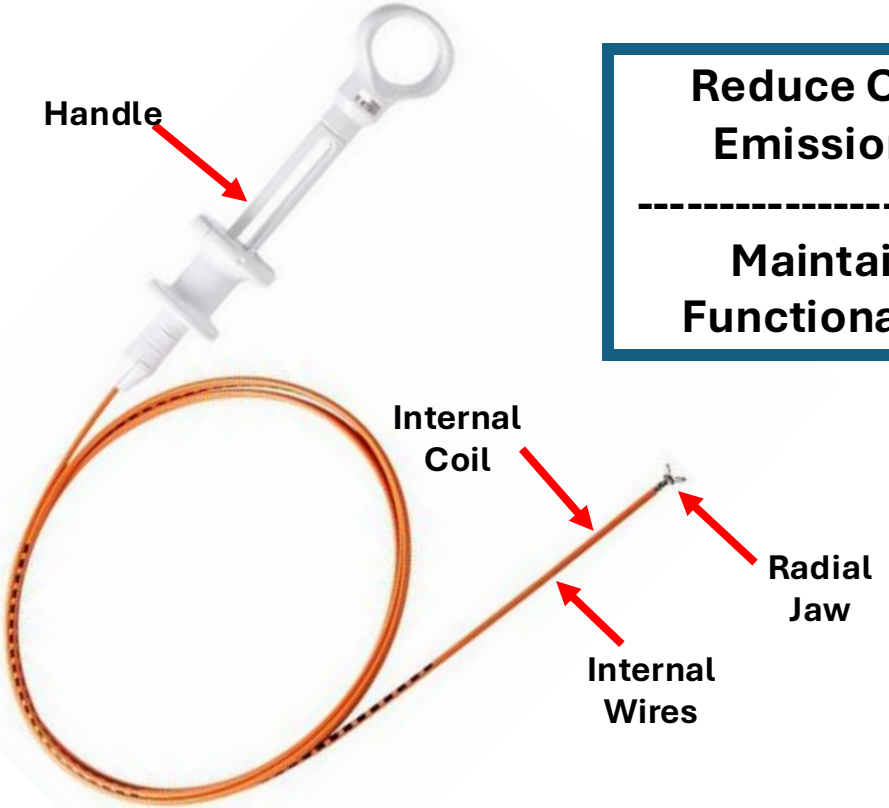




Life Cycle Analysis (% CO2 Emissions)



Initial Approach



Reduce CO2 Emissions

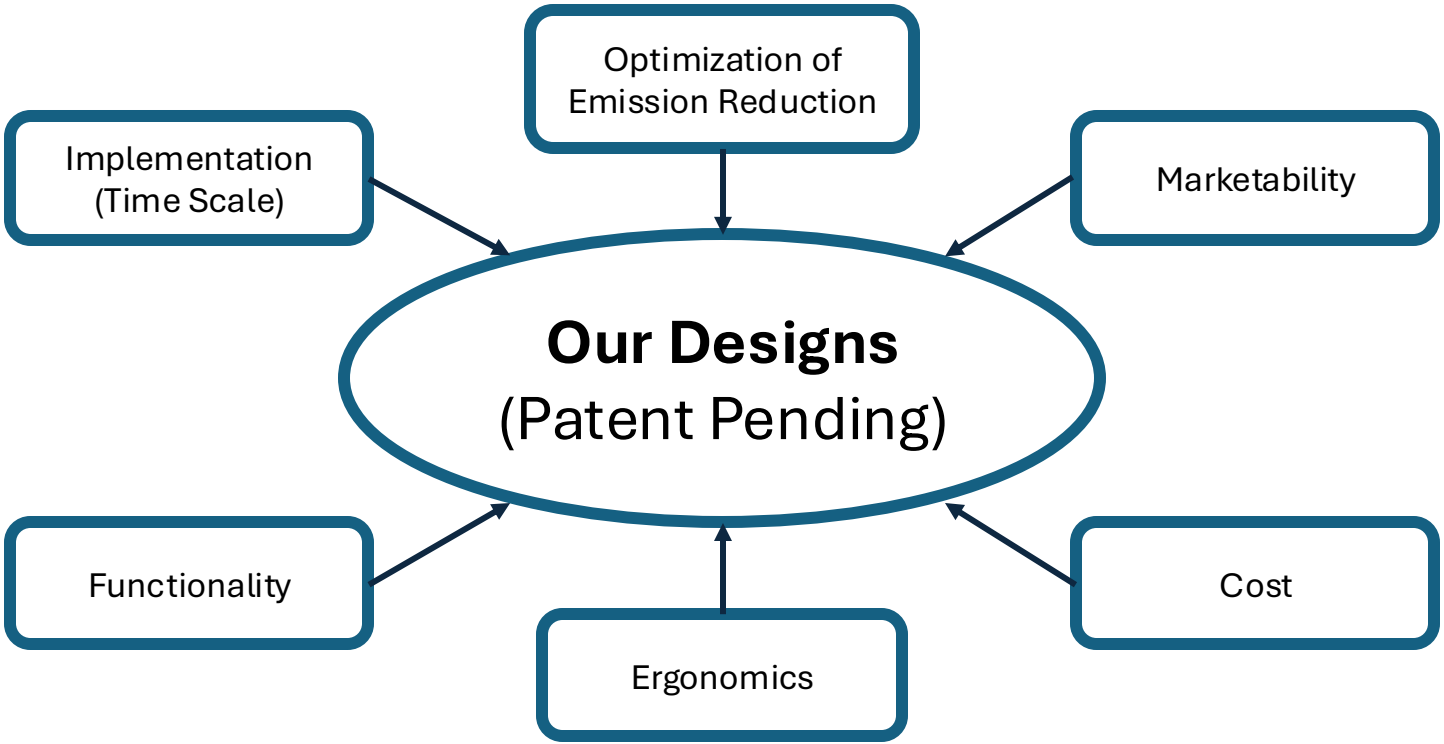
Maintain Functionality

Plastic Packaging

Design Aspects

Material	Can it be recycled?
Weight	Can less material be used?
Reusability	Can this component be reused?

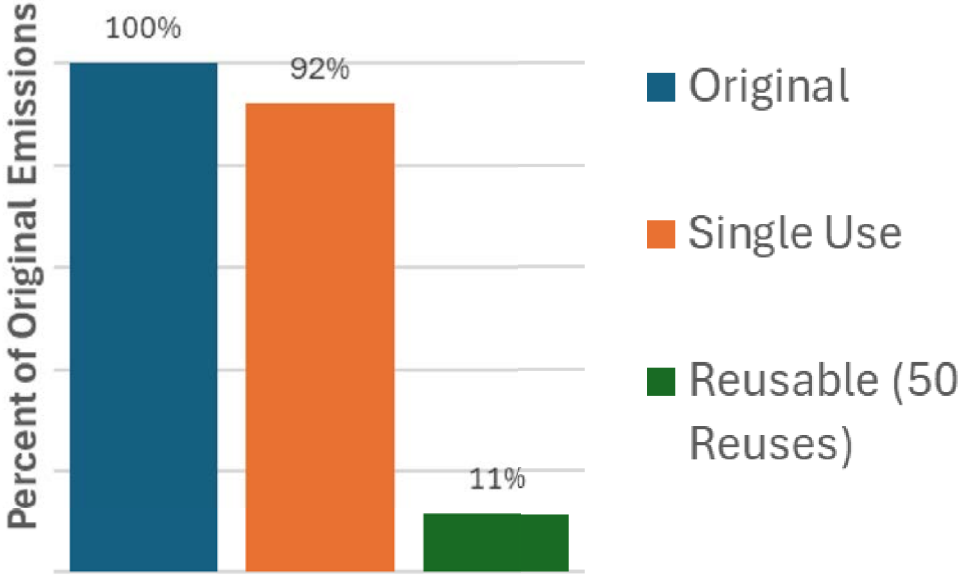
Design Considerations



Results

One single use design.

Two designs for **reusability.**



THANK YOU!

Especially to:

Andrea Martinez, Rosangel Espinoza,

Ryan Wales, Sam Anderson,

Jessica Townsend

Boston Scientific

Olin College of Engineering

Olin College of Engineering

BU WISE

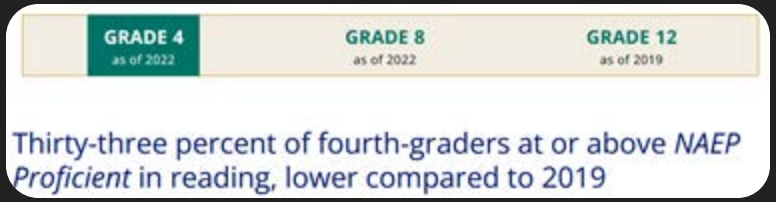
The Applications of AI in K-2 Literacy Development

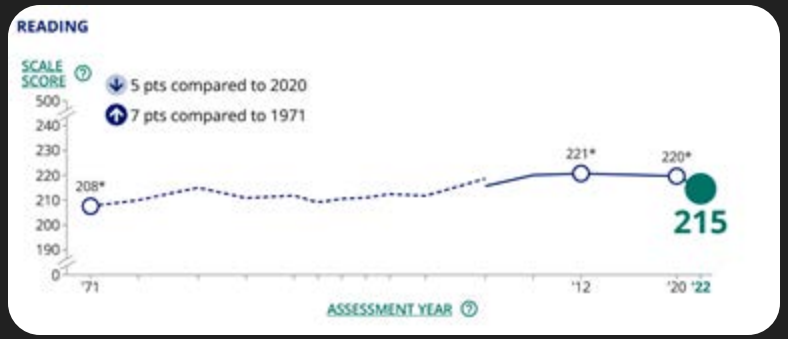
BU WISE SCOPE

Richard Li, Anmol Rattan Singh Sandhu, Aaron Codrington, Cherry Pham, Prisha Bhatia

Olin College of Engineering SCOPE
Red Hat
BU Wheelock College of Education & Human Development
Wheelock Institute for the Science of Education

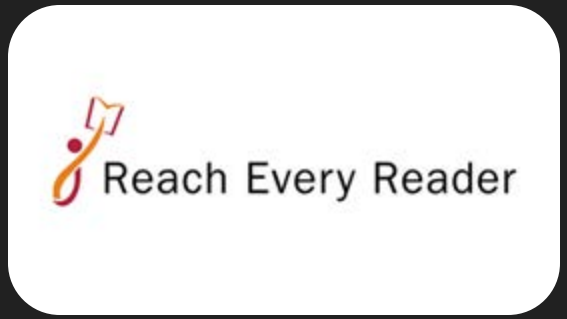
What are we working on?



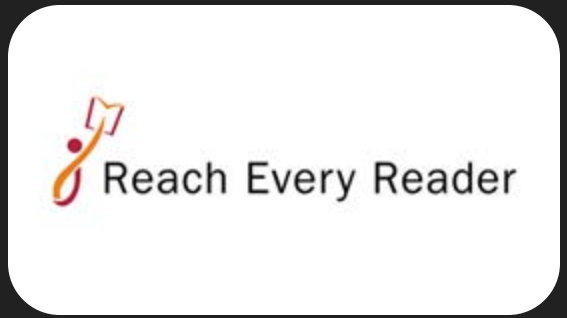


Source: National Assessment of Educational Progress (NAEP)

Who are we working with?

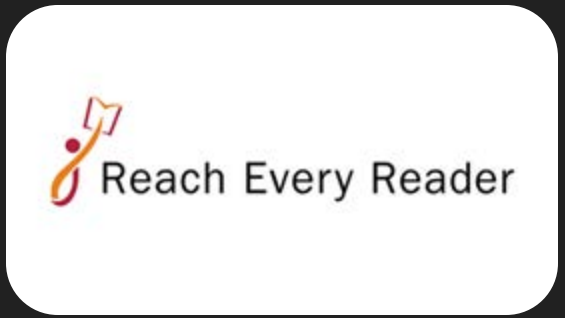


Who are we working with?



- Literacy/education experts

Who are we working with?



- Literacy/education experts
- Goal: "***all children will be readers with the skills, knowledge, and interest to read for learning and pleasure.***"

What are we doing?

- Technical advisors and consultants

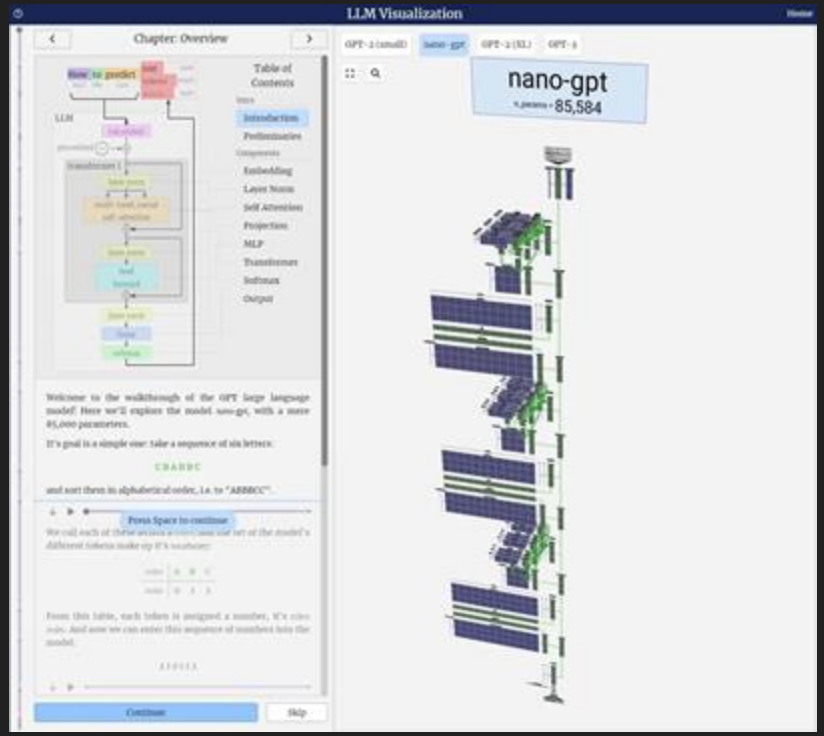
What are we doing?

- Technical advisors and consultants
- Building out digitized versions of their curriculums and tools
- Red Hat’s support for cloud infrastructure and machine learning!

What did we make?

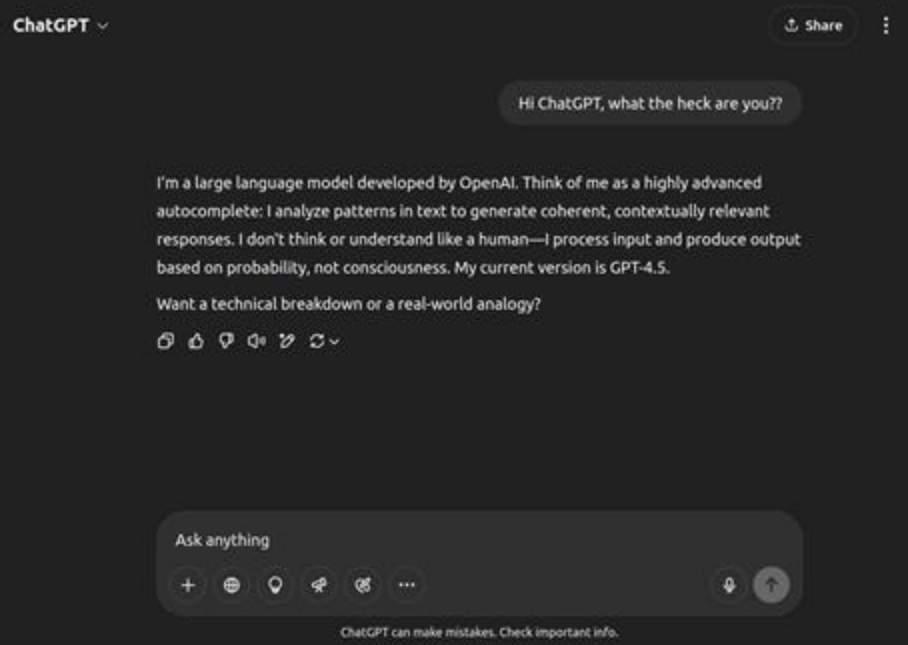
A short explanation of AI-jargon

A short explanation of AI-jargon

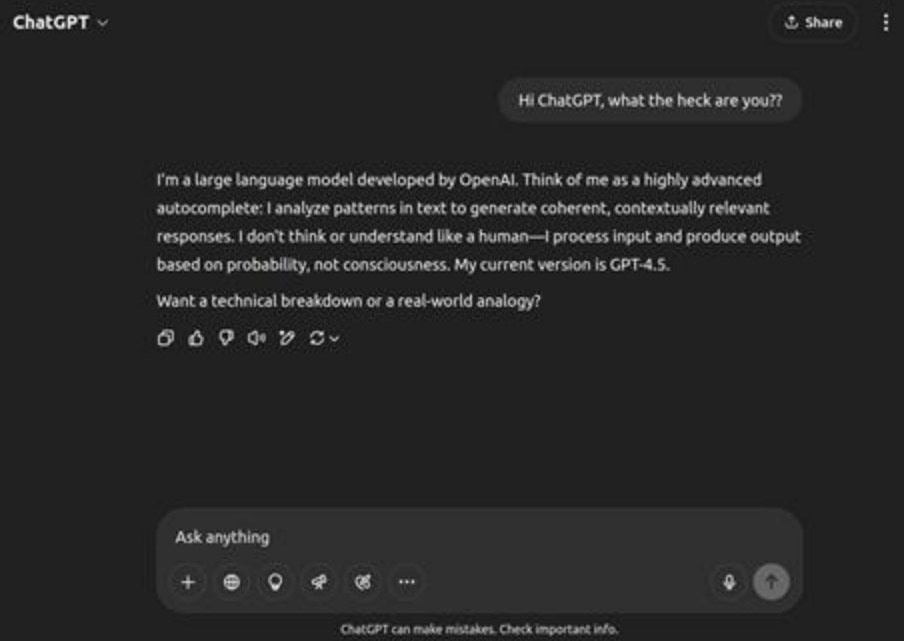


Brendan Bycroft's LLM visualization

A short explanation of AI-jargon



A short explanation of AI-jargon



- LLM = “large language model”
- Pattern-based models that output results based upon training data using matrix math
- ***“These inputs generally should yield these outputs”***

What does AI have to do with anything?

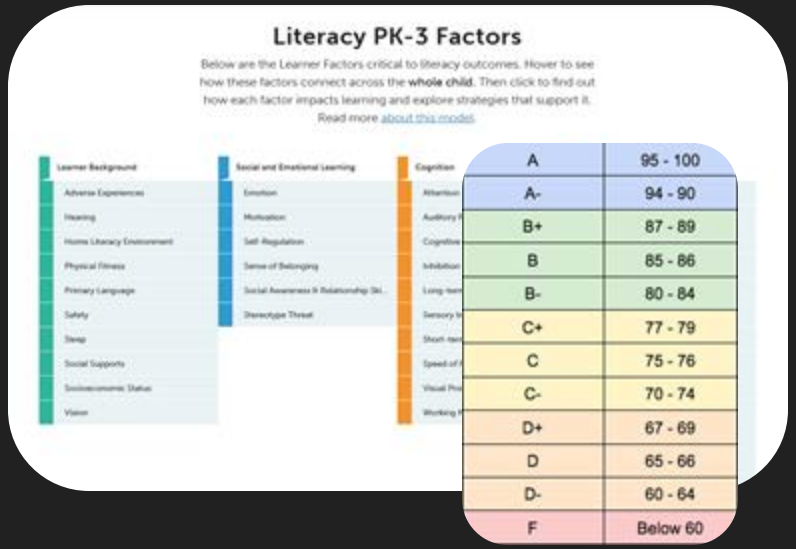
What does AI have to do with anything?

What does AI have to do with anything?

Why is AI a useful tool for this space?

Why is AI a useful tool for this space?

Large quantities of qualitative and quantitative data

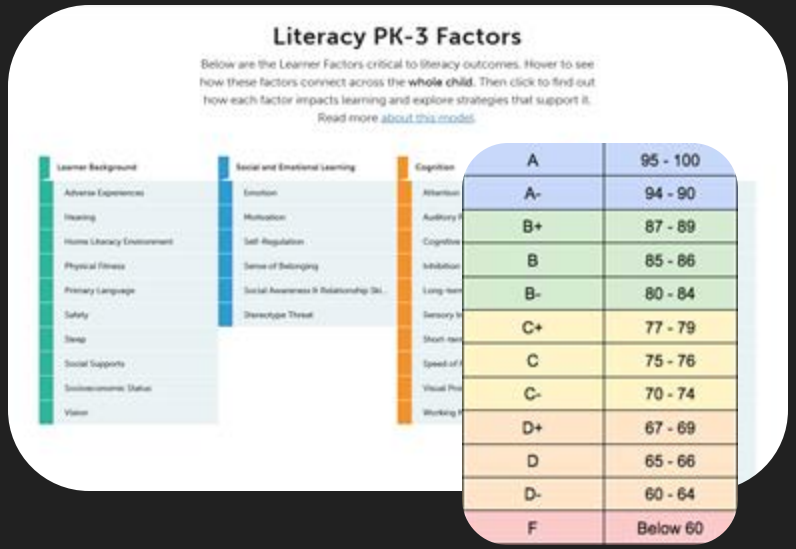


A	95 - 100
A-	94 - 90
B+	87 - 89
B	85 - 86
B-	80 - 84
C+	77 - 79
C	75 - 76
C-	70 - 74
D+	67 - 69
D	65 - 66
D-	60 - 64
F	Below 60

https://lvp.digitalpromiseglobal.org/content-area/literacy-pk-3/factors

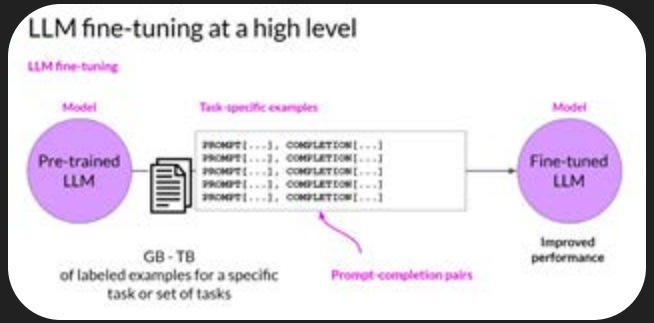
Why is AI a useful tool for this space?

Large quantities of qualitative and quantitative data



https://lvp.digitalpromiseglobal.org/content-area/literacy-pk-3/factors

"Taking into account a student with the following attributes: [STUDENT ATTRIBUTES] please suggest interventions based upon [KNOWLEDGE BASE]"



Why might AI be *dangerous* in this use case*?*

Why might AI be *dangerous* in this use case*?*

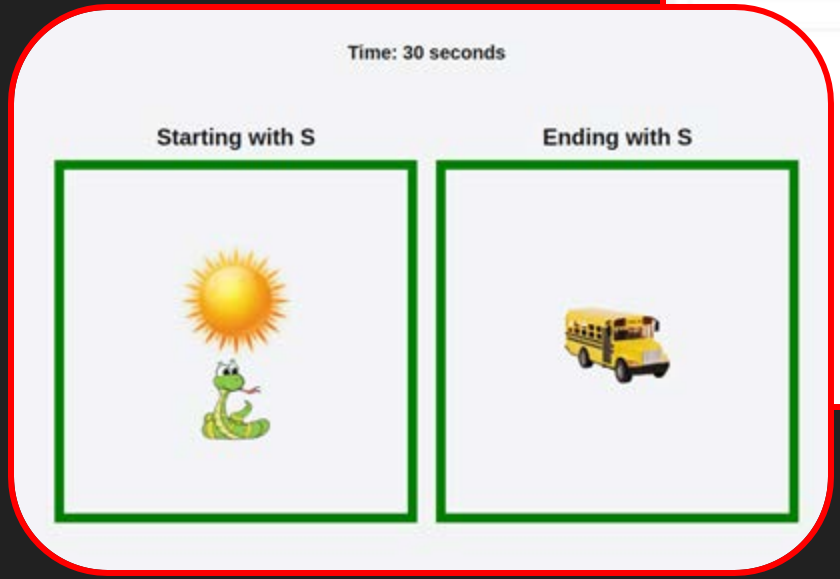
- Malintent from providers
- AI that is ***too prescriptive***
- AI can make mistakes!
- Unclear how decisions were made
- Data security
- Etc. etc. etc.

Takeaways

- We need full ownership of the system
- Augment, not overtake the role of teaching (Teacher > AI)

Okay, but actually, what did we make?

A dynamic assessment and independent practice tool



A dynamic assessment and independent practice tool

- AI-powered
  - Summarizing student performance for teachers/parents
  - Generating new practice prompts based upon performance

A dynamic assessment and independent practice tool

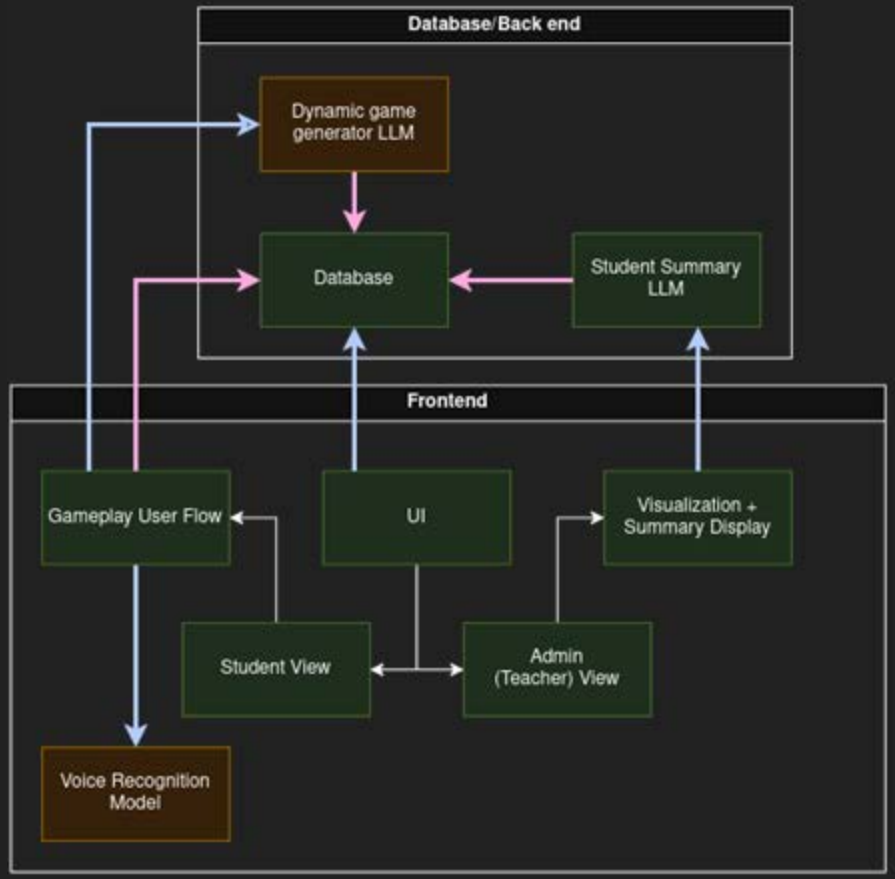
- AI-powered
  - Summarizing student performance for teachers/parents
  - Generating new practice prompts based upon performance

- Full integration to existing curriculum
  - Assessment integration and personalized lesson plans
  - Adding a component to existing digital infrastructure.

The achievements

- Deployed a real application prototype that users can interface with
- Backed this prototype with literacy/education expert support
- Laid out the software infrastructure for future teams to continue our work.

