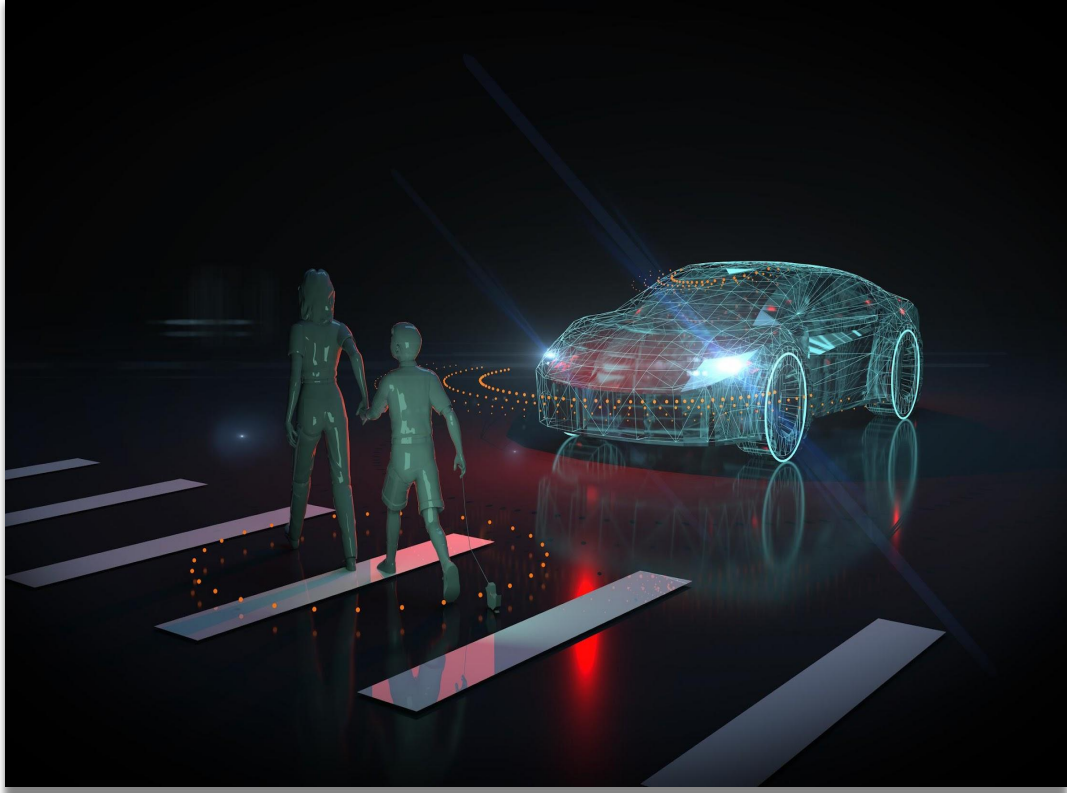
Tier IV

Final Presentation



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Meet The Team

Vimbai Muyengwa

Financial Manager & Frontend Developer

IT Systems Professional and AI enthusiast with 5+ years IT and Business experience

Ashay Koradia

Software & Backend Developer

Software Engineer, 3 years of work exp. Project Olympus Incubation cell member

Rohan Ghosh

System Admin. & Backend Developer

Software Engineer, 5 years experience in PLM domain

Youyou Huang

Process Organizer & Backend Developer

Data and IT system professional, 4 years in Information Management & Economic Research

Aakash Ajay Singh

Software & Frontend Developer

Software Engineer and AI enthusiast with cross-functional skills in backend systems and business integration

Yash Hulsurkar

Project Manager & Backend Developer

IT Systems Professional and Software Engineer, 4 years experience in IAM and Cybersecurity

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Client and Internal Partners

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Agenda

- About Tier IV
- Problem Statement: Understanding the AD Landscape
- The Challenge & Opportunity
- Initial Assumptions and Where We Are Now
- Finding & Implications + Our Solution
- Demo
- Scope of Work
- Looking Ahead: High Level Recommendations
- References

About Tier IV

TIER IV is a deep-tech startup based in Tokyo and is one of the leading developers of Autoware

Company Mission

"CO-CREATE, VALUE, DISRUPTIVELY"

Company Vision

"THE ART OF OPEN SOURCE, REIMAGINE INTELLIGENT VEHICLES."