System Diagram



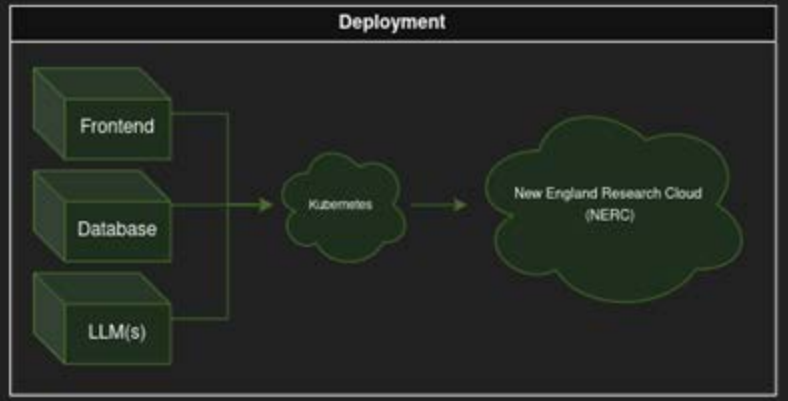
Legend

The **YELLOW** boxes indicate unimplemented features.

The **GREEN** boxes indicated implemented features

The **MAGENTA** arrows indicate data-writing, that is, adding data to the database

The **BLUE** arrows indicate queries, that is, asking the ML algorithm/database for data



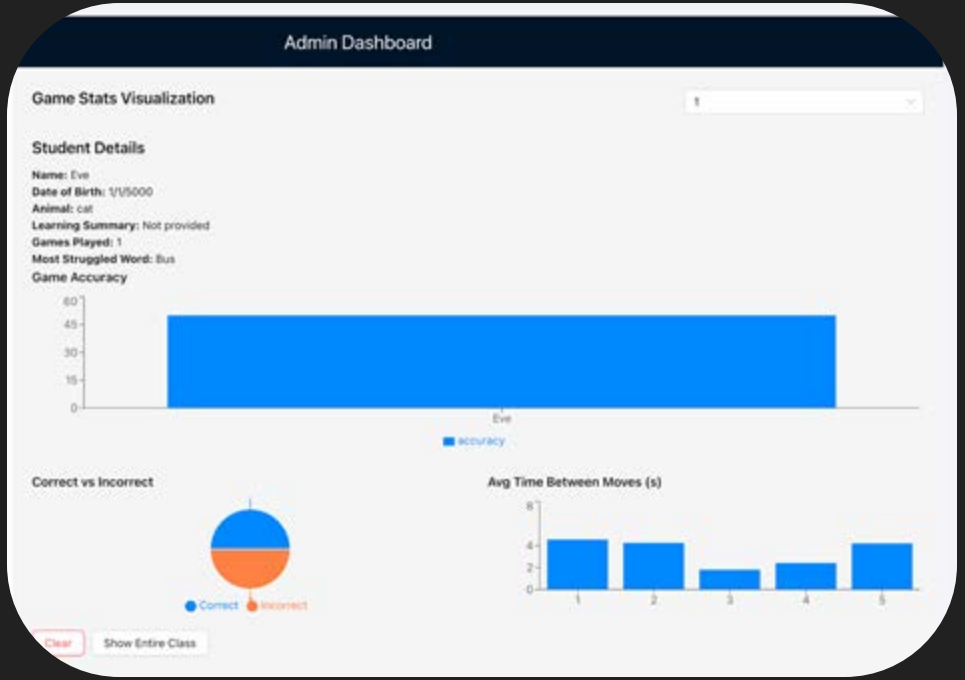
The student view of our frontend

Main Goal: create an **interactive** and **personalized game** to incentivize students to play

The admin/teacher view of our frontend

- Game data visualization
- LLM Summary of class and

  Individual students



Privacy and Security

FERPA

Family Educational
Rights & Privacy Act

COPPA

Children's Online
Privacy Protection Act

Privacy and Security

- **Role-based access** system with protected routes and cookies
- **Encrypted storage** and **transmission** of data

Thank you!

Special thanks to:

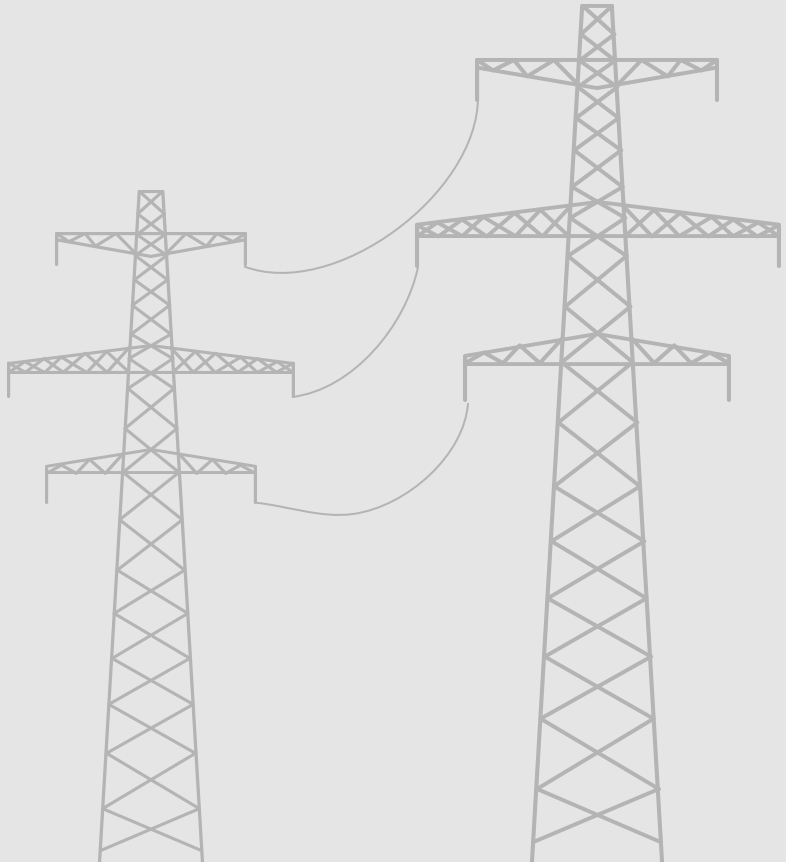
Jessica Townsend, Amon Millner, BU WISE, Reach Every Reader, Red Hat, and so many more!

Olin College of Engineering

Line Vision

Encroachment Detection

Aditi Vinod, Amit Kumar-Hermosillo, Daniel Quinteros, Kate McCurley, Olga Pidruchna



LINEVISION

Olin College of Engineering SCOPE

The LineVisionaries

Aditi Vinod

Amit KH

Daniel Quinteros

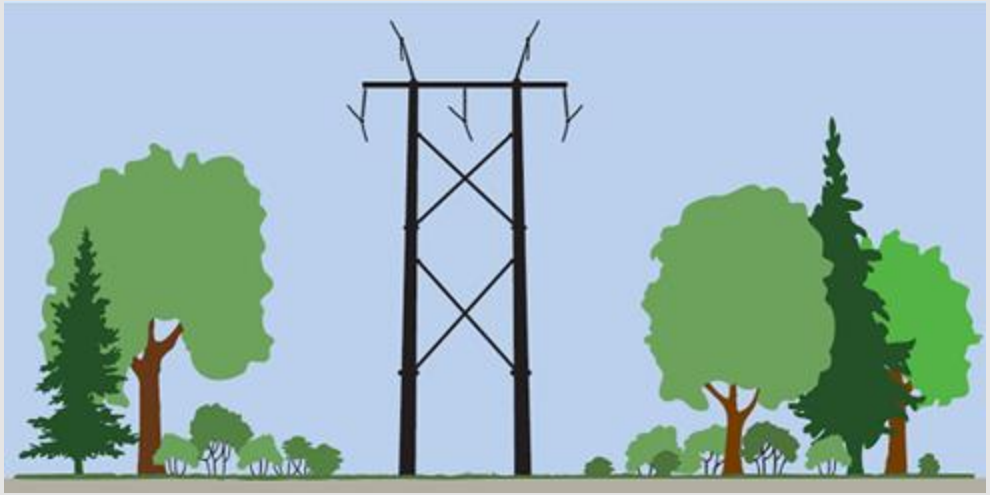
Kate McCurley

Olga Pidruchna

Advisor: Alessandra Ferzoco

Problem

Powerlines require monitoring to prevent **encroachments** (e.g. a tree branch approaching a powerline)



Area of Opportunity

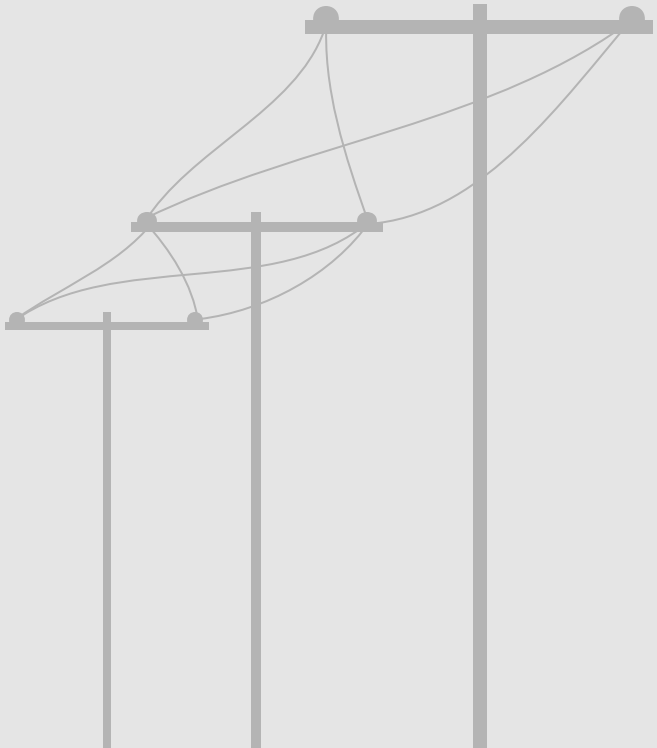
LineVision currently uses LiDAR to monitor transmission lines for encroachments & other risks

BUT…
LiDAR is limited in capability & expensive

Computer vision offers a promising, efficient alternative for monitoring & risk prevention

Objective

Recommend strategies for deploying computer vision on edge computing devices to detect encroachment on transmission lines



Full System Pipeline

Take a picture of the powerline

Capture

01

02

Identify

Run model on an image to locate powerlines and vegetation

Run depth estimation model to find encroachments

Measure

03

04

Send

Send encroachment data to user dashboard

On Hardware

Dataset

Acquired images

Collection

01

Dataset

Acquired images

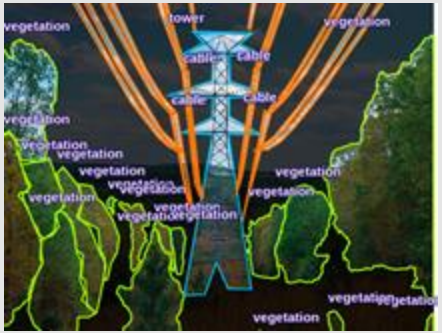
Annotated data with polygons

Collection

Annotation

01

02



Dataset

Acquired images

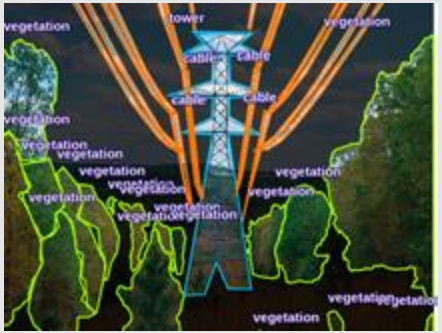
Collection

01

Annotated data with polygons

Annotation

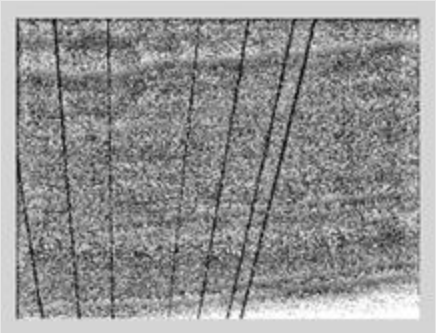
02



Increased contrast on entire dataset

Preprocessing

03



Dataset

Acquired images

Collection

01

Annotated data with polygons

Annotation

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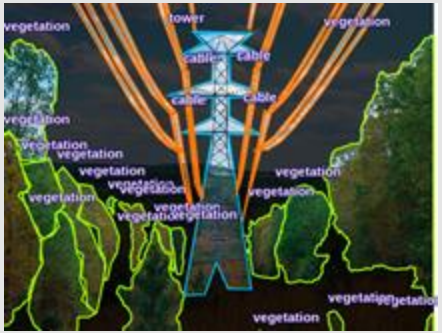
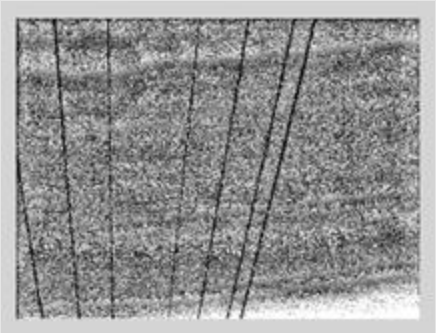


Increased contrast on entire dataset

Preprocessing

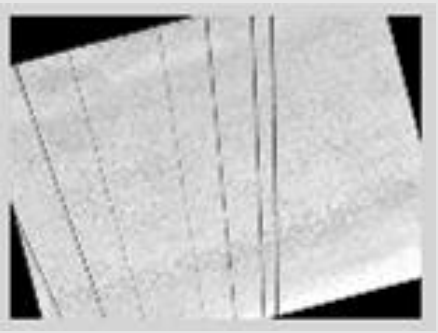
03



Transformed & added some images to dataset

Augmentation

04



Model Overview

Instance segmentation - Creates masks for individual objects
Pretrained model tuned on our dataset

Fine Tuned Weights (On Our Dataset)

Pretrained YOLO Model (On Common Objects in Context Dataset)

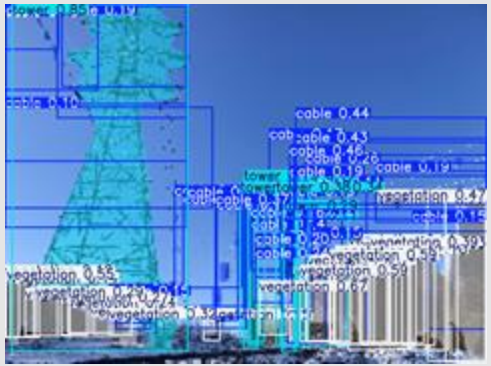
→

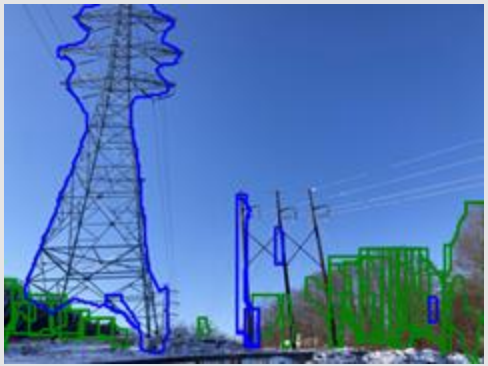
Individual Object Masks

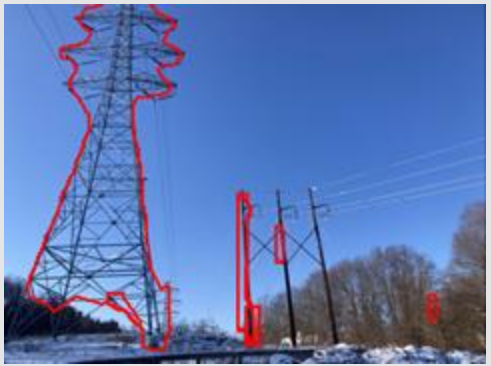
Determining Encroachment

Method #1: Find pixel distances between objects

Limited accuracy & higher risk of false encroachment alerts







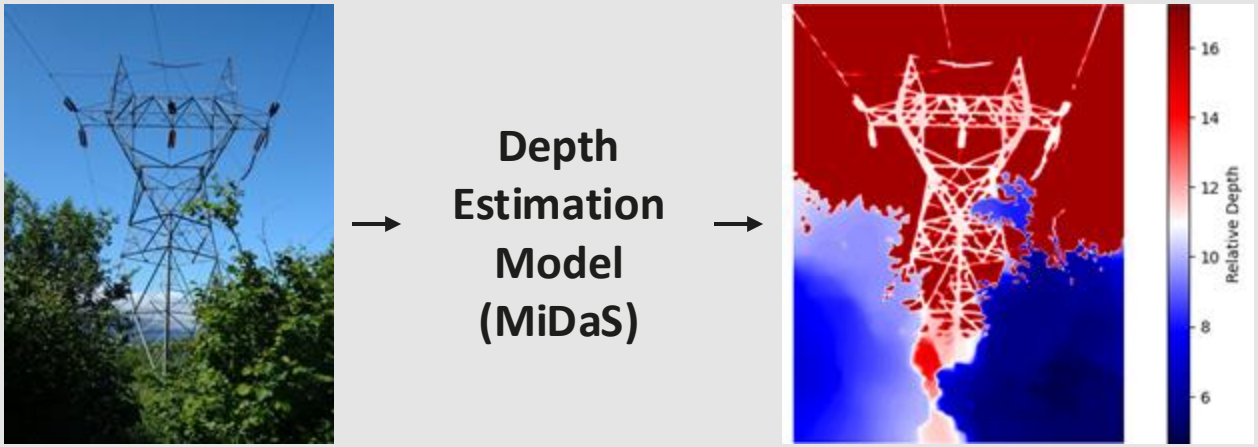
Determining Encroachment

~~**Method #1: Find pixel distances between objects**~~

~~Limited accuracy & higher risk of false encroachment alerts~~

Method #2: Use depth estimation model

More accurate (less false alerts) and compatible with camera setup



Deploying Models on Hardware

01 Compilation

Compile model from development format to final, hardware-compatible format

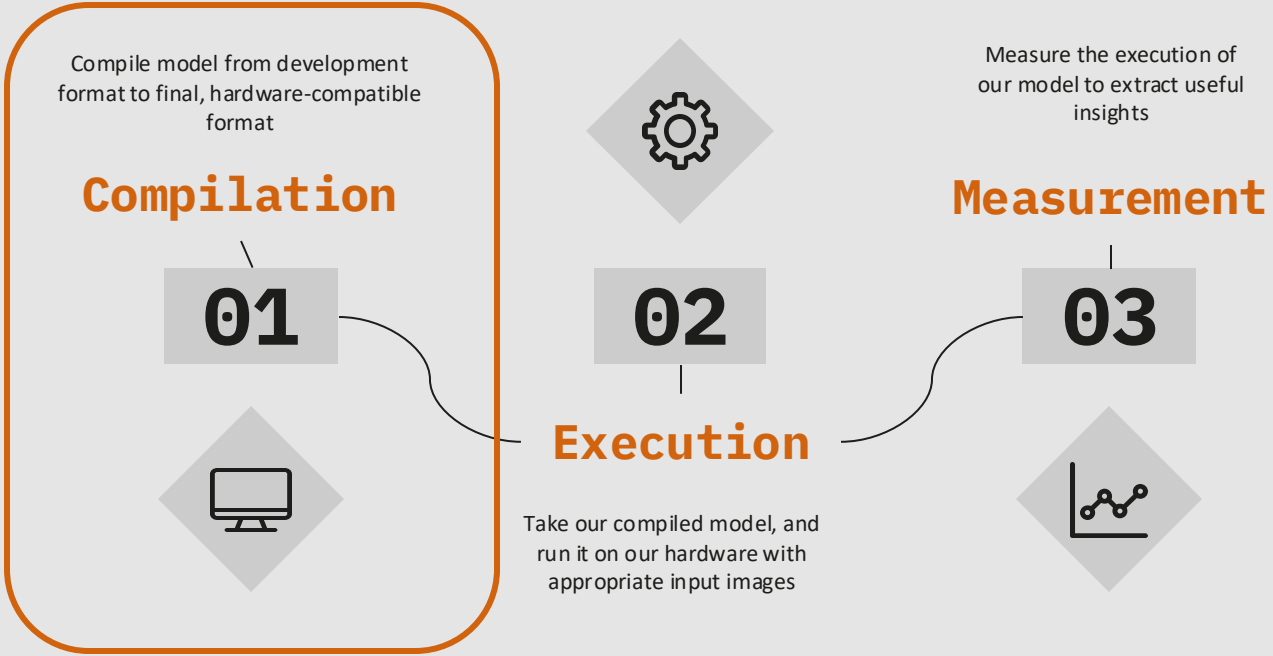
02 Execution

Take our compiled model, and run it on our hardware with appropriate input images

03 Measurement

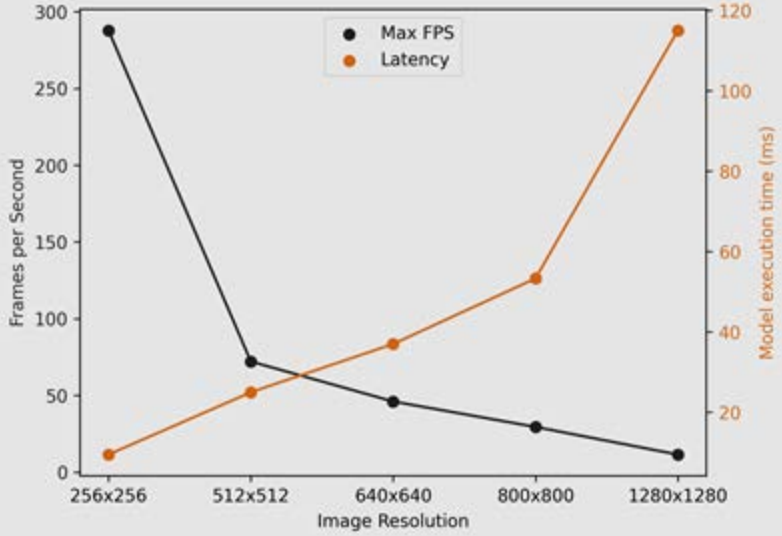
Measure the execution of our model to extract useful insights

Deploying Models on Hardware

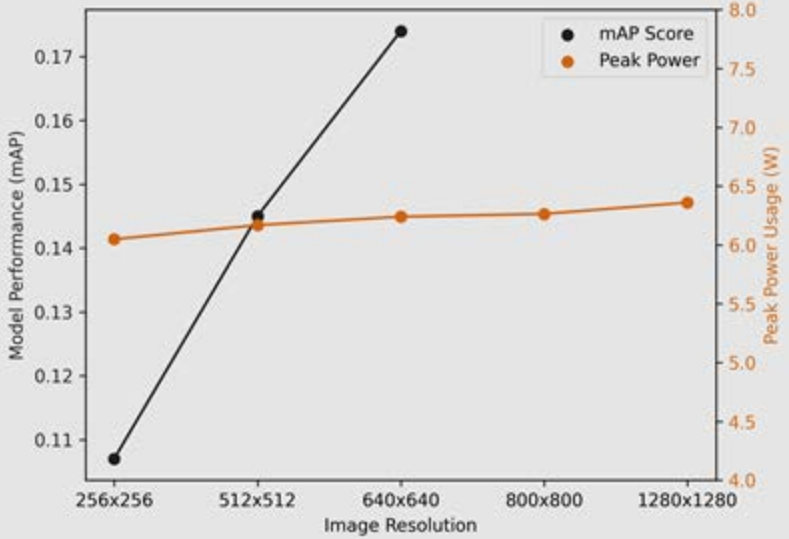


Model Performance by Resolution

Model runtime



Precision vs Power Consumption



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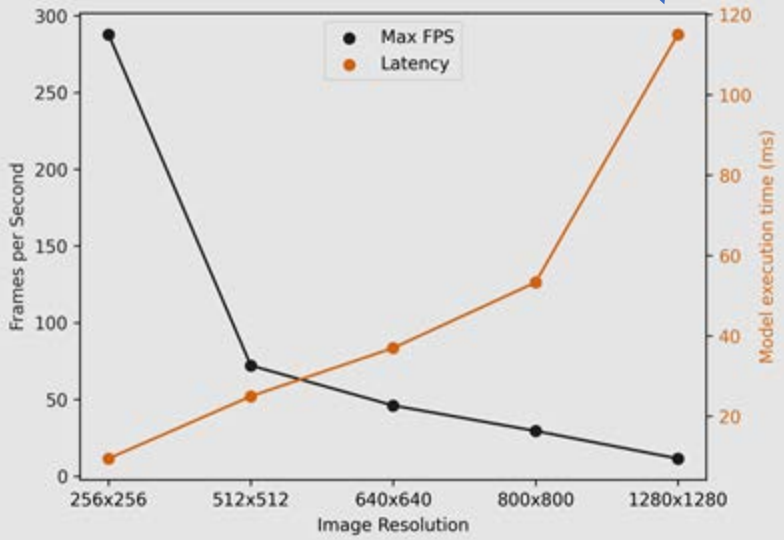
Execution time
< 200 ms



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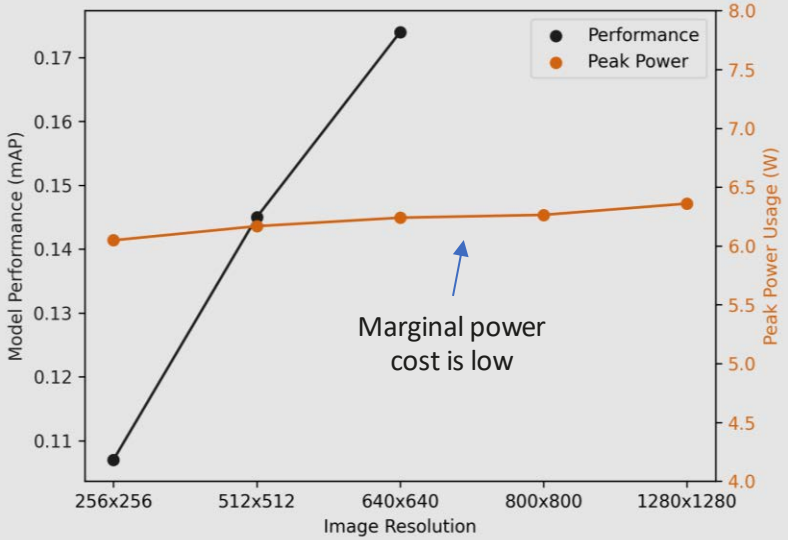
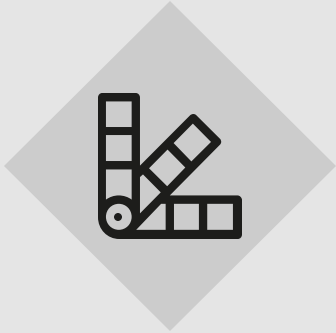


Recommendations

Create custom dataset with post-processing for changing conditions

Train & fine tune YOLO instance segmentation model on custom dataset



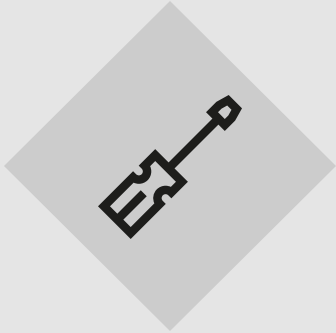
Use MiDas model to estimate depth of encroachments

Consider hardware constraints early and often; develop for high resolution

Future Exploration

Create more comprehensive dataset & further tune model

Integrate user input of environment to increase confidence



Use custom synthetic data to fine-tune depth estimation model

Finalize compilation pipeline to be able to run end-to-end tests on hardware

Thank You!

Acknowledgements:
Dominic Orlando
Mohammad Imtiaz
Alessandra Ferzoco
Steve Matsumoto
LineVision

Olin College of Engineering

Massachusetts Department of Early Education and Care

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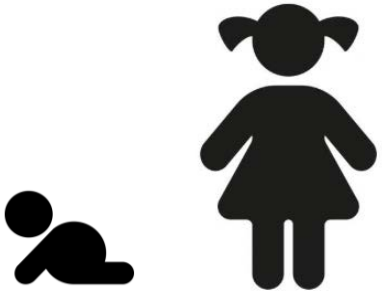

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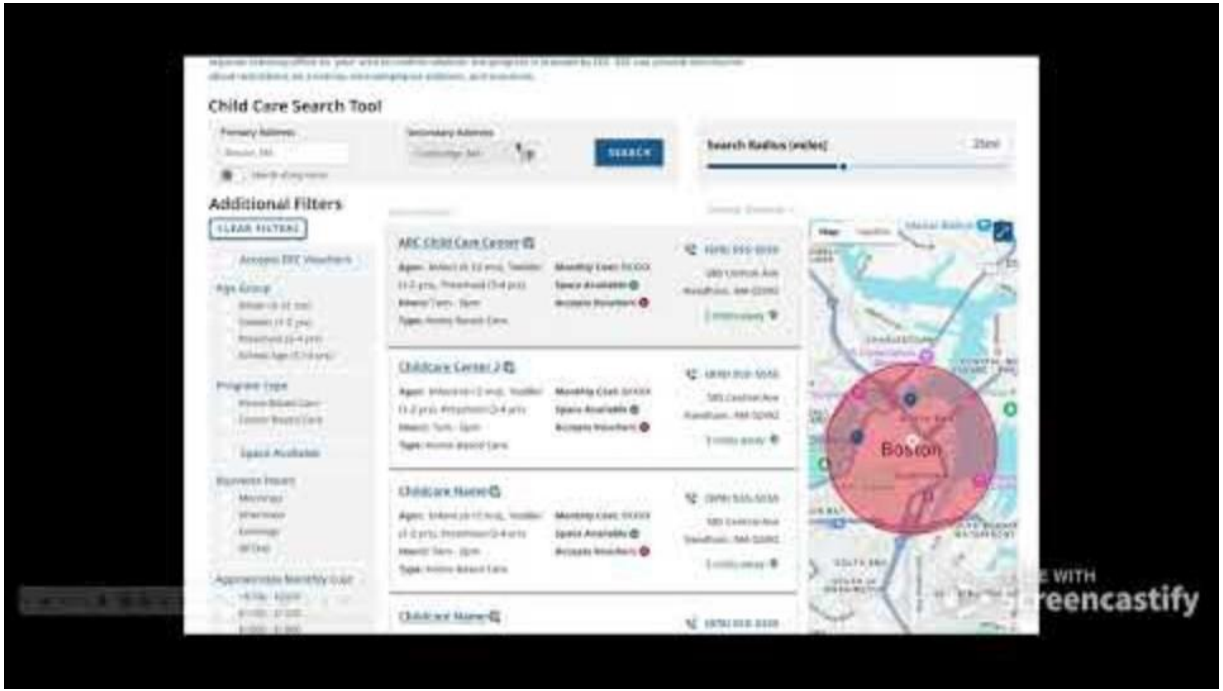

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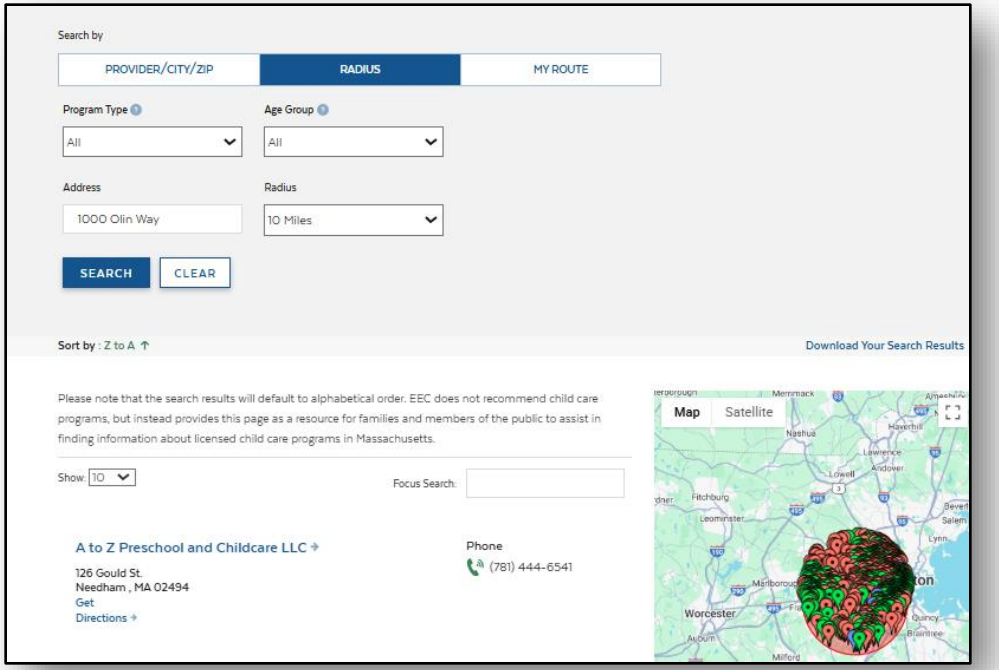

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Olin College of Engineering SCOPE

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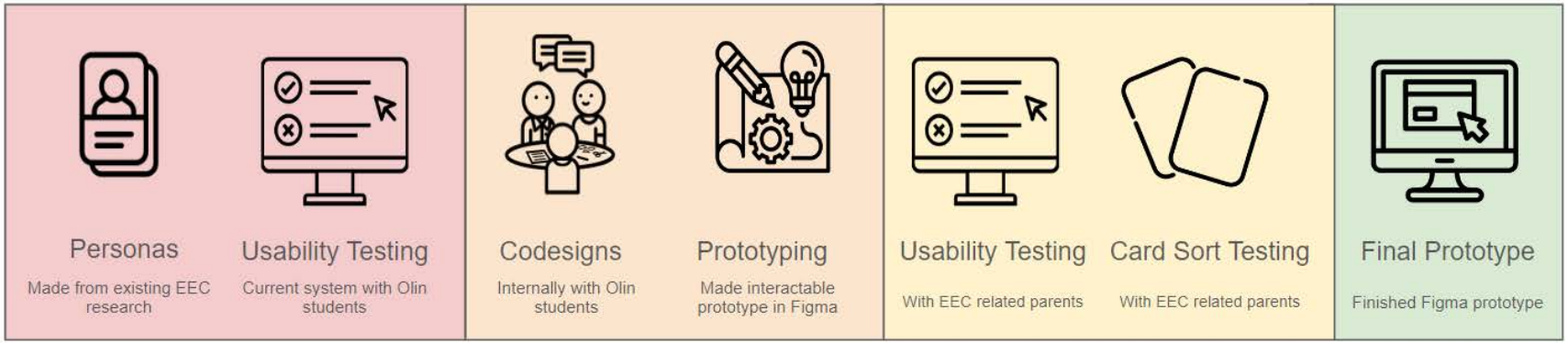

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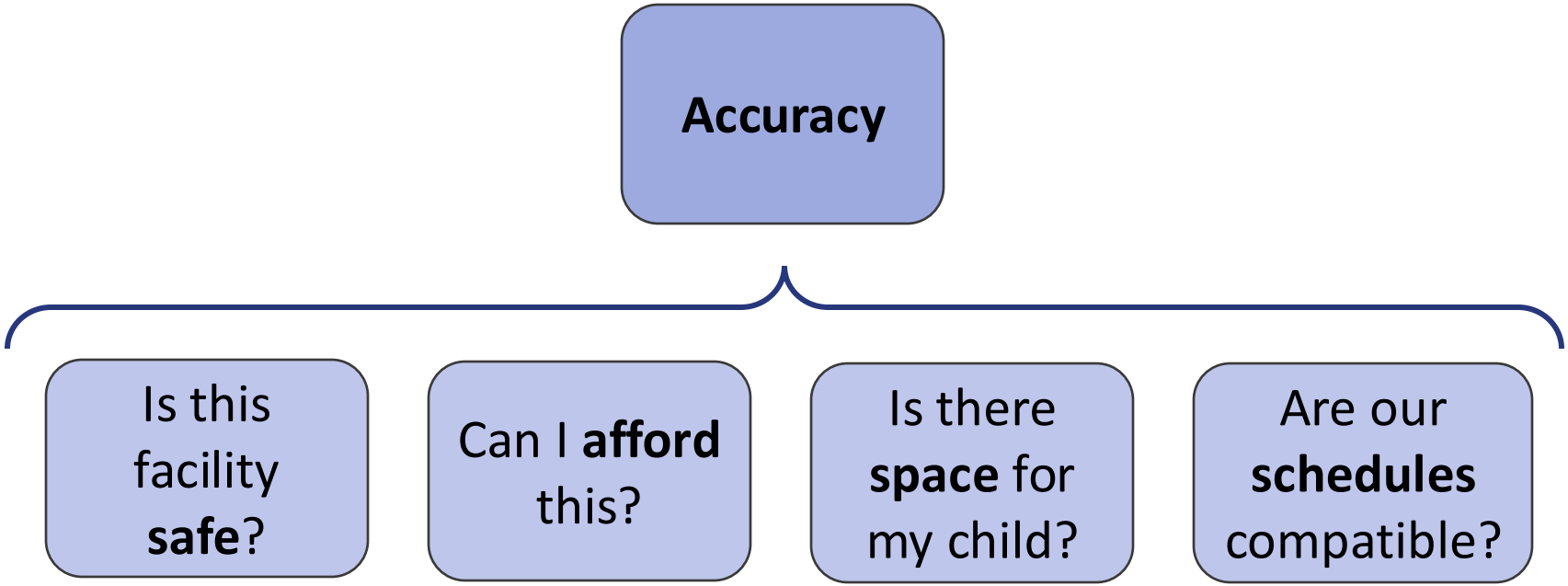

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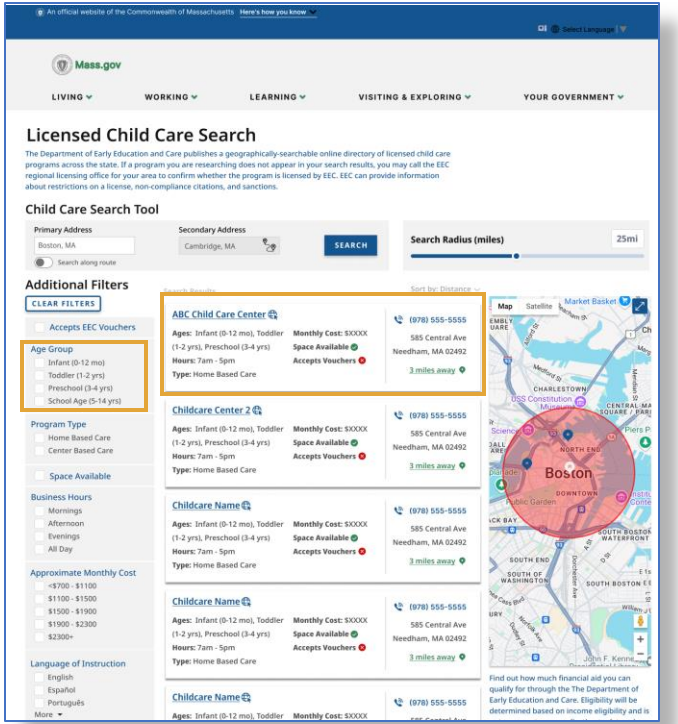

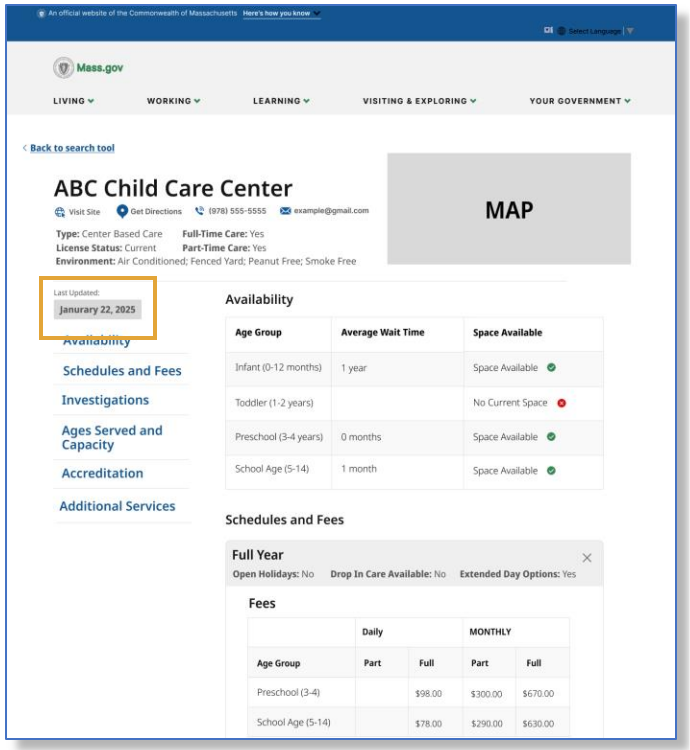

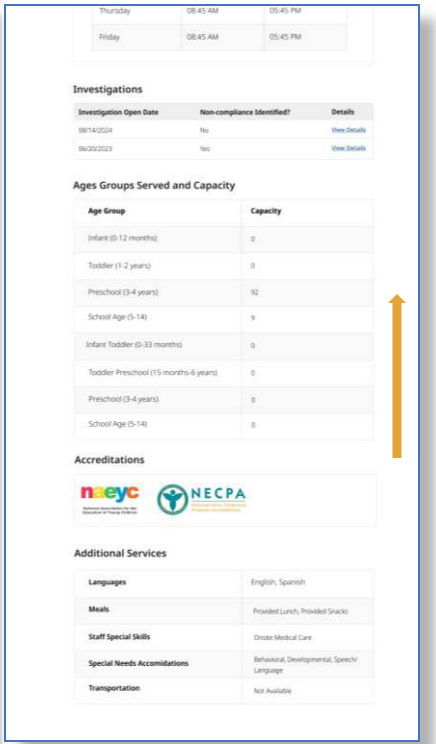

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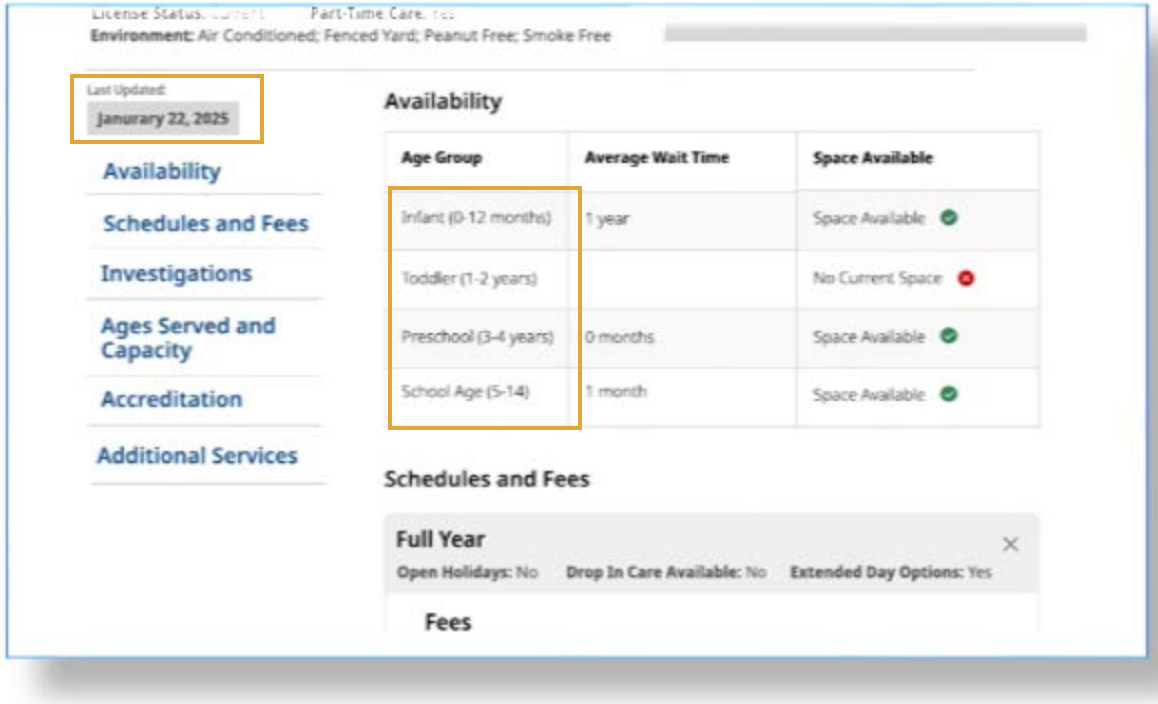

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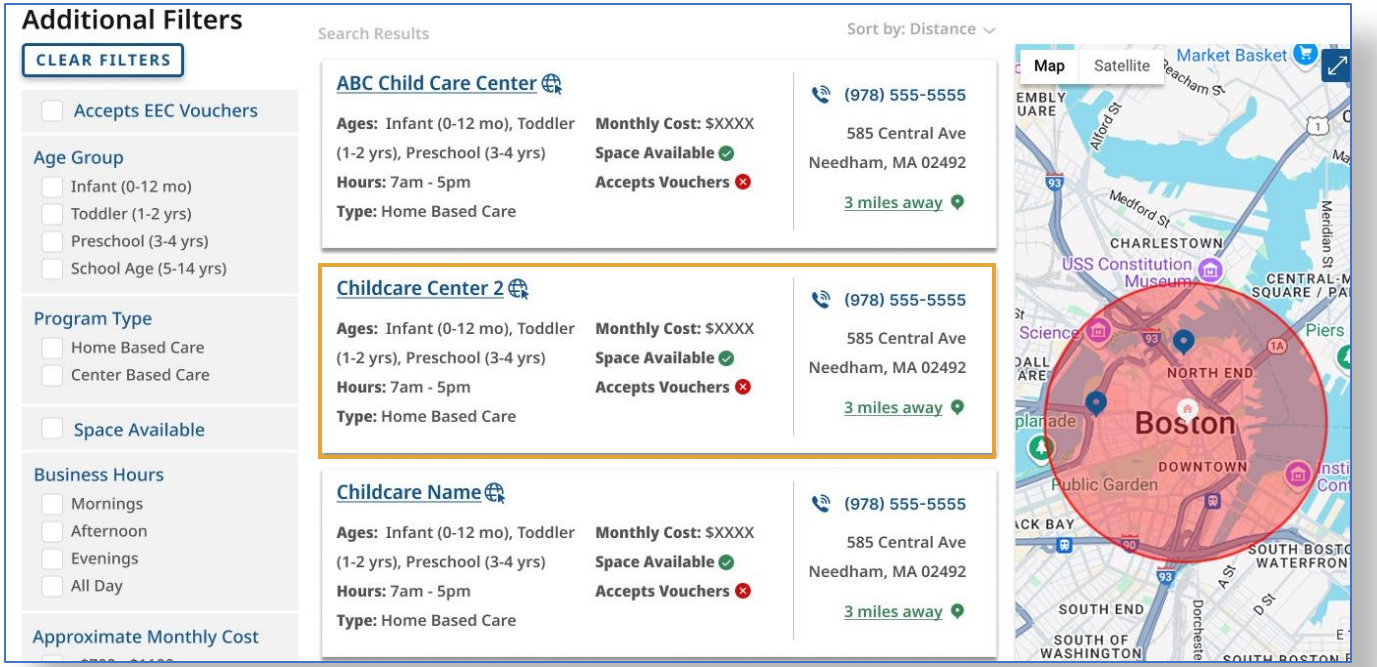

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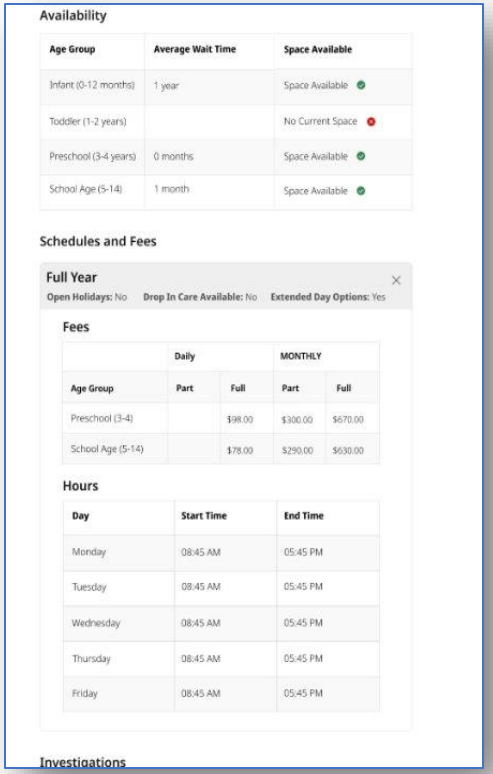

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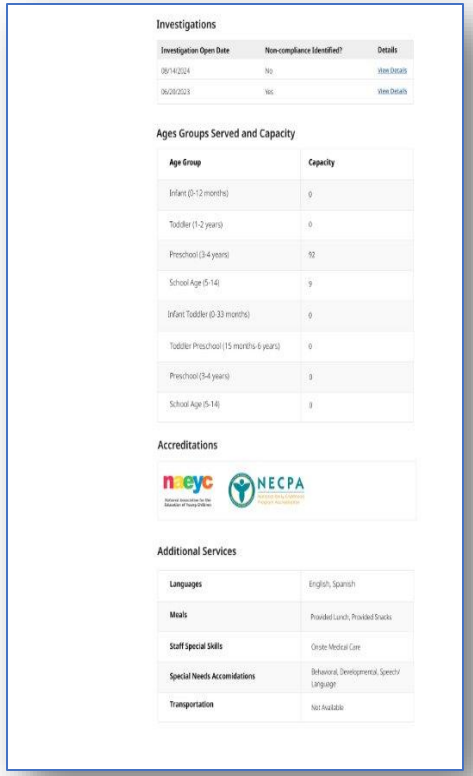

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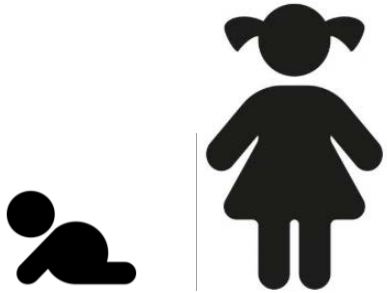

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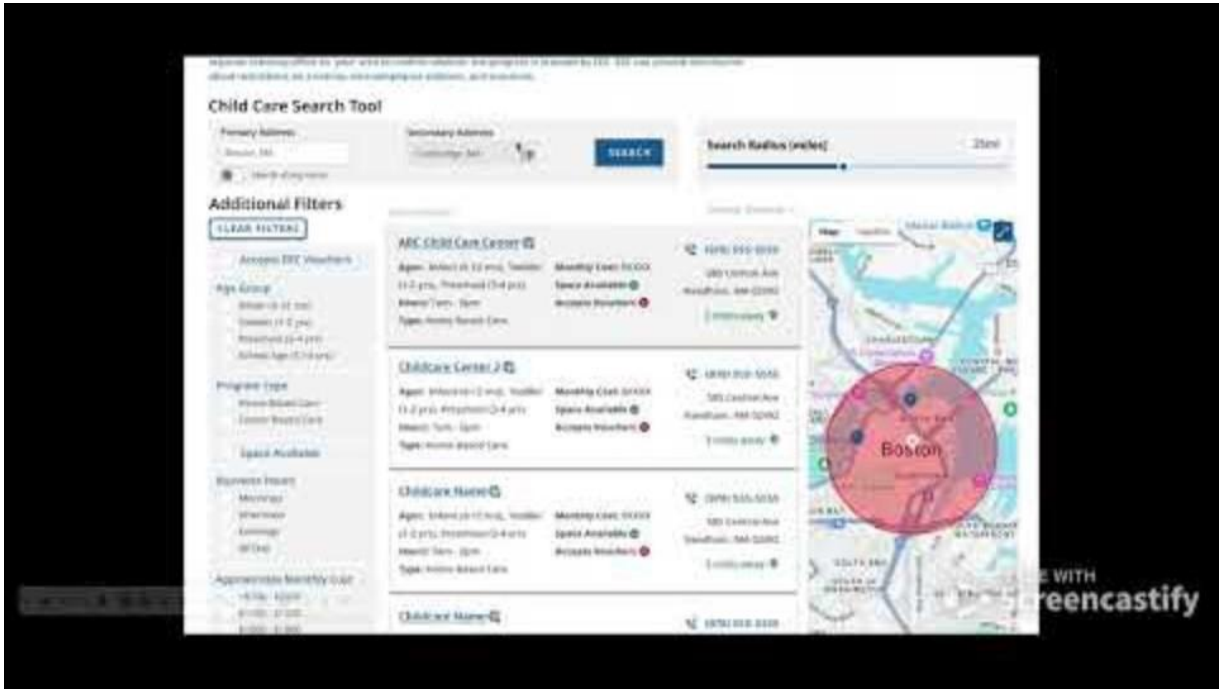

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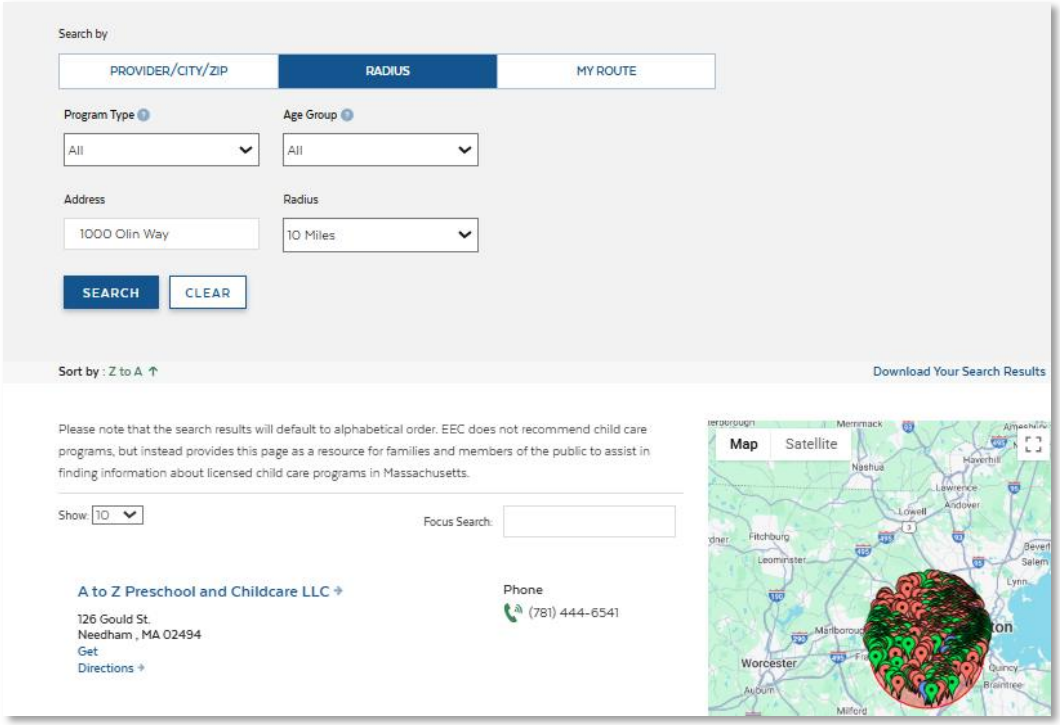