TIER IV, with the world's first open-source software for **Autonomous Driving (AD)**, has a vision of evolving the autonomous driving market through:

- **Open access** to AD technology
- Drives **implementation of AD technology** in tandem with customers
- Primary deployment areas are the Japan and U.S. geographic regions

Understanding the AD Landscape

Traditional Autonomous Vehicle (AV) companies have defined the **Operational Domain Design (ODD)** as the target deployment region itself leading to constraints

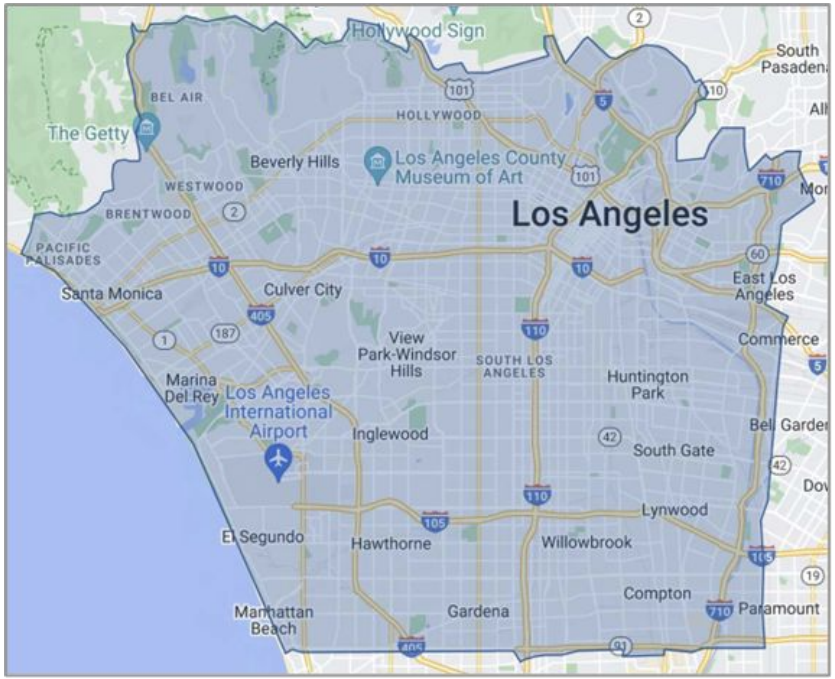
An ODD "defines the operating conditions under which an ADS is designed to operate safely" (ISO 34503)

For example

If they define **Los Angeles** as the **ODD region**, they must **develop, test, and validate** within **Los Angeles**.

Constraints

- ***Regional Constraints:***
  *Difficulty of **scaling into new regions***
- ***Capital constraints:***
  *Significant **capital investment to collect data***



ODD Specification of Waymo, via cpuc.ca.gov

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The Time for Autonomous Driving is Now

AVs are coming out of the trough of disillusionment Level 5 AVs will be available by 2030 and the AV market will surpass **$75 billion**

Society of Automotive Engineers (SAE)

Levels	Description
Level 0	Vehicles equipped with no automated features, requiring the driver to be in complete control of the vehicle.
Level 1	Vehicles equipped with one or more primary automated features such as cruise control, but requiring the driver to perform all other tasks.
Level 2	Vehicles equipped with two or more primary features, such as adaptive cruise control and lane-keeping, that work together to relieve the driver from controlling those functions.
Level 3	Vehicles equipped with features that allow the driver to relinquish control of the vehicle's safety-critical functions depending on traffic and environmental conditions. The driver is expected to take over control of the vehicle given the constraints of the automated features after an appropriately timed transition period.
Level 4	Vehicles equipped with features that allow the driver to relinquish control of the vehicle's safety-critical functions. The vehicle can perform all aspects of driving even if the driver does not respond to a request to intervene.
Level 5	Fully autonomous vehicles that monitor roadway conditions and perform safety-critical tasks throughout the duration of the trip with or without a driver present. This level of autonomy is appropriate for occupied and unoccupied trips.