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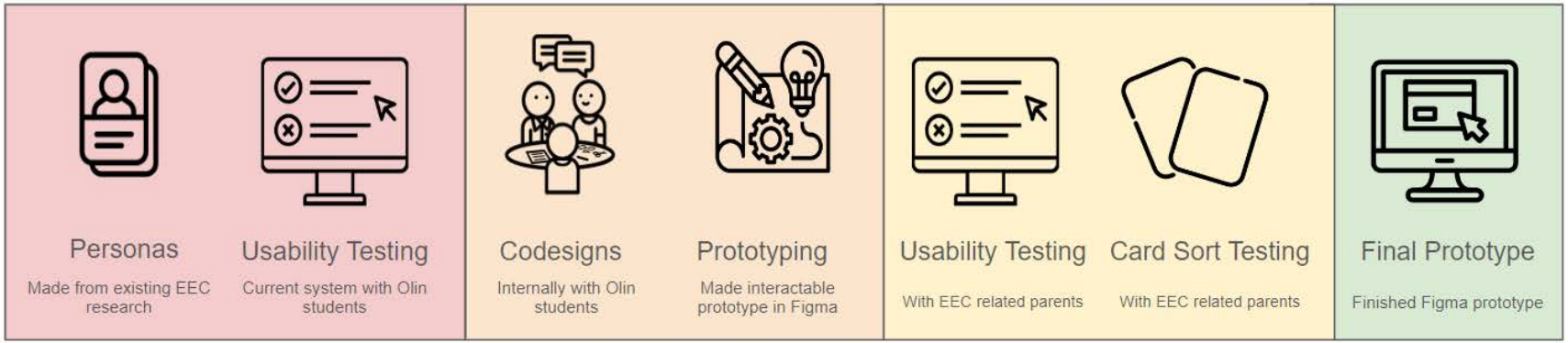

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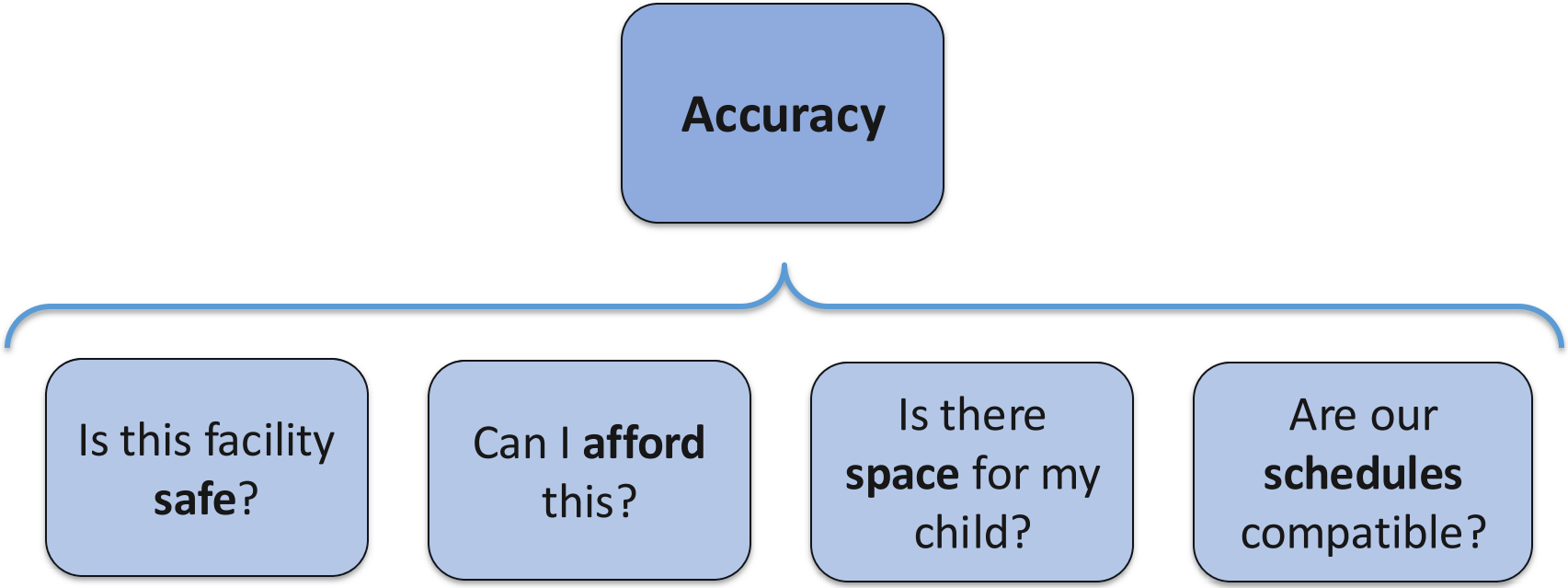

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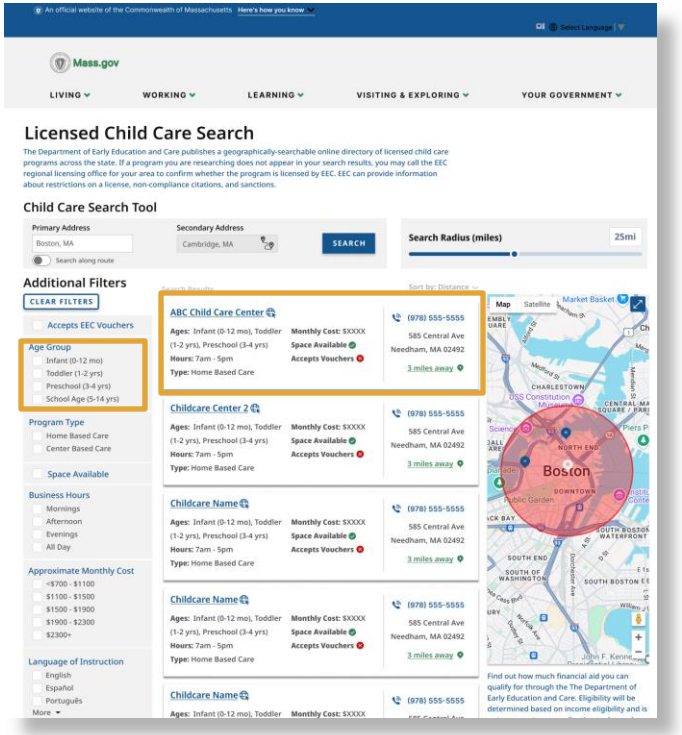

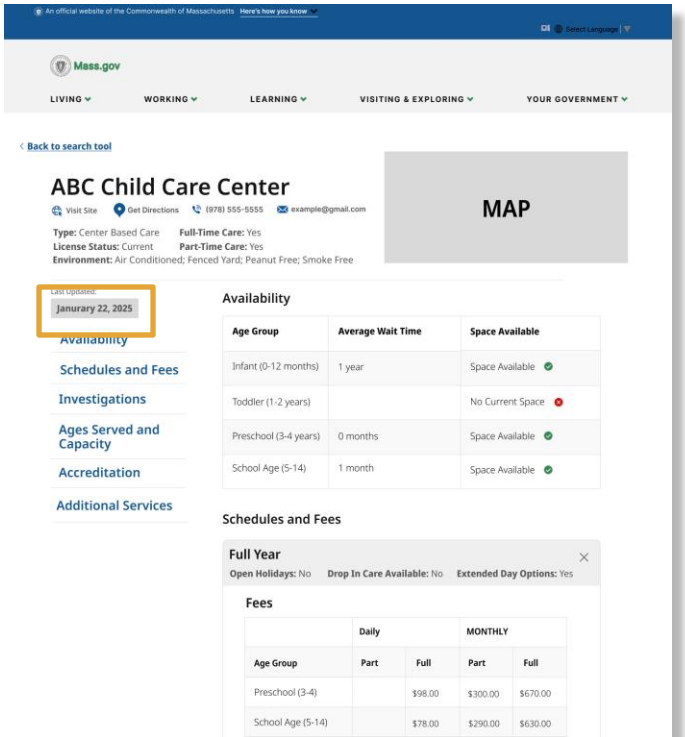

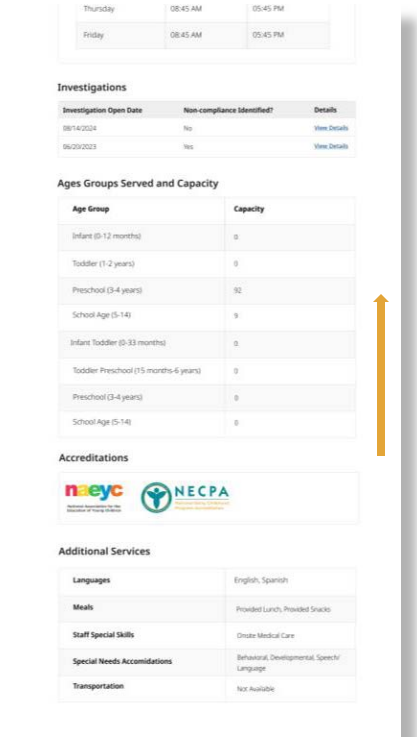

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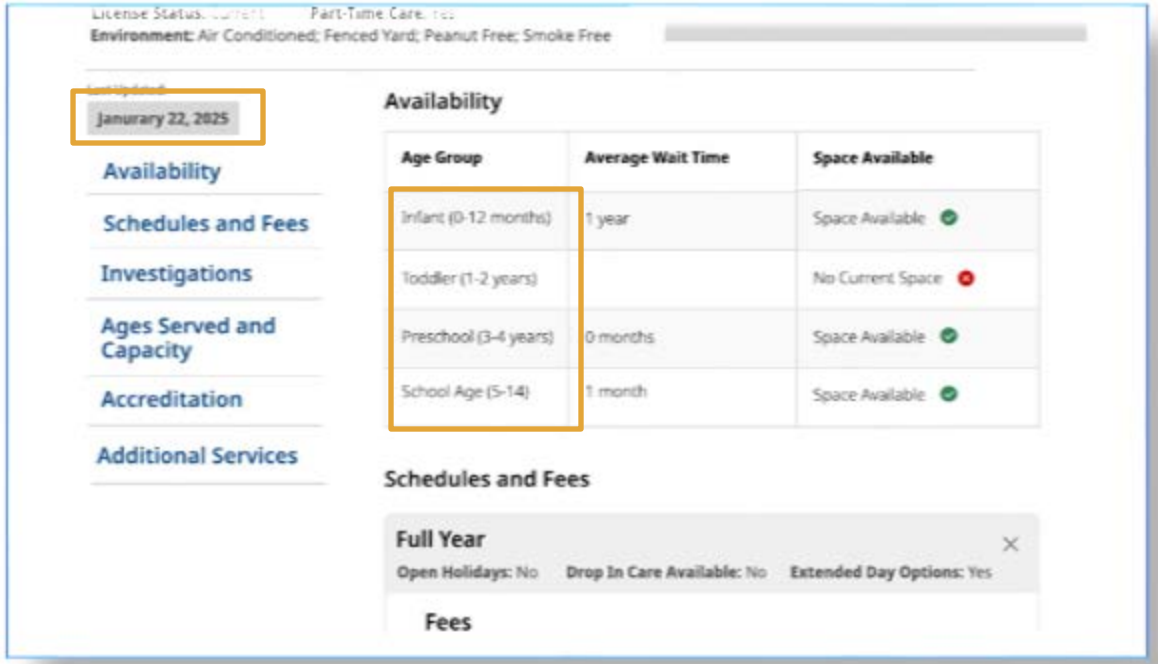

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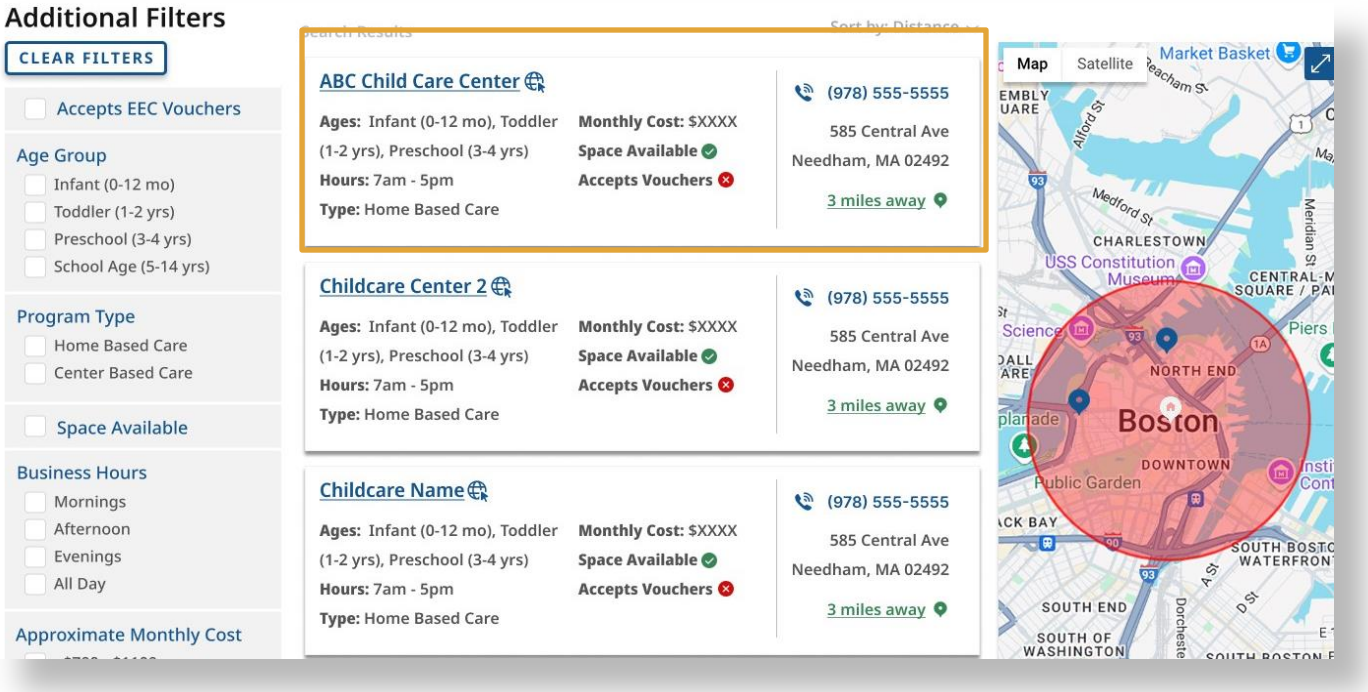

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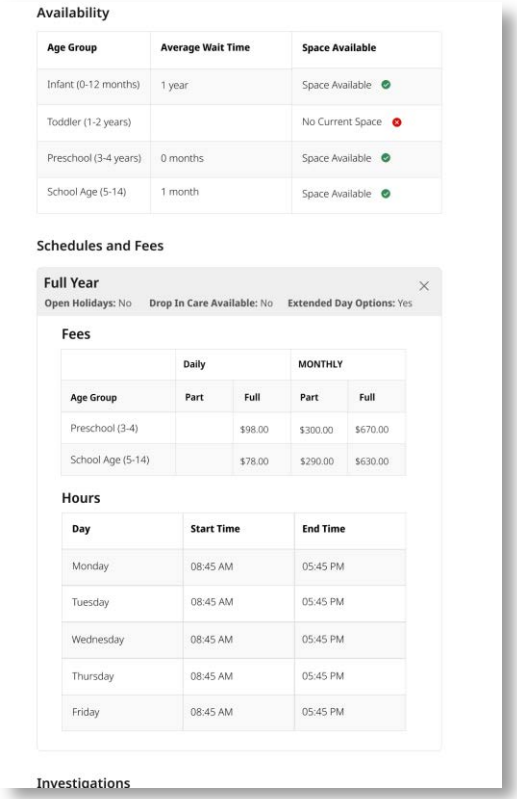

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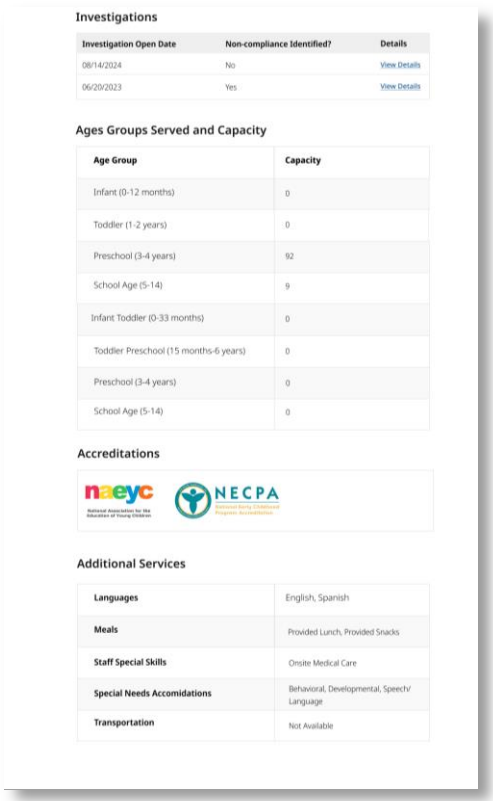

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Olin College of Engineering

10 Minute BREAK

Olin College of Engineering

Microsoft NERD / flok

Building Better Consent For Health Data Sharing

Microsoft NERD and flok

We need your consent to set cookies on your device.

To agree, click "Accept below.

Accept

Reject

More information

Microsoft

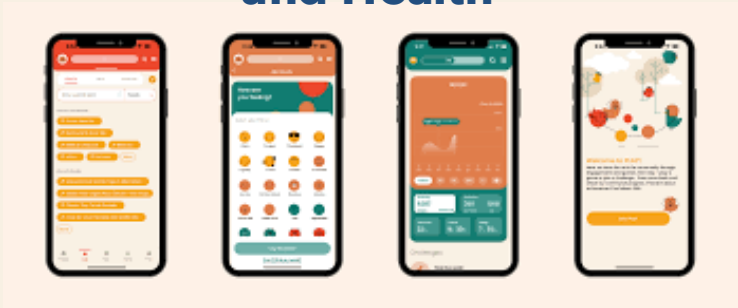
flok

flok

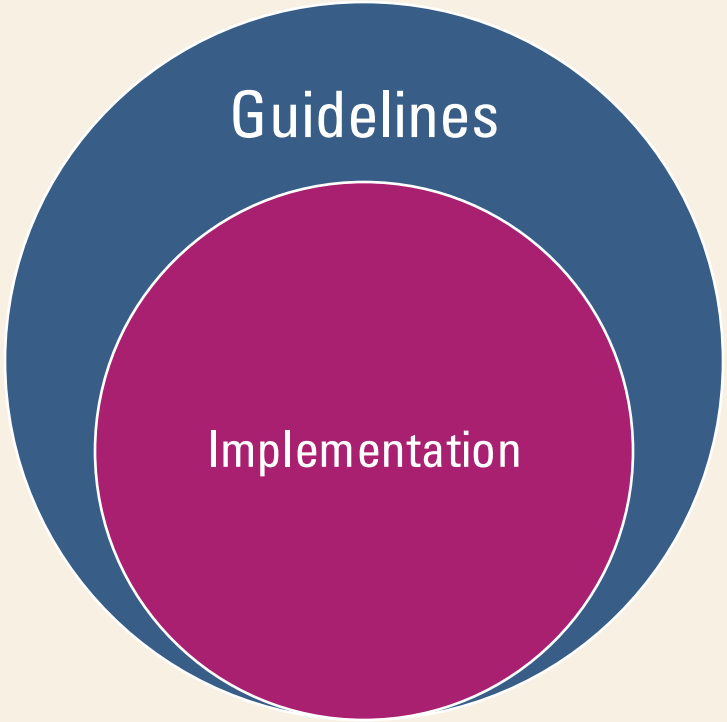
Community Facilitator

** Image used with permission from flok*

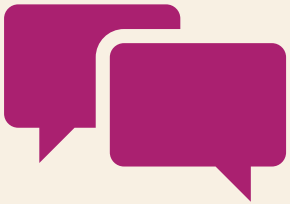
App for tracking Metabolic Diet and Health



Defining A Consent Framework

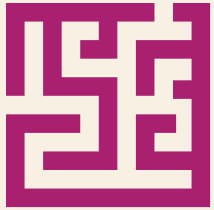


Digital Consent & Health Data



IMPLEMENTATION IS MORE THAN VERBAL.

ONGOING



REVOKING DATA IS MORE COMPLICATED.

Freely Given — a voluntary decision made without pressure or influence which could impact the decision

Active — Applications must allow users to personalize what they consent to and must directly and unambiguously ask for consent

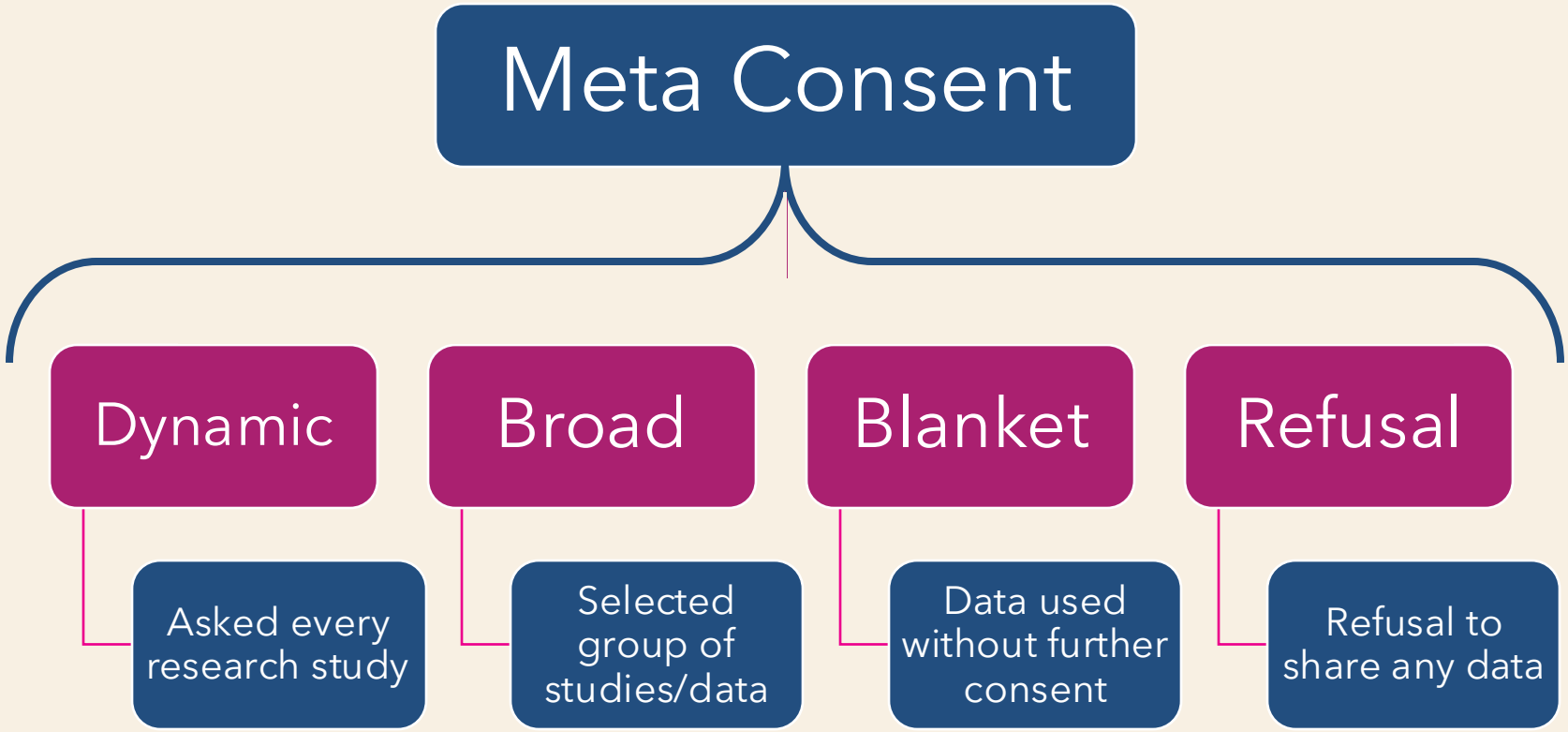
Informed — Users have access to specific information on how their data is collected and used. All information is easily found.

Reversible — Users can pause data collection and can request data deletion at any time

Human Centered Design

Focus Groups

Community Co-designs


Meta Consent
Dynamic
Asked every research study
Broad
Selected group of studies/data
Blanket
Data used without further consent
Refusal
Refusal to share any data

Meta Consent Example

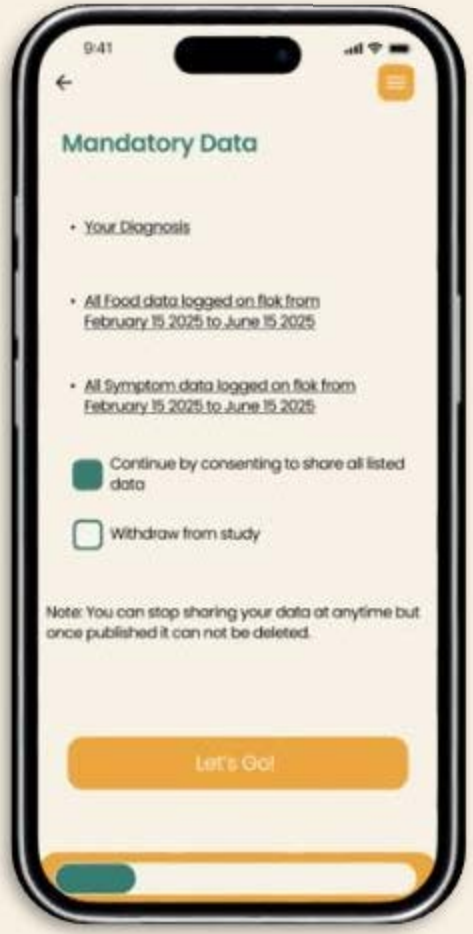
Meta consent form								
Content		**Dynamic**		**Broad**		**Blanket**		**Refusal**	
Electronic patient records									
Tissue									
Health data									
Non-health data									
Context		**Dynamic**		**Broad**		**Blanket**		**Refusal**	
Private	Public								
Commercial	Non-commercial								
National	International								

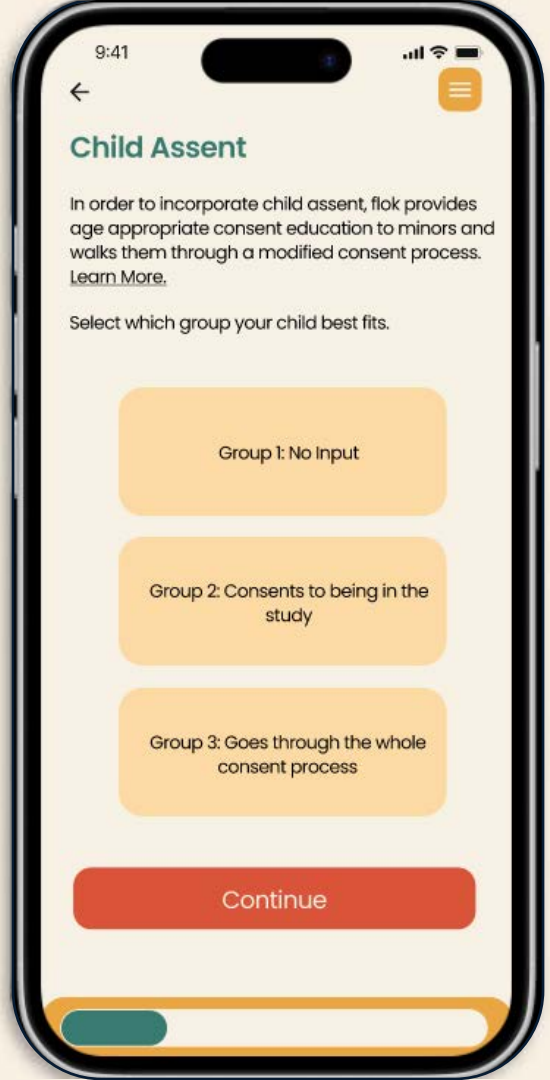
Source: Meta consent framework example : a flexible and autonomous way of obtaining informed consent for secondary research (Ploug and Holm (2016))

New Consent Interface

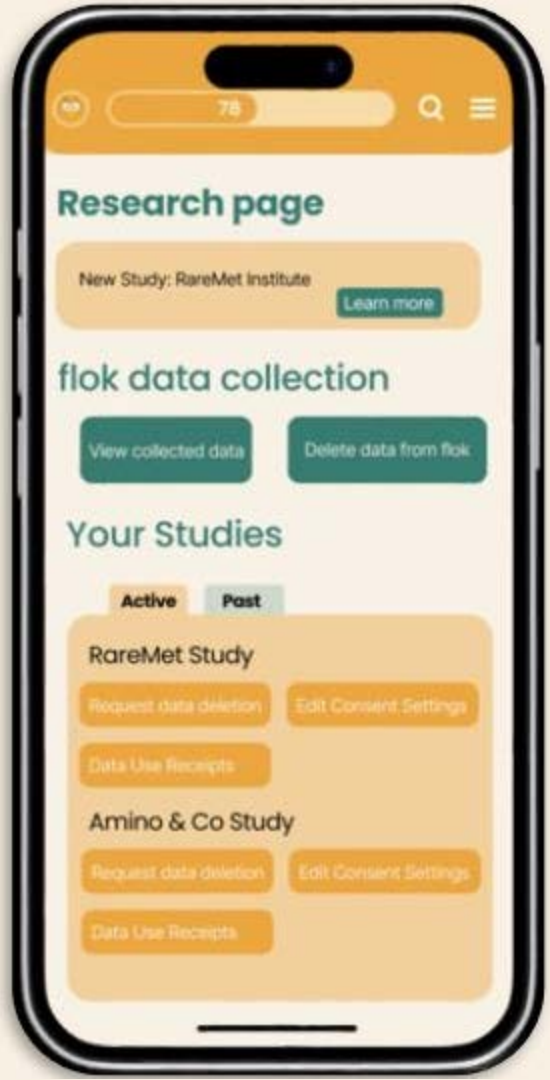
Point of view: A caregiver for a child with a metabolic disorder

Consent Scope



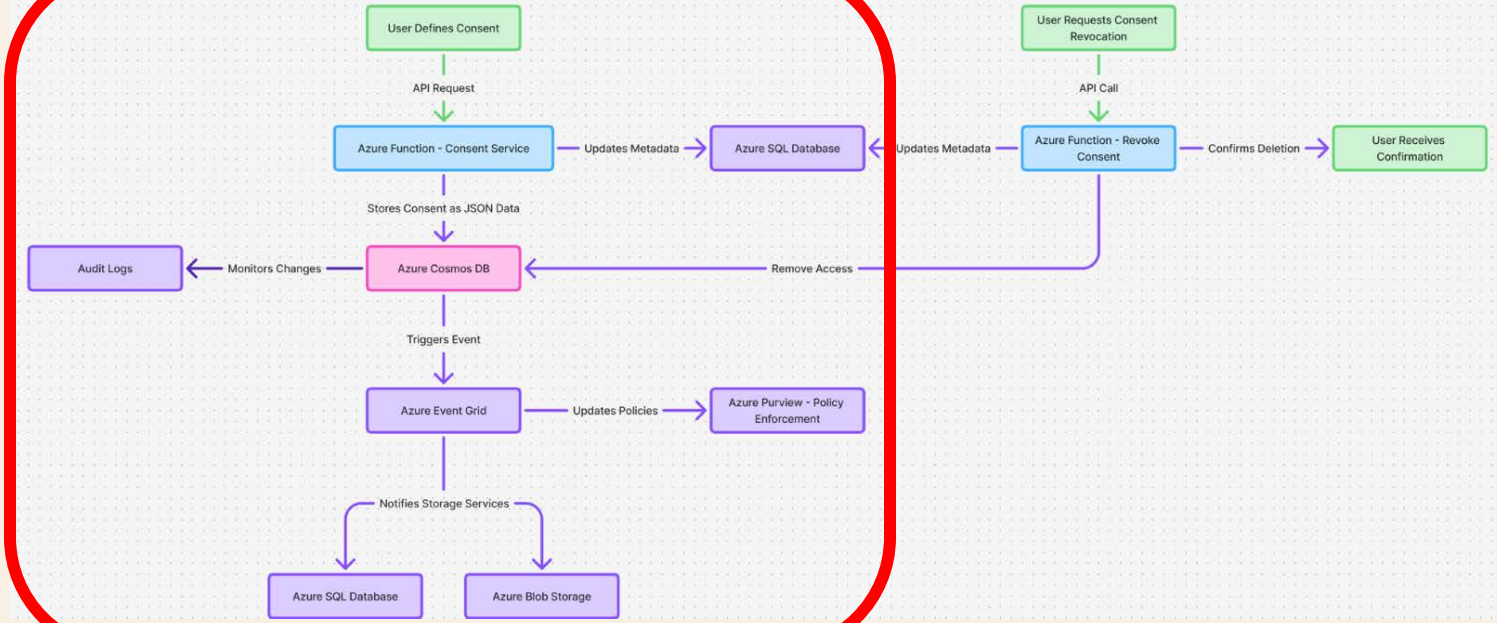


Child Assent

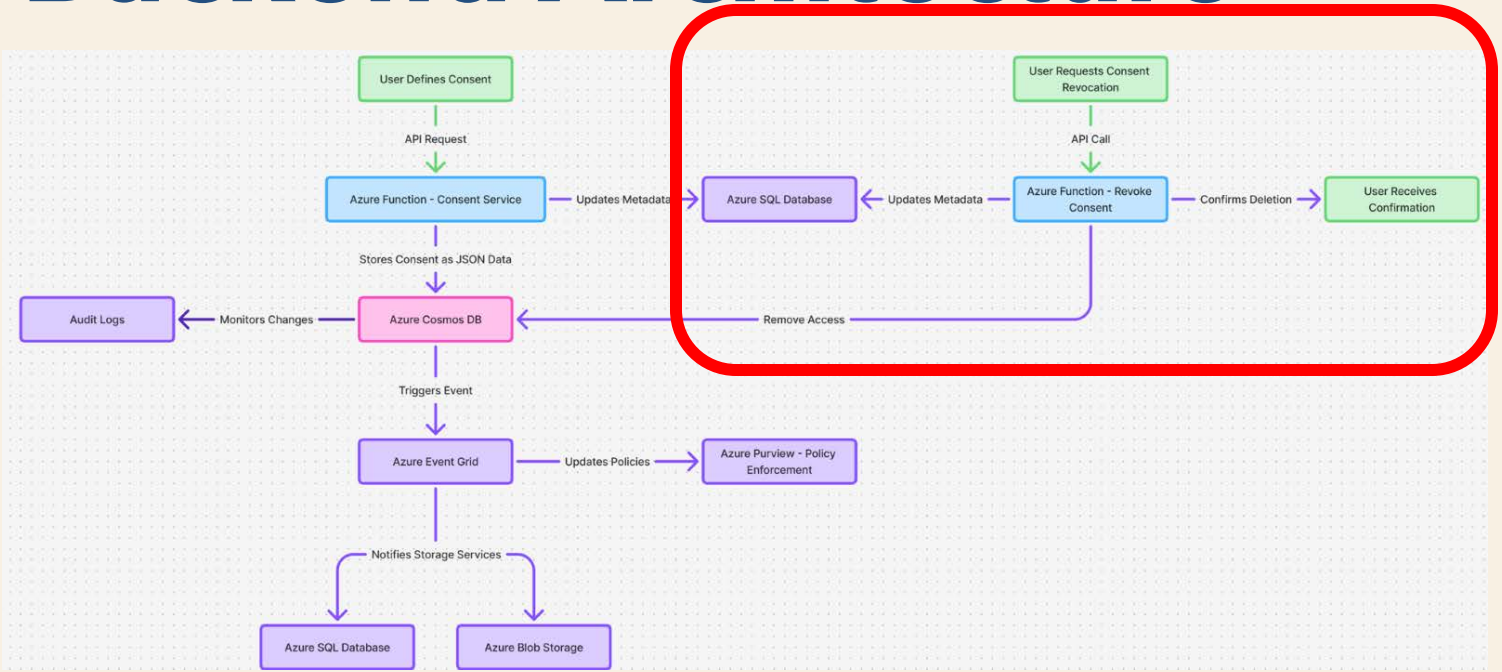


Reversible Consent

BACKEND ARCHITECTURE



Backend Architecture



Conclusion

Next Steps

flok

Microsoft NERD

Thank You!

Special thanks to our SCOPE advisors, SMEs, and liaisons at both Microsoft and flok

Olin College of Engineering

Moderna

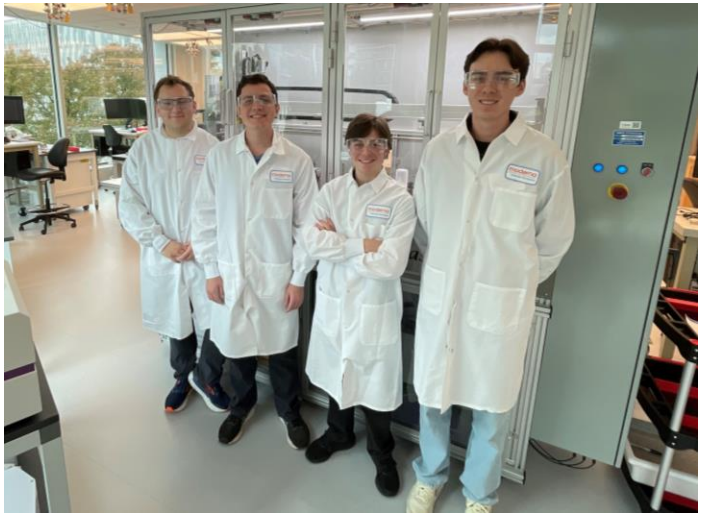
Olin College of Engineering

Open-Source Biotech Robot Orchestration

SCOPE Summit

Olin College Moderna SCOPE Team

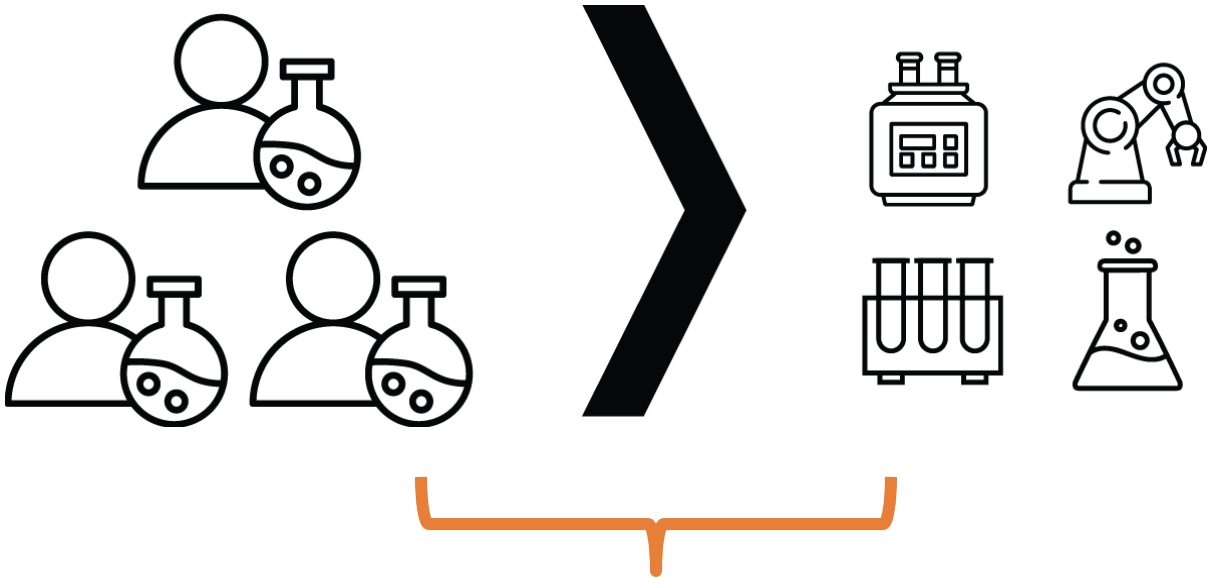
05/09/2025



moderna®

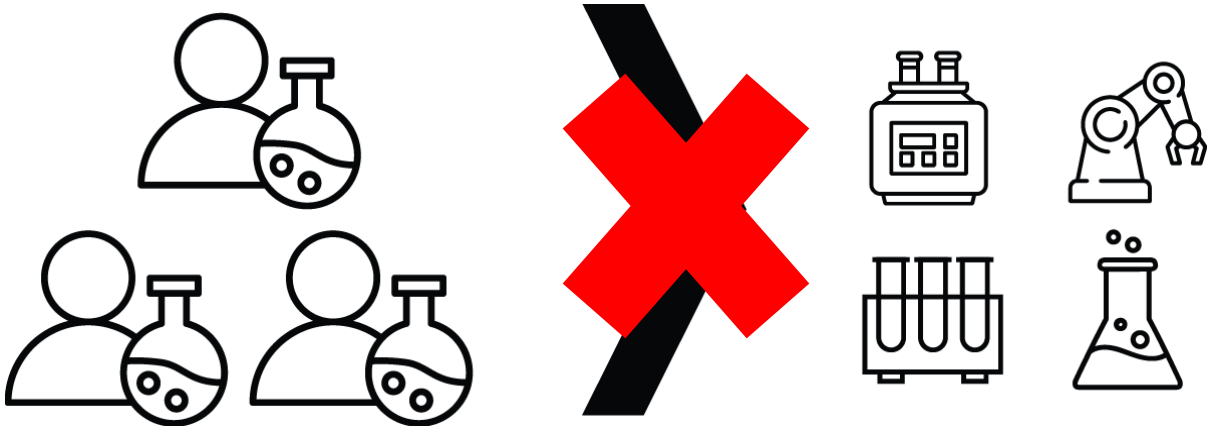
Machines Accelerate Drug Development

Software Bridges the Gap

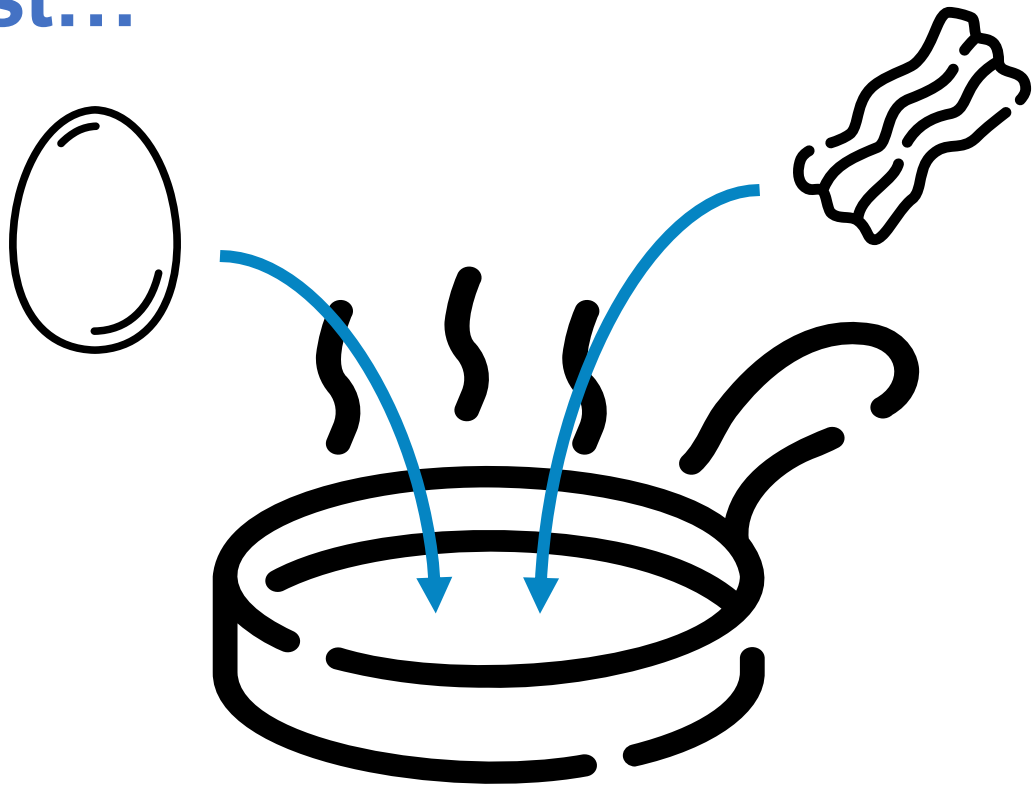


Orchestration Software

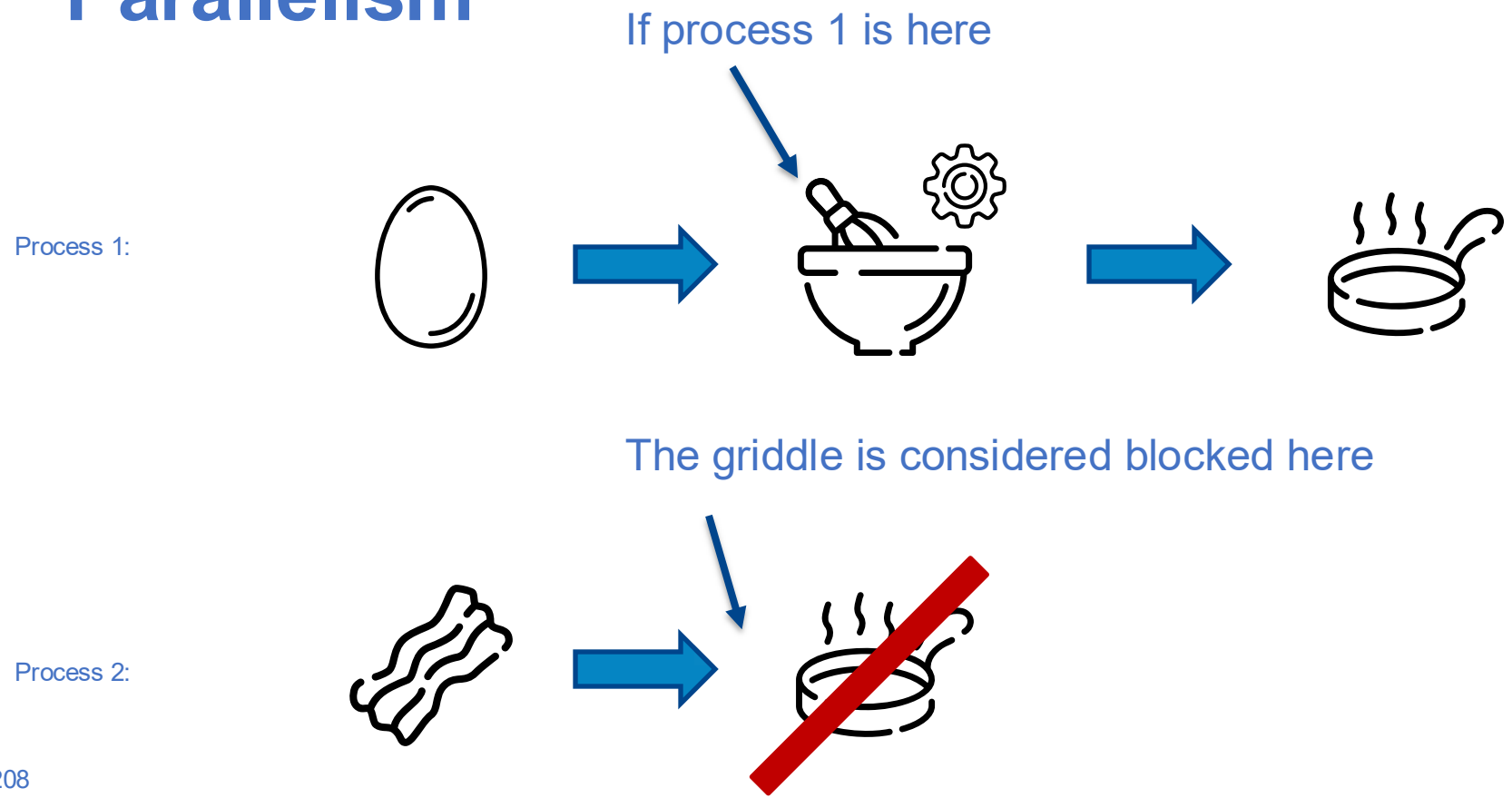
Current Software Fails



Scheduling experiments is like making breakfast…



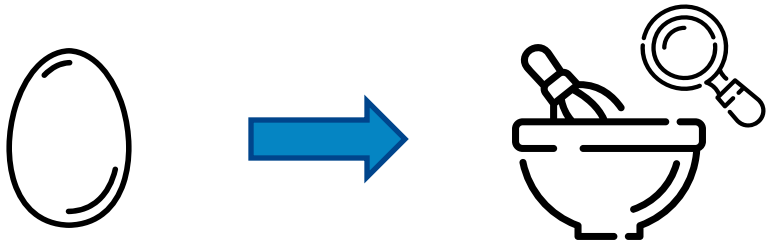
Parallelism



Intervention

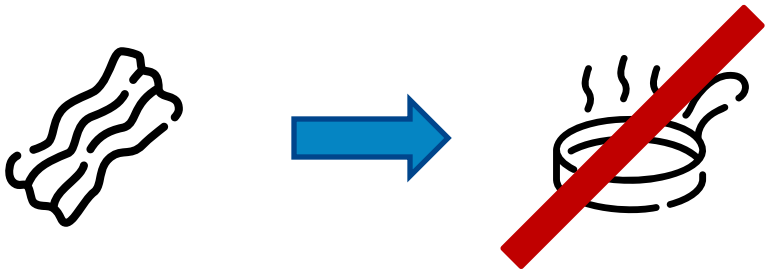
If I intervene on any piece of equipment

Process 1:



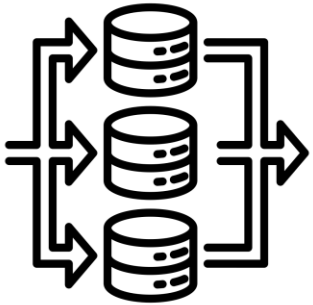
All equipment goes down

Process 2:



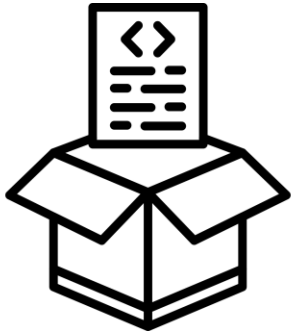

estra

Software Features



Parallel Workflows

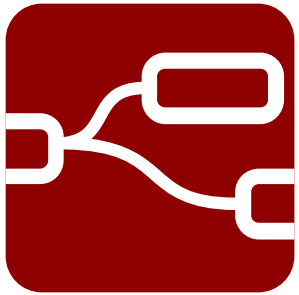
Robust



Stand-Alone

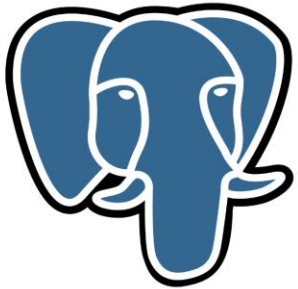
Open Source

Software Components



Node-RED

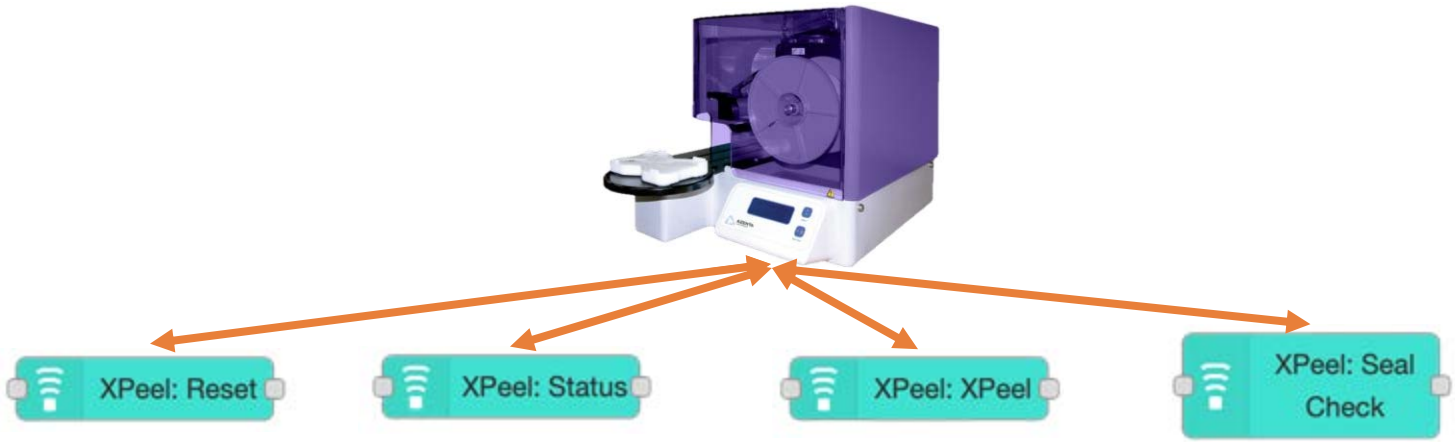
Python



SQL

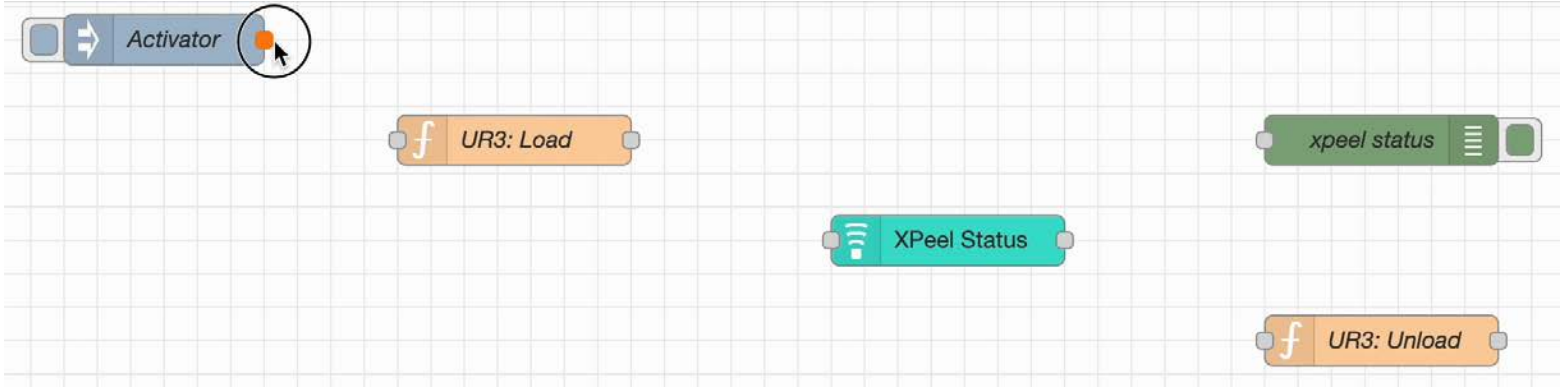
Creating Workflows

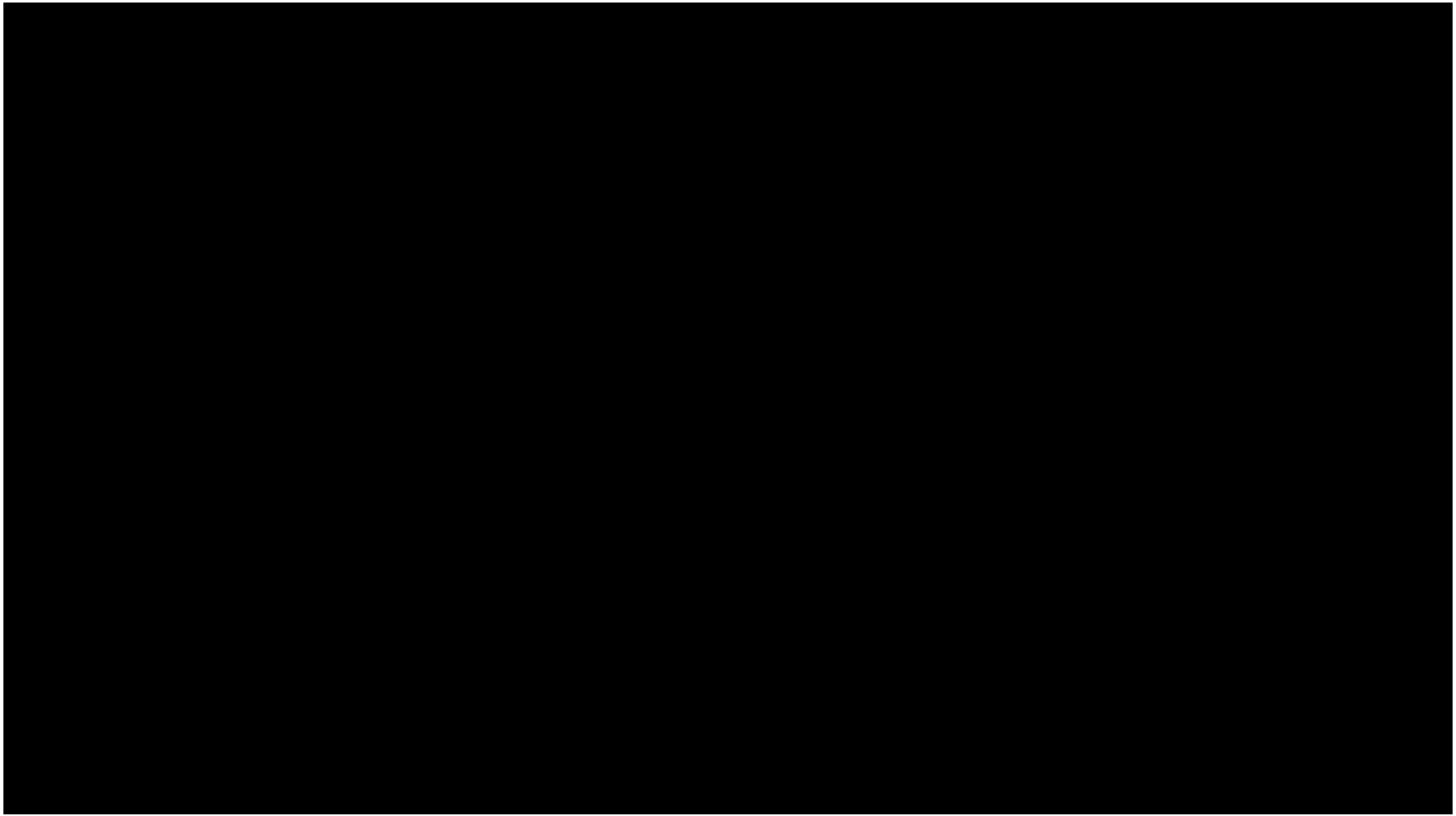
Device functions become simple blocks



Drag, Drop, Connect!

Compose individual processes via drag & drop:





Olin College of Engineering

Open-Source Biotech Robot Orchestration

SCOPE Summit

Olin College Moderna SCOPE Team

05/09/2025

Olin College of Engineering

New Balance - Press

NEW BALANCE SCOPE TEAM

PRESS

Oliver Buchwald, Mateo Macias, Aja Capel, Ellie Ramos, Sahil Patel

new balance

Meet the TEAM

Oliver Buchwald
Mechanical Engineer

Aja Capel
Manufacturing Engineer

Sahil Patel
Mechanical Engineer

Mateo Macias
Mechanical Engineer

Ellie Ramos
Mechanical Engineer

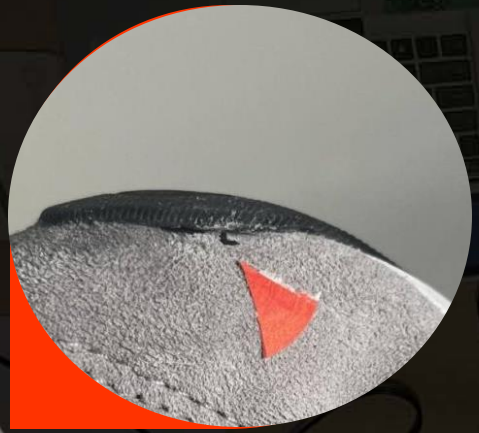
THE PROBLEM

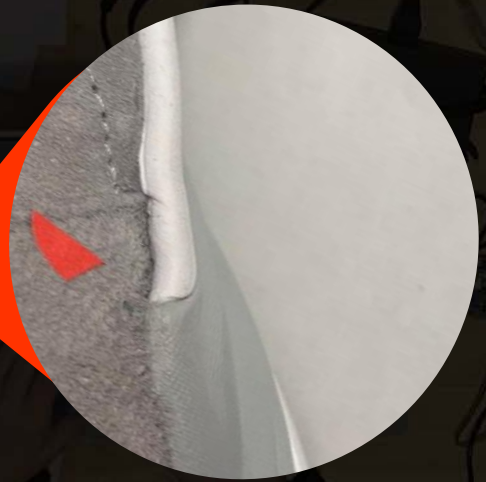
- Manual push test for quality check
- Risk of repetitive strain injury (8,400 thumb presses/day)
- Inconsistency in manual testing
- Importance of automation for efficiency and consistency

OUR APPROACH

"What is a gap?"

"How can we open a gap?"





What is a gap?

- Definition of a gap in the shoe manufacturing process
- Factory visits and expert consultations
- Shoe sample analysis and marking frequent gap locations

How can we open a gap?

First Sprint

- Research on how to open gaps

Rapid prototyping cycles with 3D printing and laser cutting

Last Sprint

- Iterative development with feedback from New Balance liaisons

Our Focus

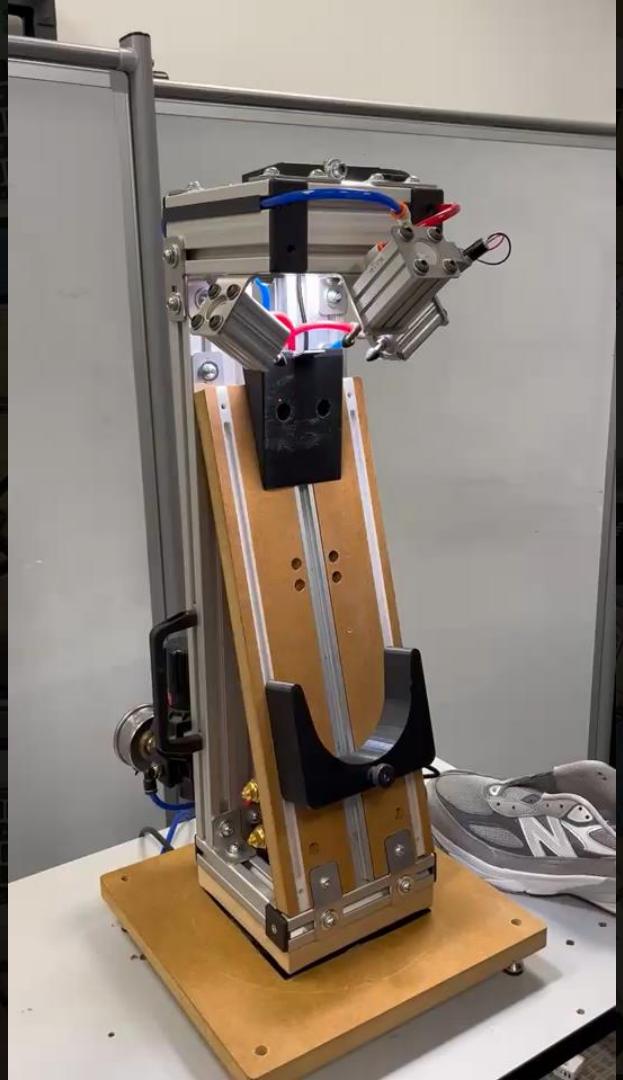
The toe tab region of the shoe

- Complex geometry
- High force required

Maximum potential for improvement due to automation

OUR SOLUTION

- 3-point push pneumatic system
- Universal to both left and right shoes
- Adjustable for shoe sizes, Adaptable to different shoe models
- Hands-free, consistent, and easy-to-use design



IMPACT

- Addresses a previously unsolved problem
- Improves product consistency and quality
- Reduces injury risk for workers
- Lays groundwork for future automation at New Balance

FUTURE STEPS

To be continued by a SCOPE team next year

- Additional validation & testing on more shoes
- Expansion into different shoe materials
- Adding additional push points
- On-site testing on the New Balance line
- Incorporation into the manufacturing process

NEW BALANCE SCOPE PRESS TEAM

THANK YOU

We couldn't have done this without the support of our liaisons from New Balance,

Patrick McCleary & Bryce Chu,

and the guidance from our advisor,

Lawrence Neeley

Olin College of Engineering

New Balance - Stitch

Identifying Manufacturing Variations in Computerized Stitching

New Balance Stitch SCOPE Team, Olin College

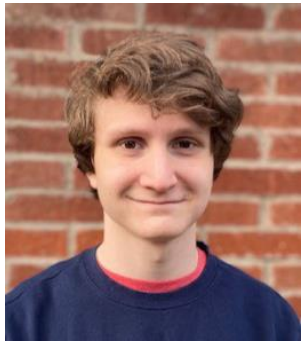
The Team

Lauren Armstrong

Mechanical Engineering

Lily Dao

Mechanical Engineering



Bryce Ferguson

Mechanical Engineering

Diana Garcia

Mechanical Engineering

Diego Riverbay

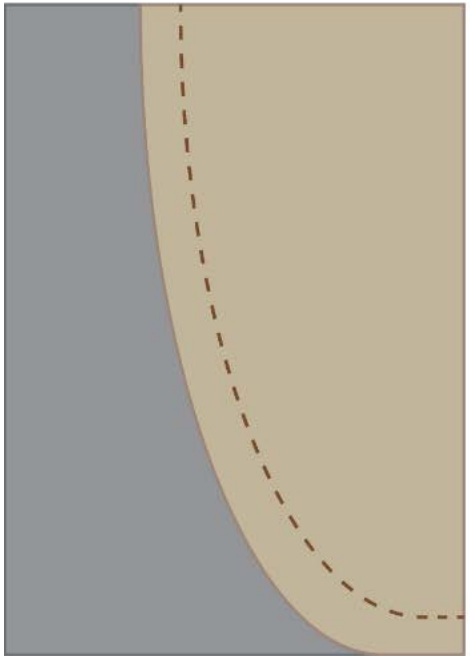
Mechanical Engineering

Project Overview

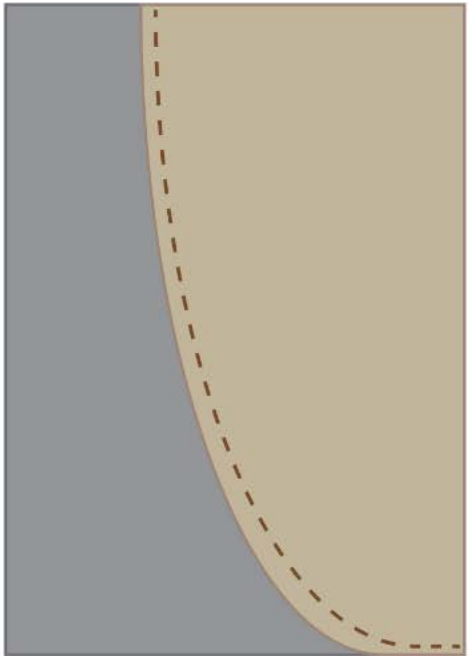
History

- Since the emergence of computerized stitching in the 1990s, there has been potential for variation in stitching.
- Multiple attempts to identify the variation, no root causes have been found.

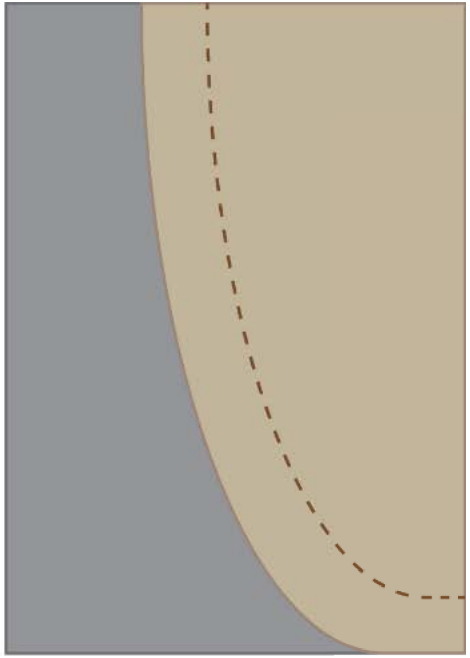
Stitching Allowances



PASS (1-3mm)



FAIL (<1mm)



FAIL (>3mm)

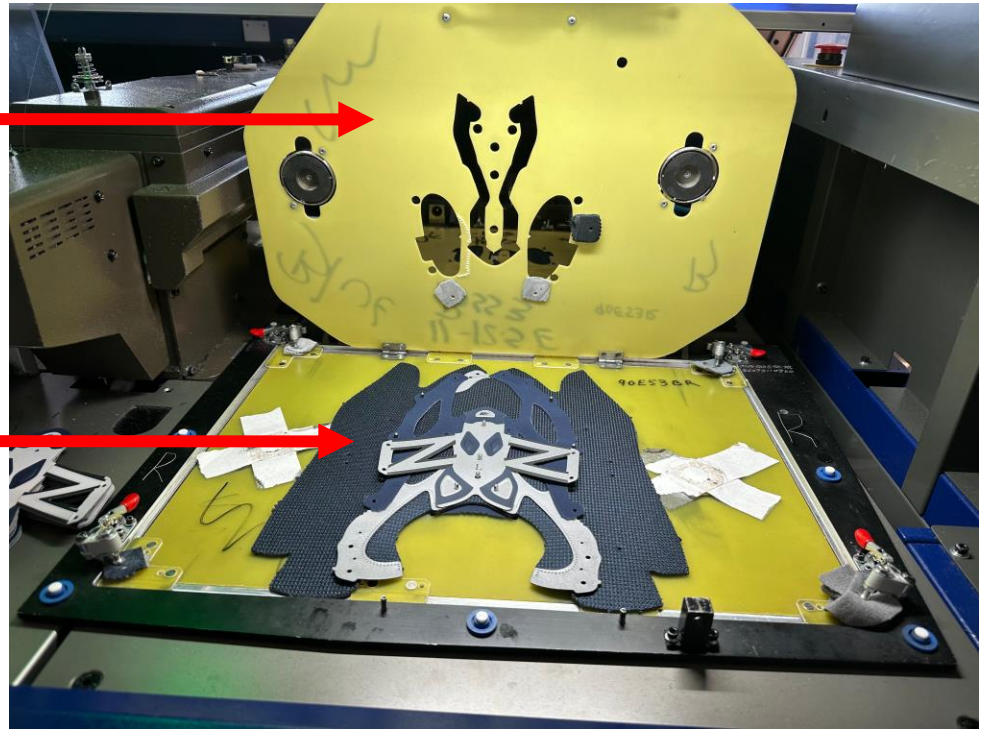
Computer Stitching

Pallet

Material holder

Material

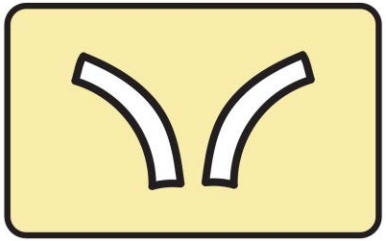
Future shoe



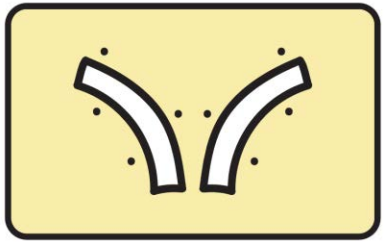
Current Process

Pallet

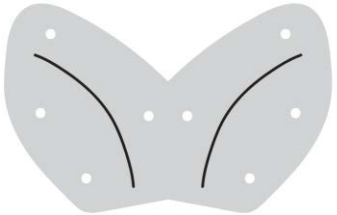
Blank Pallet



Cut Pallet Slots

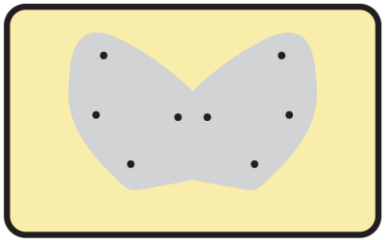


Insert Pins

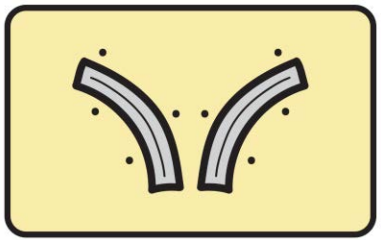


Material

Cut Piece



Place Fabric on Pins

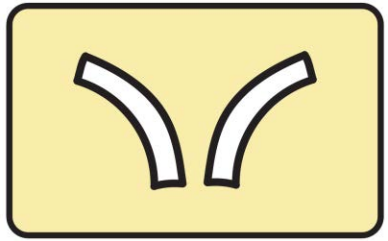


Close Lid and Stitch

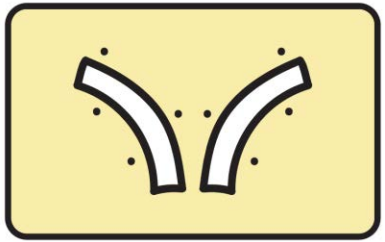
Current Process

Pallet

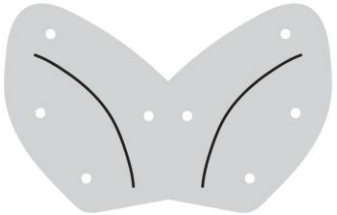
Blank Pallet



Cut Pallet Slots

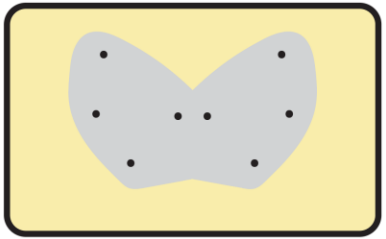


Insert Pins

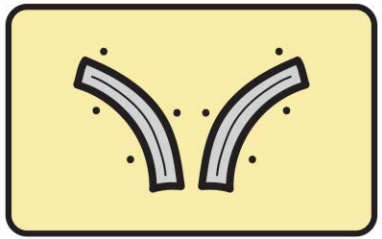


Material

Cut Piece



Place Fabric on Pins



Close Lid and Stitch


Testing

Test Piece Development

Key Features

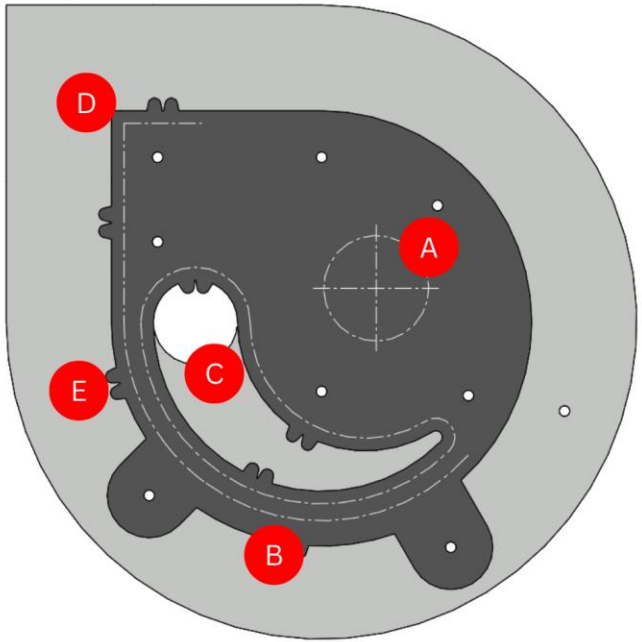
A – Target

B – External Curve

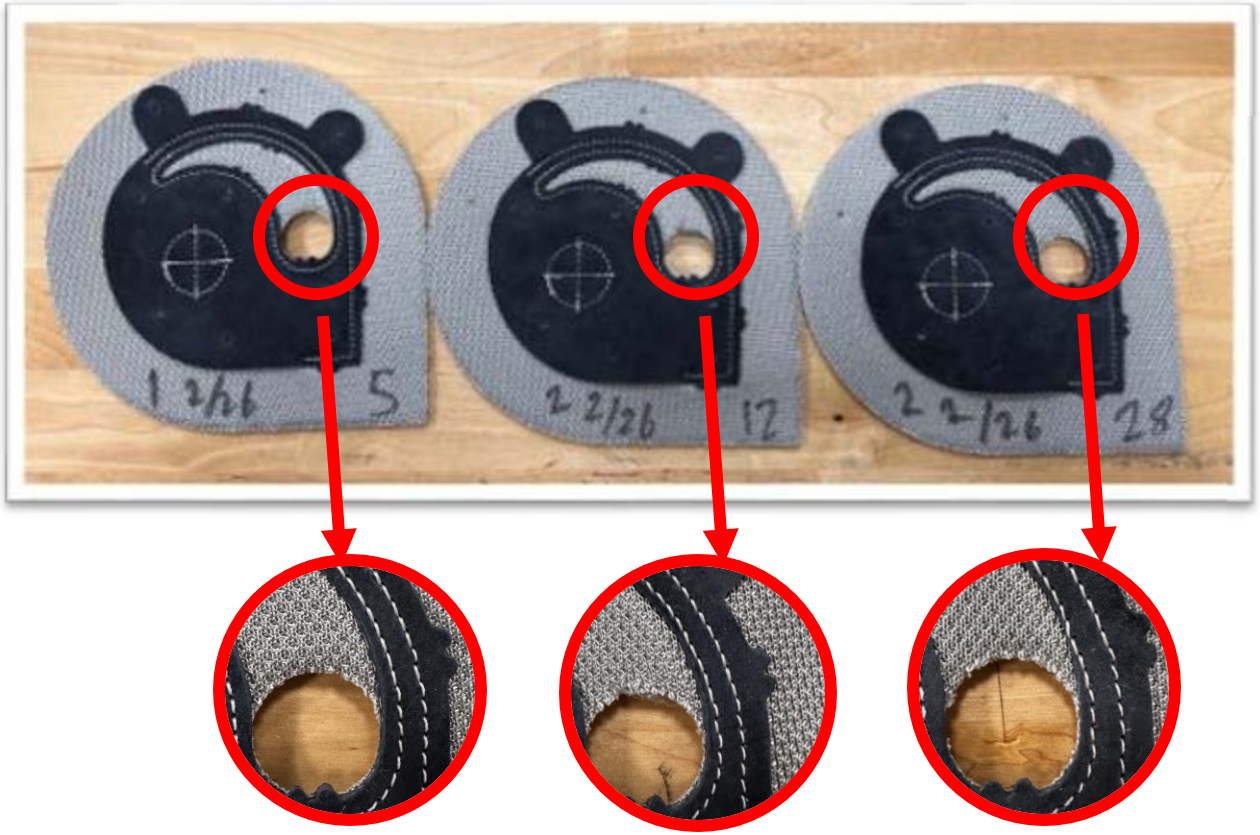
C – Pocket

D – Corner

E - Nubs

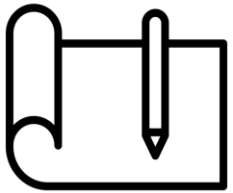


Goal: Reduce Variation Potential



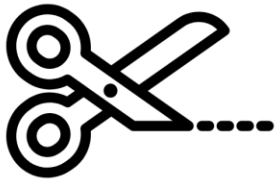
Test Procedure

Design Test



Take pictures

Cut Test Pieces



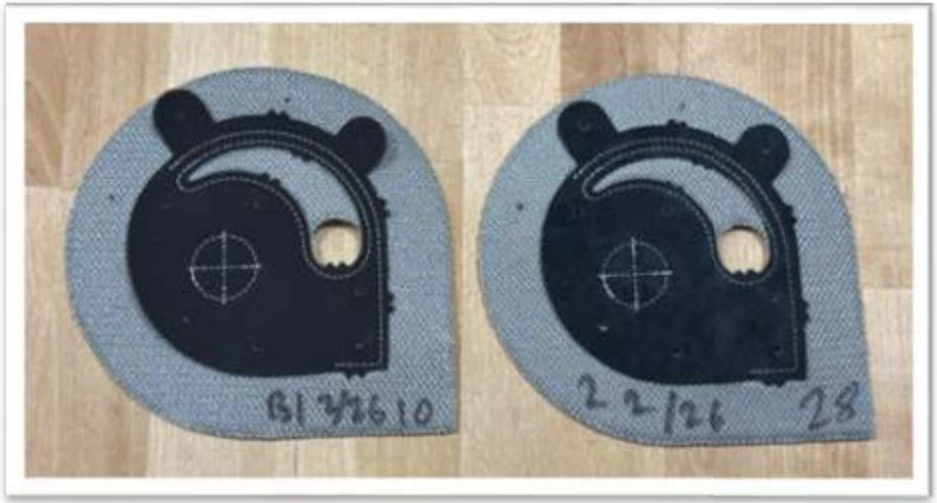
Collect Data

Stitch Test Pieces

Synthesize Data

Material Variables

- Synthetic Leather (Control)
- Leather Quality (2)
- Multi-Layer Stitching
- Multi-Ply Die Cutting



Pallet Variables

- Foam
- Sandpaper
- Pin count

Measurement Procedure

Cognex Camera

Cognex Identification Software

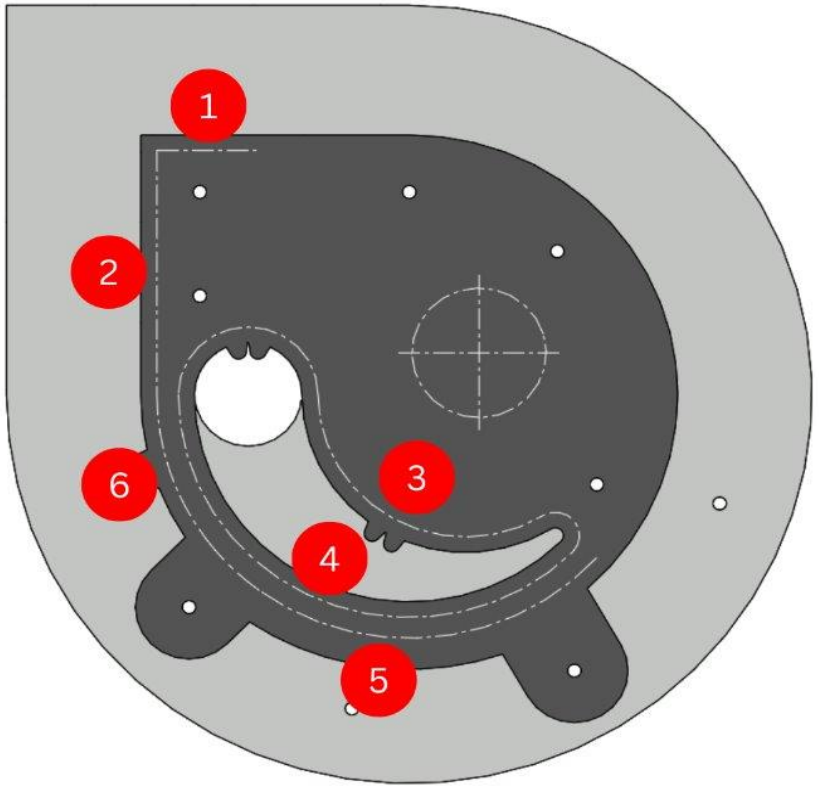

TEST PIECE FRONT 2MM
TEST PIECE FRONT 2·5MM
TEST PIECE FRONT 3MM
2MM

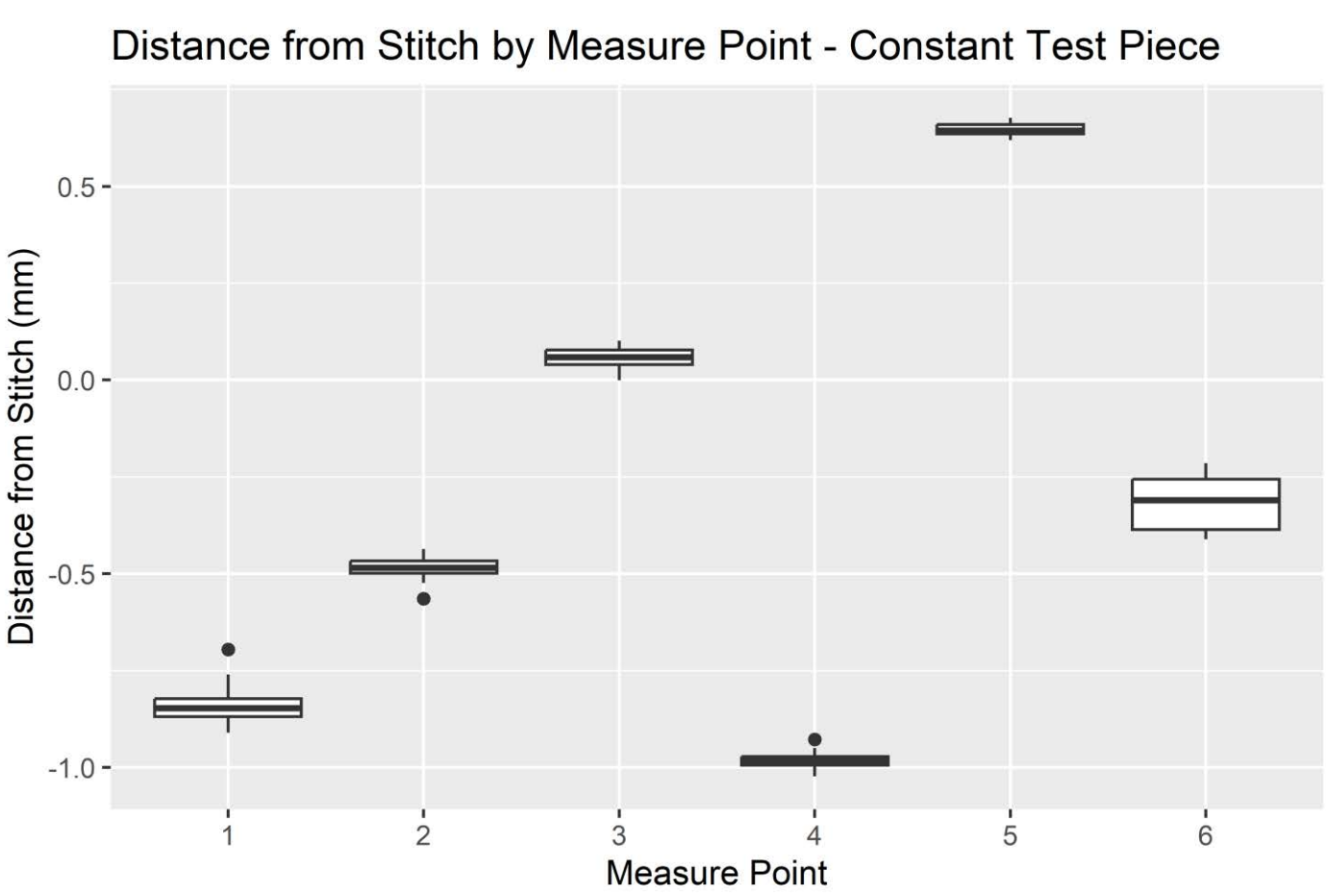
Results

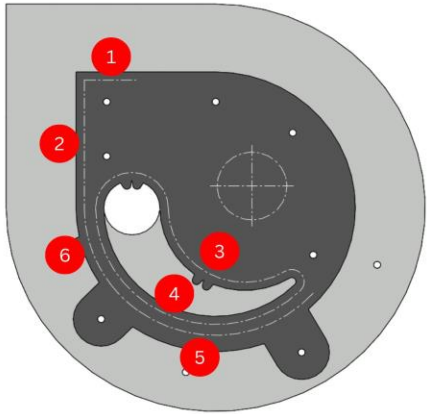
Measuring

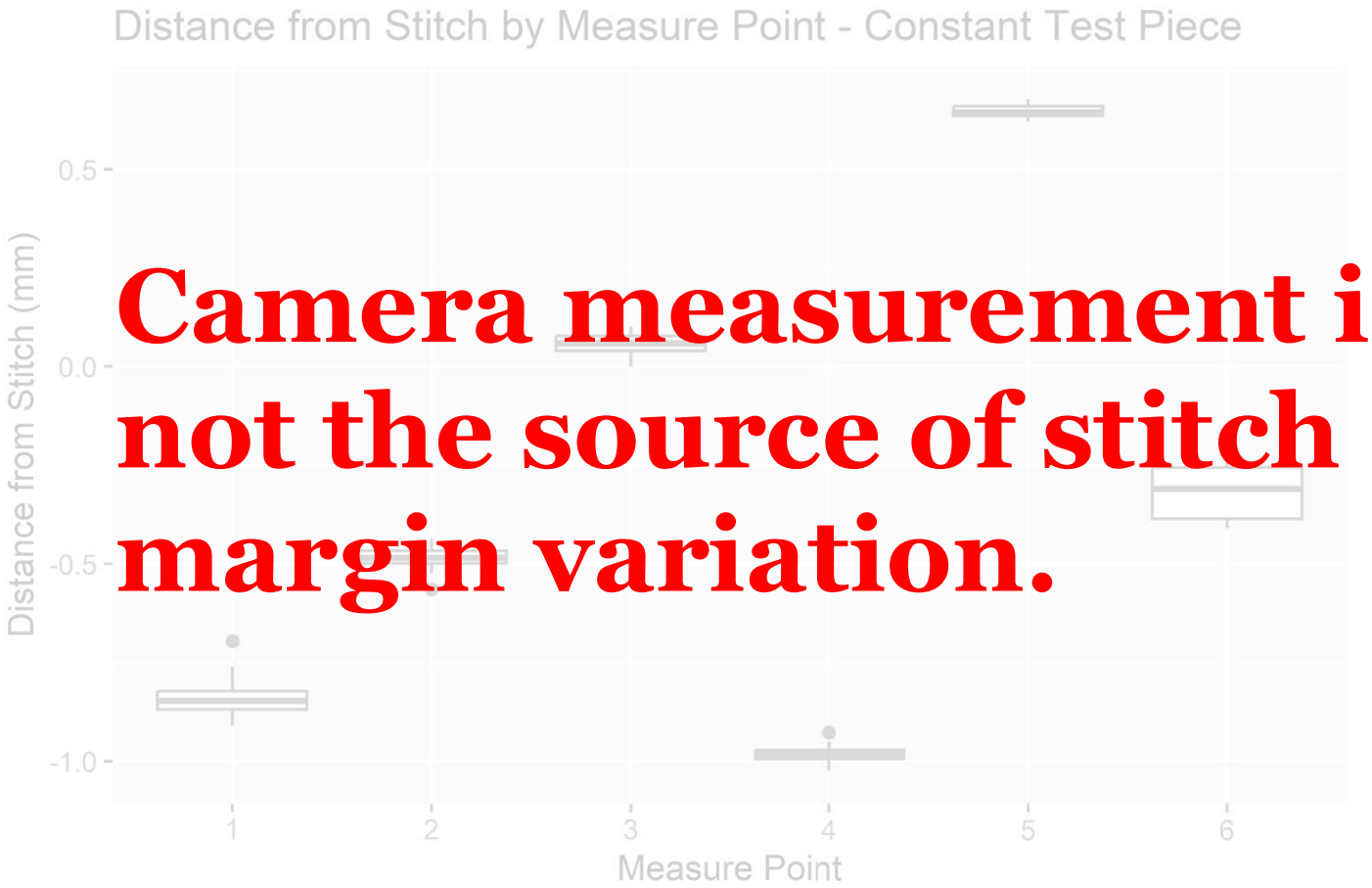
Measuring Variation

- Standard deviation – how spread out the data is
- Coefficient of variation – how spread out the data is relative to the mean

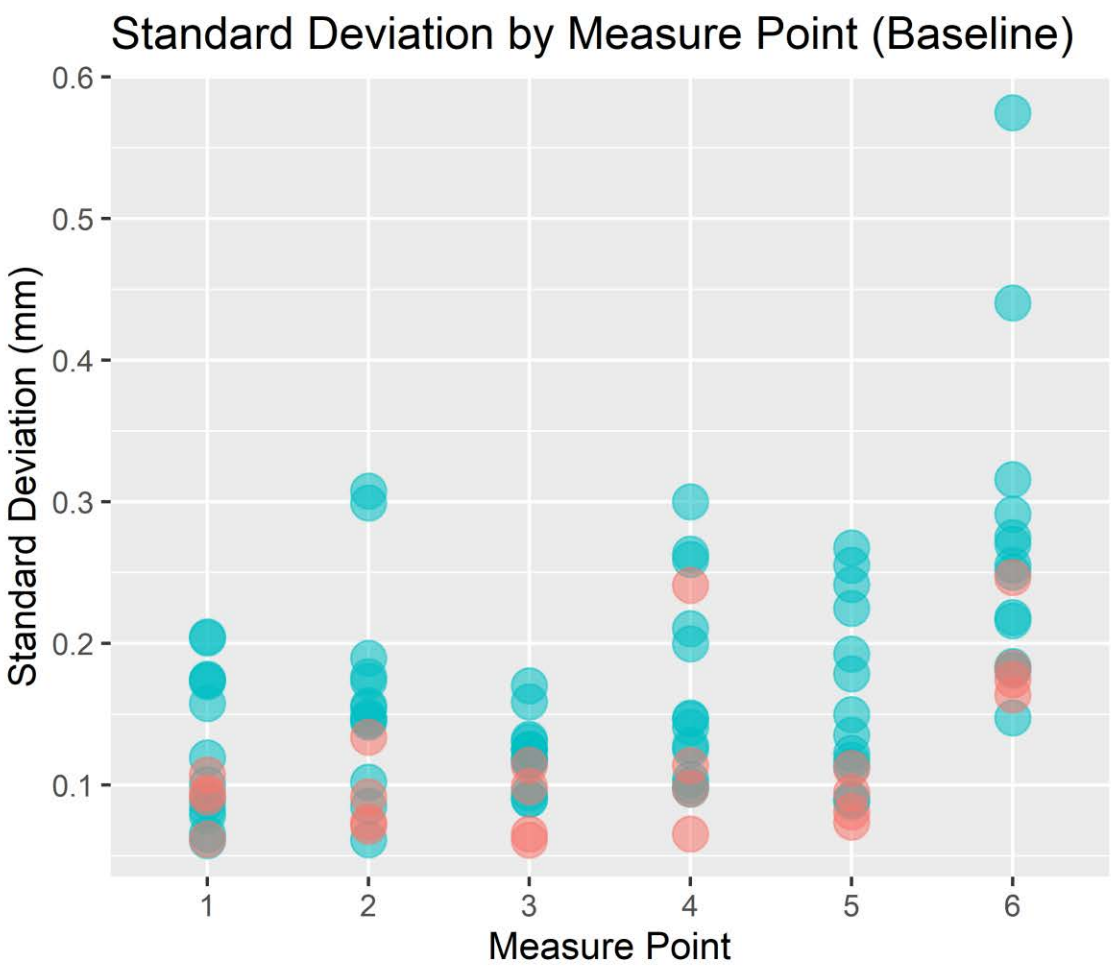


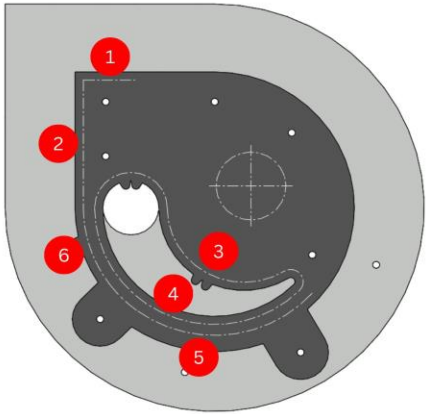

Distance from Stitch by Measure Point - Constant Test Piece
Distance from Stitch (mm)
0.5
0.0
-0.5
-1.0
1
2
3
4
5
6
Measure Point


1
2
3
4
5
6



Camera measurement is not the source of stitch margin variation.

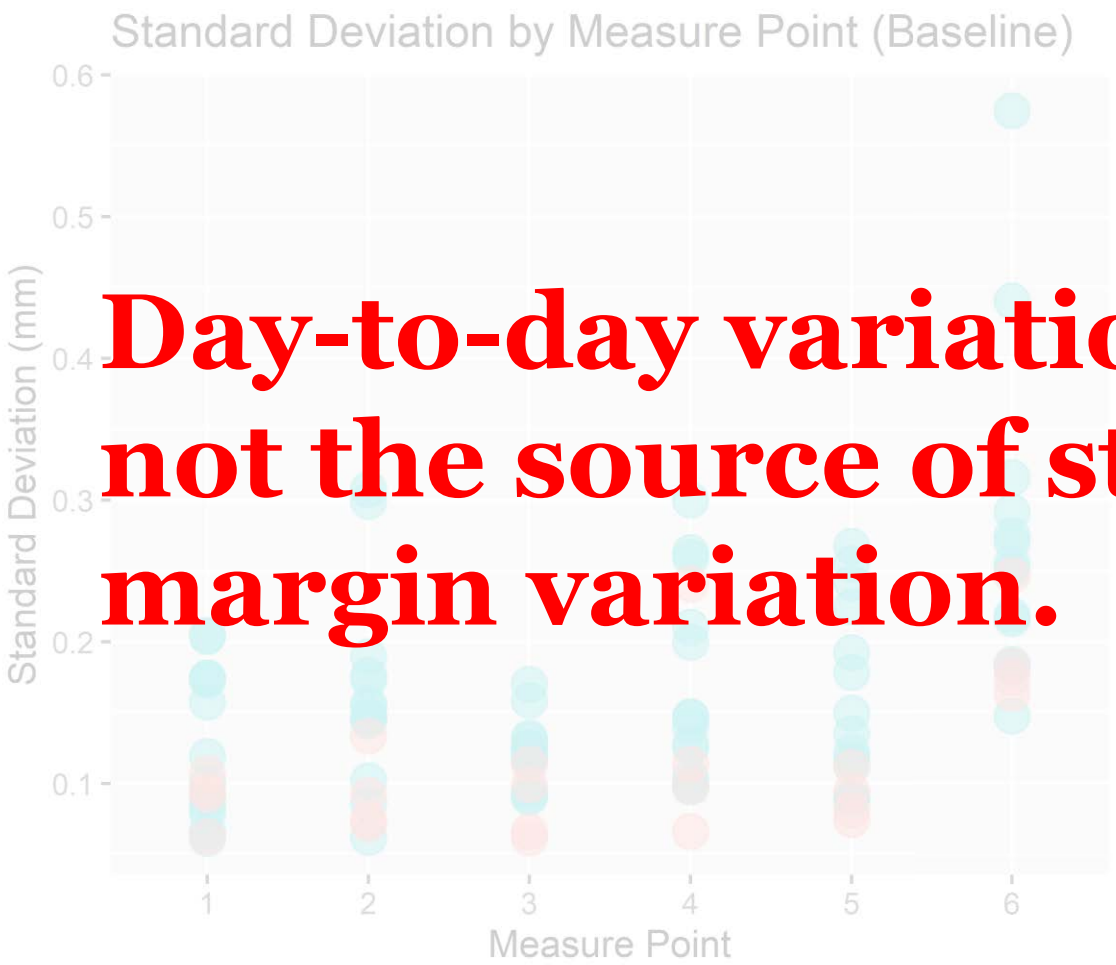




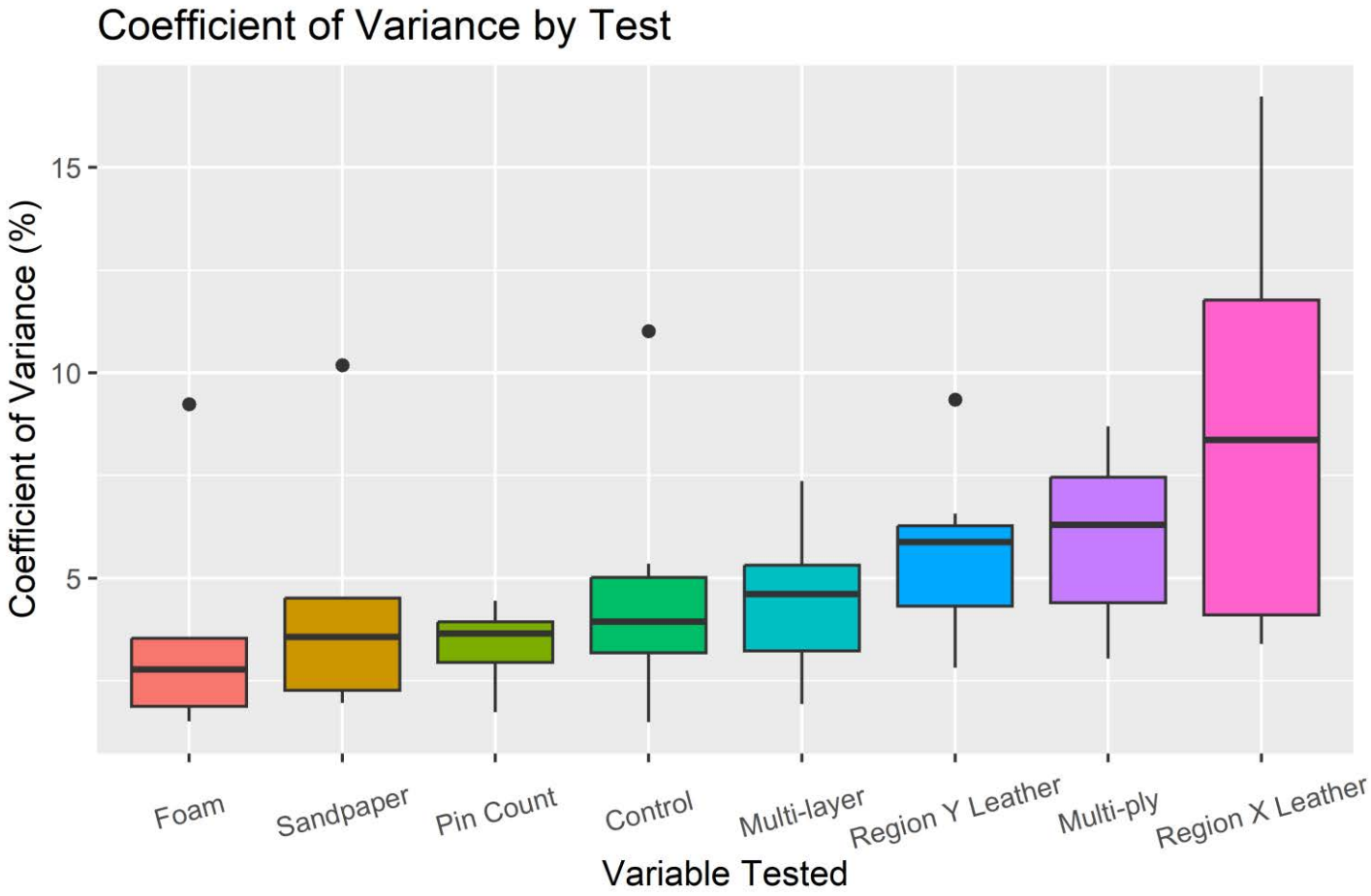
Data

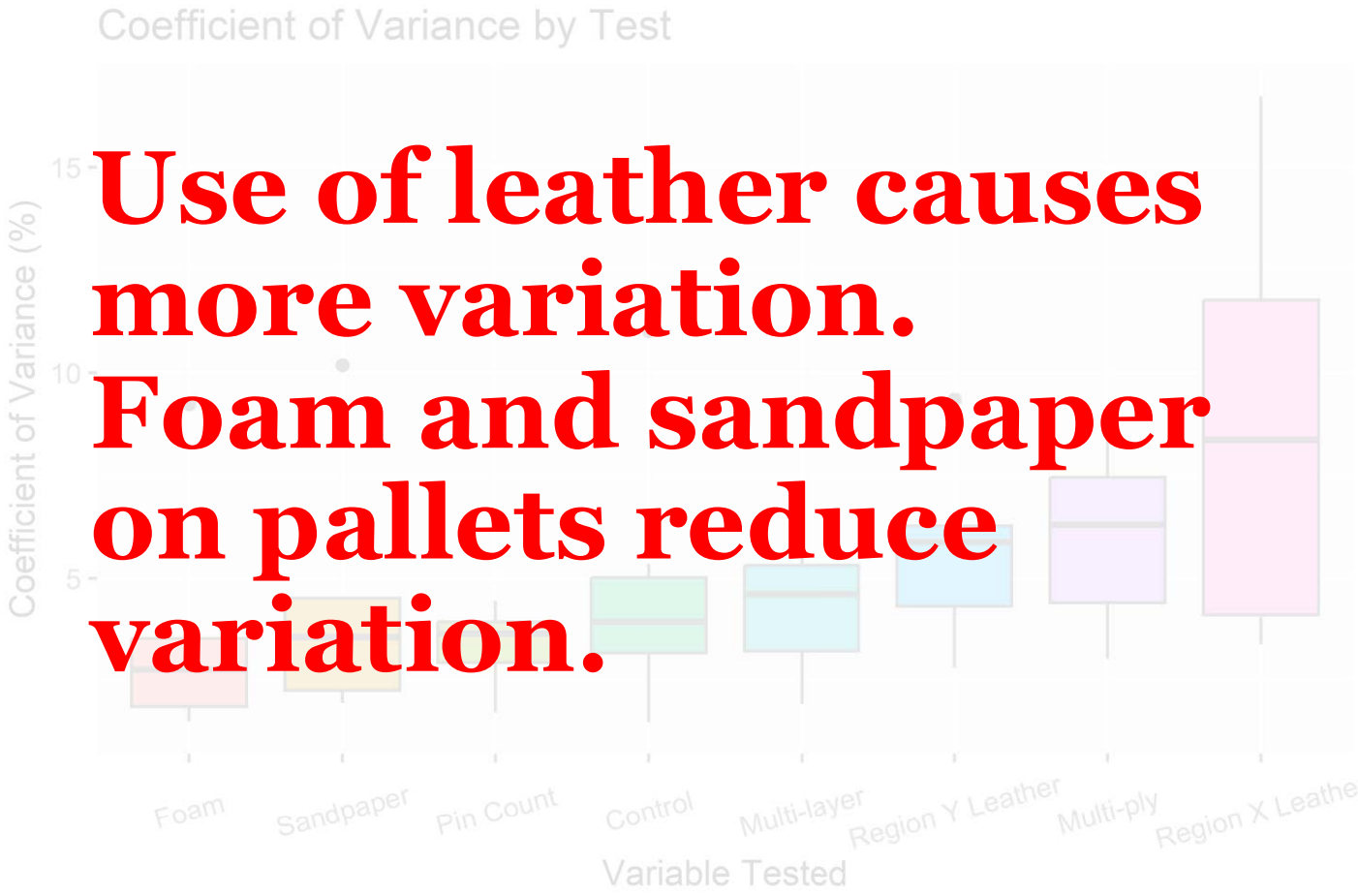
Baseline Data

Full Data

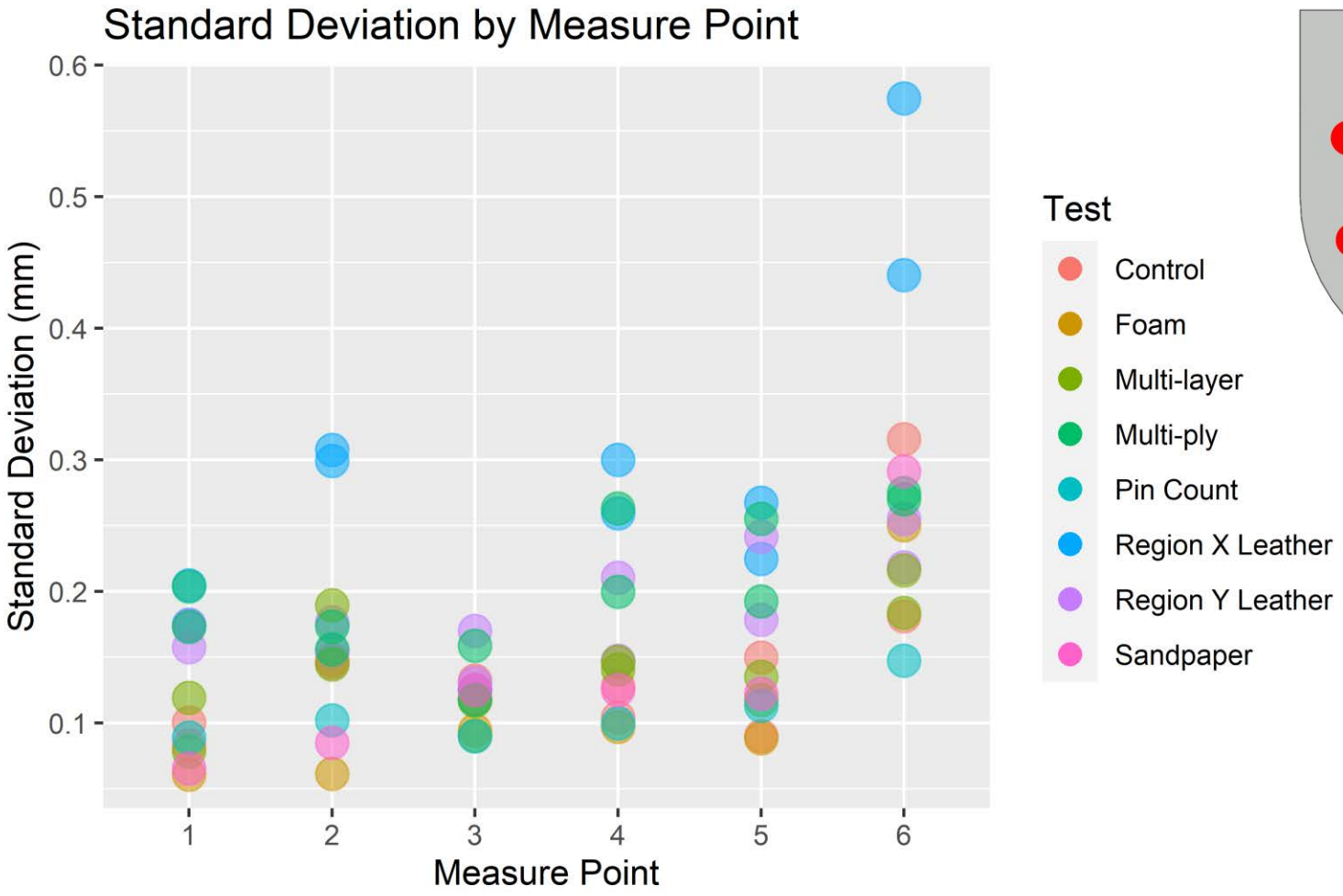


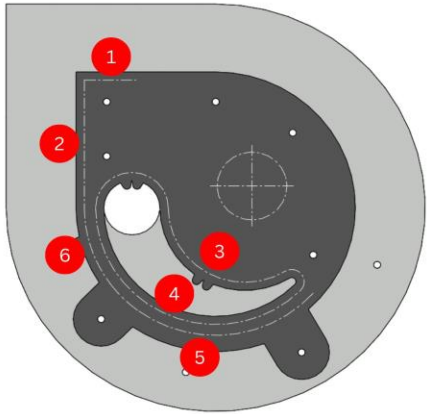
Day-to-day variation is not the source of stitch margin variation.

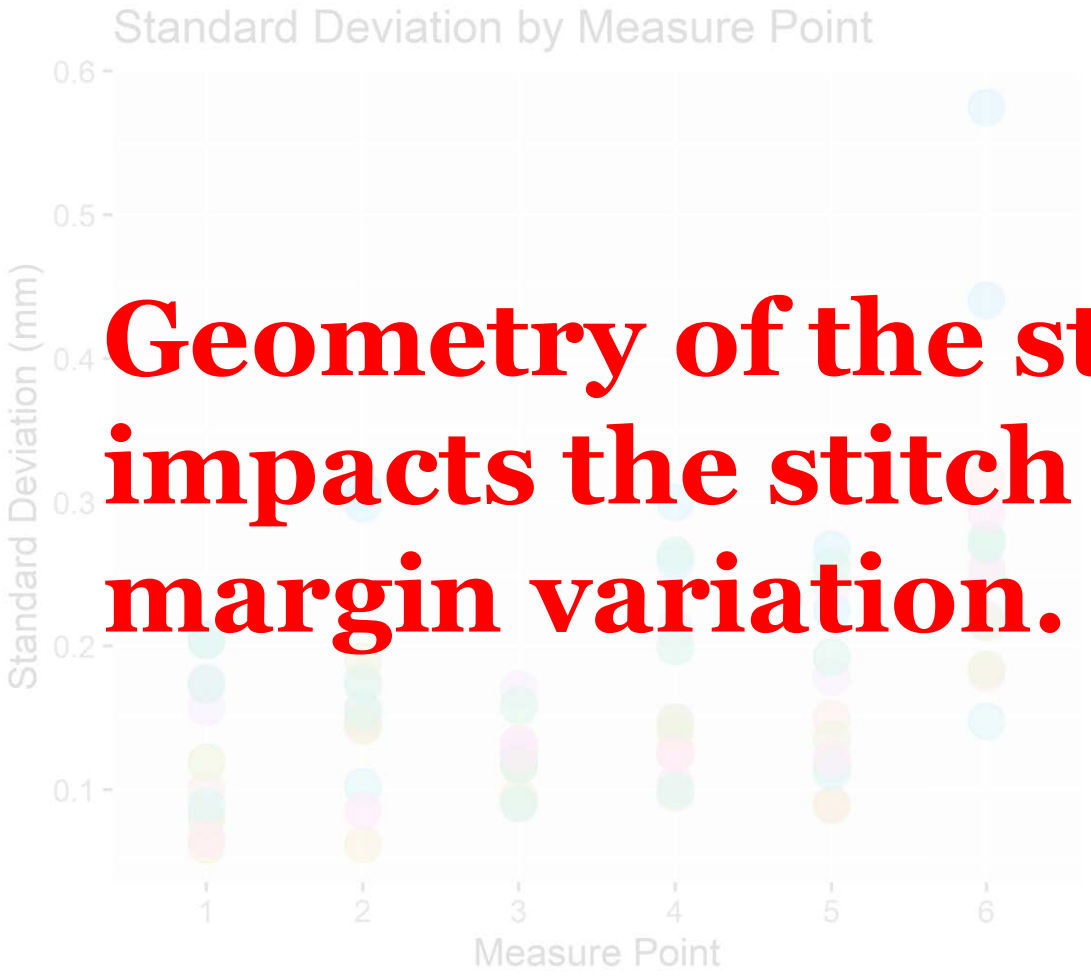

Coefficient of Variance by Test
Coefficient of Variance (%)
15
10
5
Foam
Sandpaper
Pin Count
Control
Multi-layer
Region Y Leather
Multi-ply
Region X Leather
Variable Tested



Use of leather causes more variation. Foam and sandpaper on pallets reduce variation.


Standard Deviation by Measure Point
Standard Deviation (mm)
0.6
0.5
0.4
0.3
0.2
0.1
1
2
3
4
5
6
Measure Point
Test
Control
Foam
Multi-layer
Multi-ply
Pin Count
Region X Leather
Region Y Leather
Sandpaper


1
2
3
4
5
6



Geometry of the stitch impacts the stitch margin variation.

Conclusions

Based on the data from the tests conducted, we found:

- Sandpaper and foam decrease variation
- Region of leather cut impacts variation
- Cutting method has some influence on variation

In the future, we would:

- Run additional tests
  - Stitch order/speed
  - Stitch geometry
  - Pallet variations
- Refine camera measurement system

Special Thanks To:

David Sullivan
Kelly Goldfarb
Daniery Cabrera Munoz
Lawrence Neeley

Olin College of Engineering

Pfizer

Clinical Supply Process Optimization Tool

SCOPE Pfizer Team

The Team

Engineering w/ Computing

An Grocki

Lily Jiang

Electrical/Computer Engineering

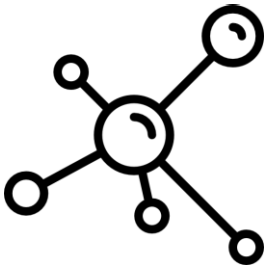
Madison Tong

Marc Eftimie

Raiyan Siddique

Olin College of Engineering

Pfizer develops a broad variety of products...



Molecule Type

Therapeutics

Clinical Trial Phases

Pfizer Global Clinical Supply (GCS)

Sources and supplies the investigational product

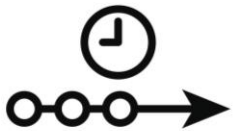
Delivers drugs to patients

Manages ~400 active clinical trials

Deliver HOPE to patients

COVID Vaccines

Pfizer committed to speeding up clinical trials during COVID



Reduced timelines while mitigating risk to get vaccines to people in need

Post-COVID, wants to extend these optimizations into their current supply chain system

Supply Chain Planning for trials is STILL time-intensive

We learned that GCS employees:

Identify risks based largely on intuition and prior experience

Manually reference multiple databases and lengthy documents

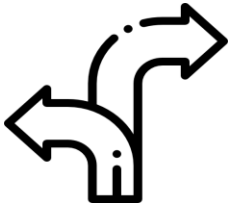
Coordinate long meetings requiring multiple functional lines to be present

PROJECT GOAL

Develop a tool that **identifies optimizations** in Pfizer processes while also **minimizing risk.**

Project Solution

References study documents and other data (risks, timelines…)



Proposes potential alternatives to the process to speed up the timeline

Identifies associated risks in the proposed process

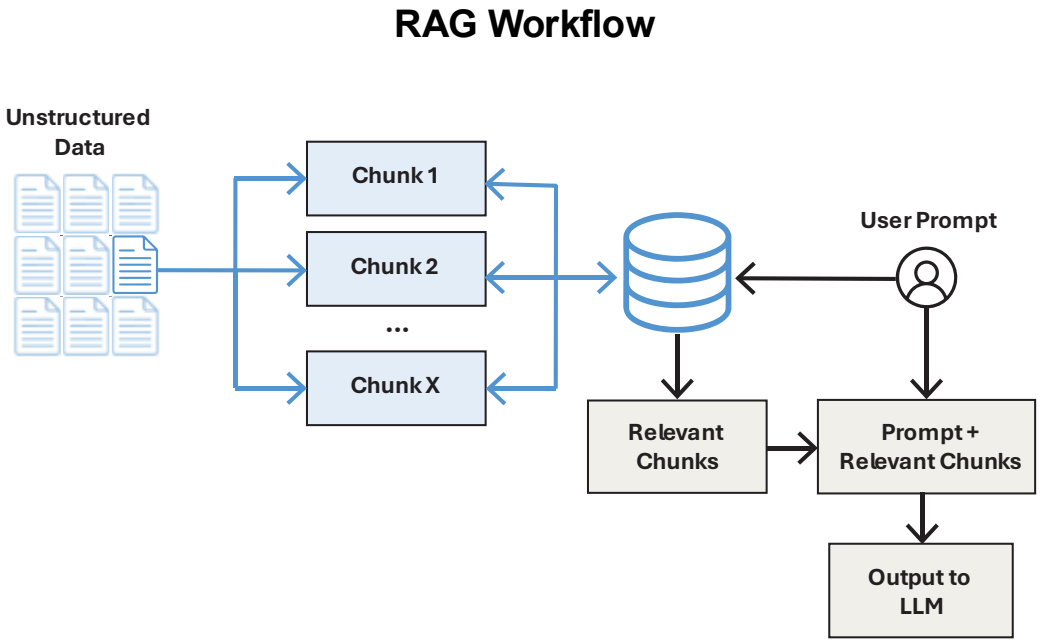
Research Methods

1.  Background Research
2.  Interviews with Liaisons
3.  Understanding the Data
4.  Co-Design Sessions

Product

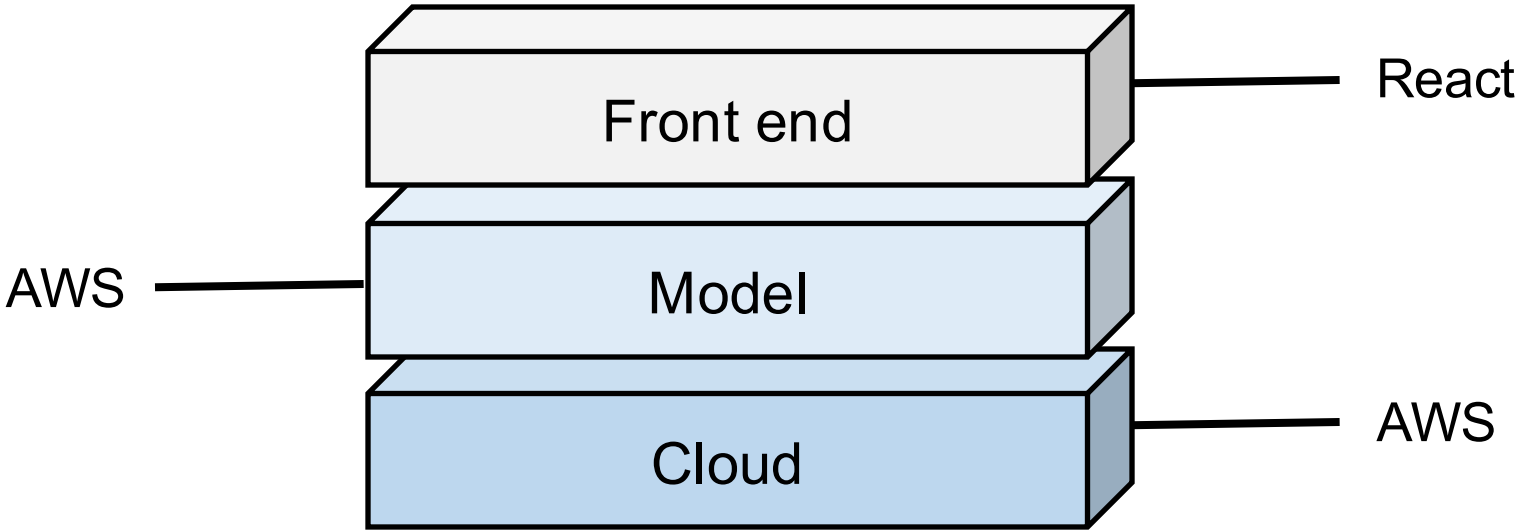
Model

- **Large Language Model (LLM)** approach to text-based data
- **Retrieval-Augmented Generation (RAG)** Model to retrieve relevant data
- **PDF Processing** to break long docs down to usable chunks



Tech Stack

- Each level of our stack aligns with the Pfizer ecosystem
- Limited open-source libraries



Impact

Optimize Pfizer's Process

Identify optimizations and risks based on past data

Support employees with data driven answers

Optimize supply chain → deliver supplies quicker → save lives

Deliver HOPE to patients

What's Next?

Next Steps

1

Hand off code + documentation to Pfizer's tech team

2

Tech team takes our solution and adjusts the tech stacks to Pfizer's system

3

Pfizer GCS leaders can make more efficient, data-driven decisions

Special Thanks to:

Michele Frey
Val Ochollah
Kristin Sullivan
Wendy Spader
Shawn Musselman
Pfizer Tech Team
Jessica Townsend
SCOPE Teaching Team

Olin College of Engineering

Santos/Volpe

Data Illuminators

Nighttime crosswalk contrast and brightness evaluation method

SCOPE **Summit 2025**

Meet the Team

Maya Cranor

Rucha Dave

Allyson Hur

Daeyoung Kim

Natsuki Sacks

Overarching Goal

Identify an **accessible, sustainable, time-saving data collection method** that will enable municipalities to evaluate which crosswalk lighting projects they should prioritize.

Why is our work important?

In 2023, **over 7,300** people were killed by drivers while walking.

[1] U.S. Department of Transportation, Federal Highway Administration Center for Accelerating Innovation
[2] U.S. Department of Transportation, Federal Highway Administration Center for Accelerating Innovation

Why is our work important?

According to the FHWA, **76%** of pedestrian fatalities occur **at night.**[1]

Nighttime crashes at rural and urban intersections can be **reduced** by **33-38%** with well-designed lighting.[2]

[1] U.S. Department of Transportation, Federal Highway Administration Center for Accelerating Innovation
[2] U.S. Department of Transportation, Federal Highway Administration Center for Accelerating Innovation

TECHNICAL CONTEXT

Contrast

Crosswalk lighting should illuminate the pedestrian with **positive contrast** to make them more visible to the driver.[1]

Negative contrast - Pedestrian is dark while the background is starkly lighter.

Positive contrast - Pedestrian is lit while the background is starkly darker.

[1] U.S. Department of Transportation, Federal Highway Administration

CURRENT crosswalk evaluation process

- Blocks off streets; impedes traffic
- Very precise, detailed process
- Requires resources/manpower
- Can only be done at night
- Hard to scale without downsampling

OUR SOLUTION

NEW crosswalk evaluation process

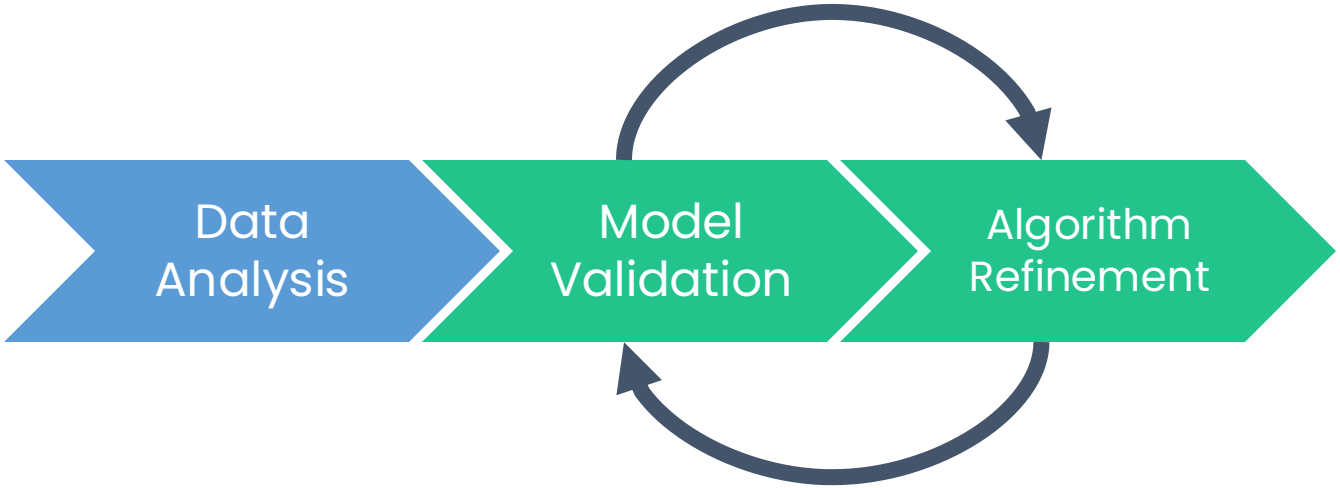
Prediction from:

- Streetlights
- Road segments
- Crosswalks

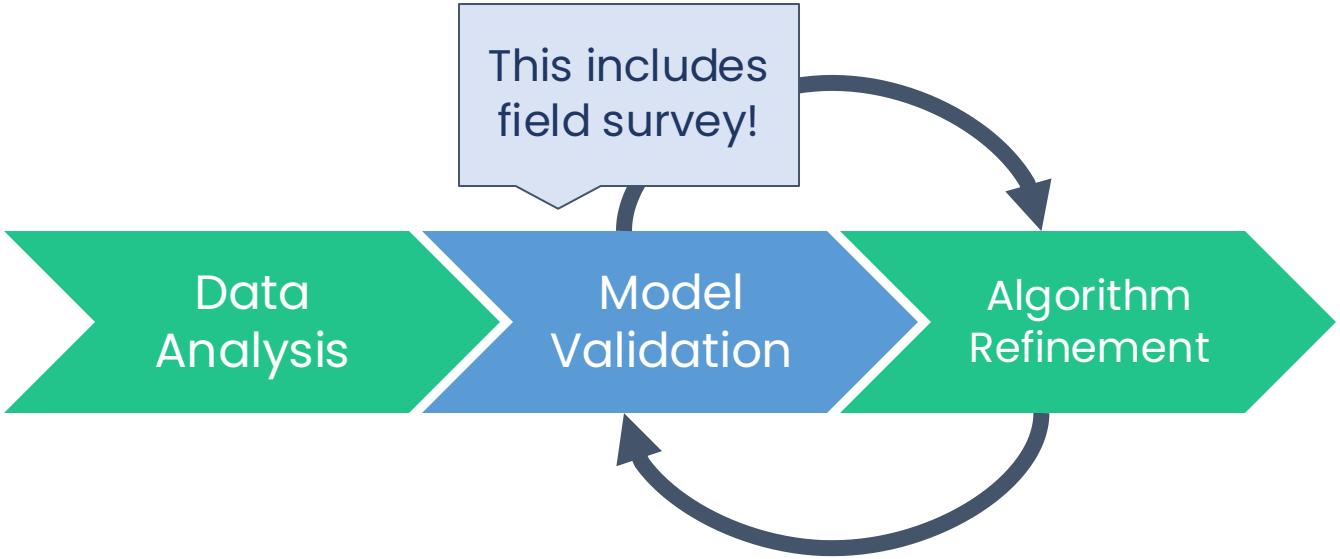
*__geographic information system__ (GIS) data

Interactive contrast map

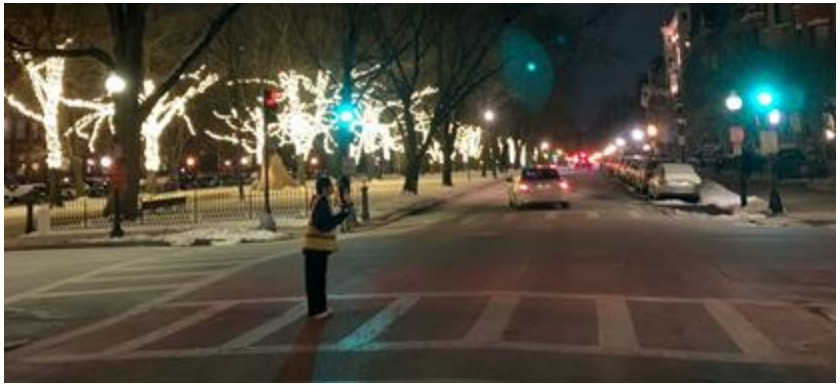

Boston Contrast Map...
Datasets (3)
Add Data
crosswalk_centers_lig...
14,893 rows
boston_crosswalks.ge...
10,611 rows
classified_streetlights...
68,931 rows
2 More
Layers
Add Layer
Point
contrast
Point
masked lights
Geojson
light-crosswalk lines
Geojson
boston_crosswalks
Point
all lights
Layer Blending
normal
Map Overlay Blending
normal
Center for Integrated Life Sciences and Engineering
College of Communications
Morse Auditorium
Physics and Biology Research Building
Life Science and Engineering Building
Cummington Mall
Blandford Mall
Massachusetts Turnpike
Beacon St
Metcalf Science Center
strong negative contrast
no contrast
20 m

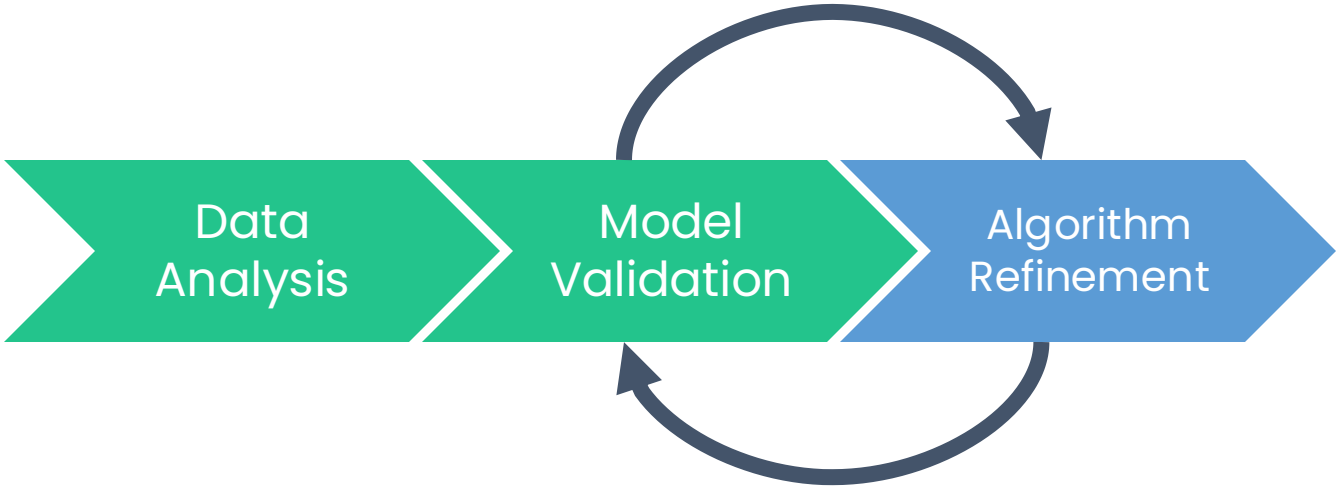


- Collecting and cleaning crosswalk, streetlight, and road segments data sets
- Creating contrast and brightness values for each crosswalk



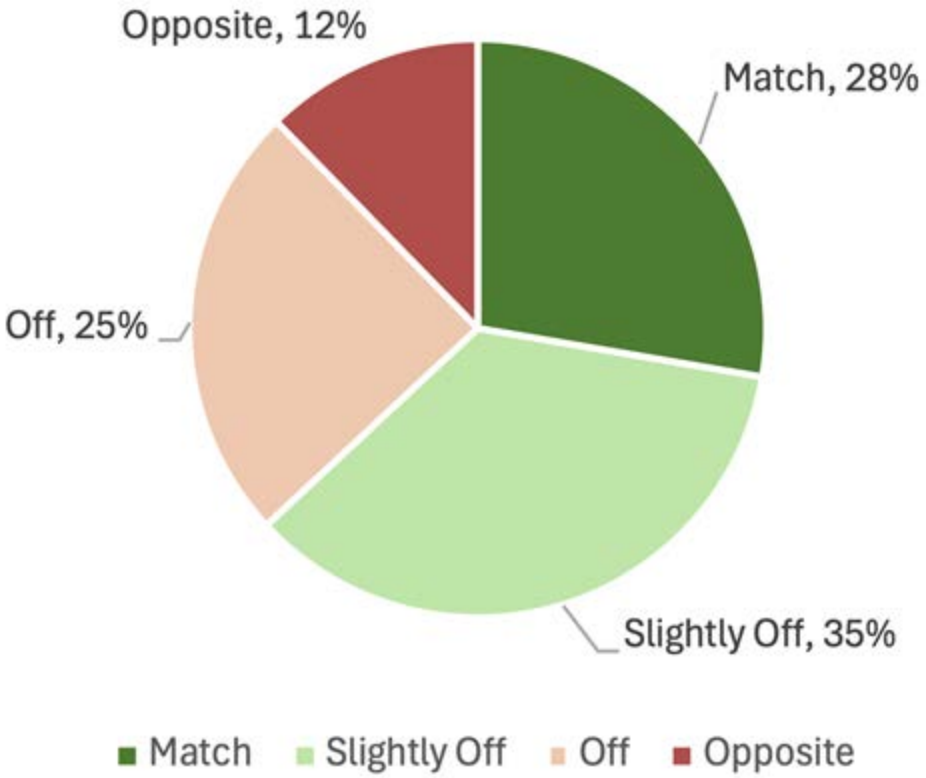
- Going into Boston
- Checking whether our algorithm's contrast and brightness predictions match real-life





- Determined reason for errors (i.e. environmental, dataset mismatch)
- Adjusted algorithm as necessary
- Repeat!

Distribution of model evaluation



*validated against 66 manually collected crosswalks

Overall results of our model

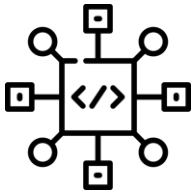
- Works great in simple configurations (not too much interference)
- Up-to-date dataset is critical

TO CONCLUDE...

Impact

1. Novel method to screen pedestrian visibility based on contrast
2. Drastically reduced time for rough estimates on contrast types
3. Basis for future crosswalk improvement projects and data collection

Next Steps



Improve current model

Diversify data sources

Work with local municipalities

Thank You

SPECIAL THANKS

Prof. Lawrence Neeley
Our Volpe, FHWA, and WSP liaisons and SMEs
Our Santos Family Foundation Sponsors

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