Level 5

Fully autonomous vehicles that monitor roadway conditions and perform safety-critical tasks

1

Center for Sustainable Systems, University of Michigan. 2024. "Autonomous Vehicles Factsheet." Pub. No. CSS16-18.

The Challenge/Opportunity

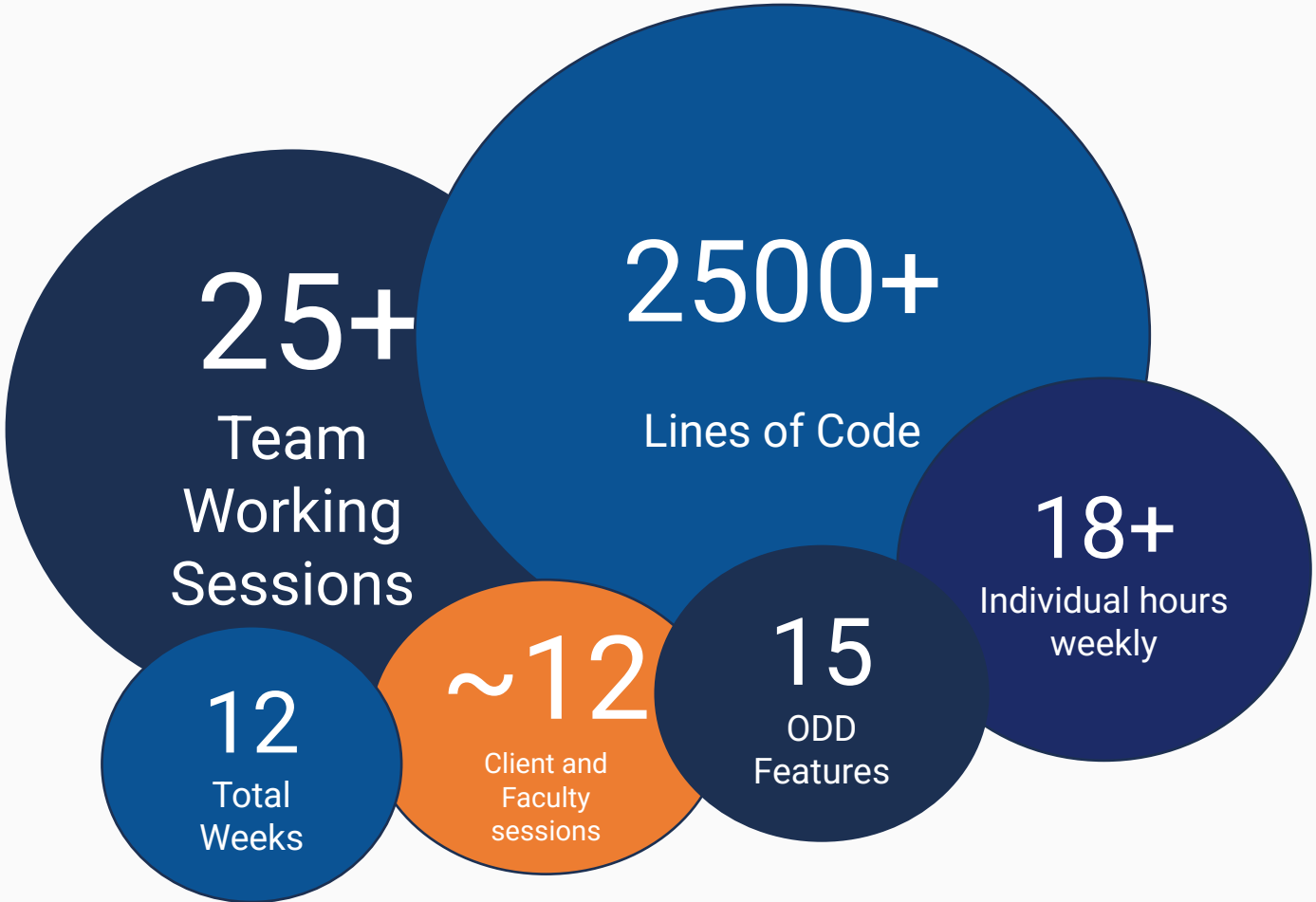
Tier IV can improve ODD **safety standards** for autonomous vehicles preventing premature state level policies push

42,795 people died in vehicle crashes in 2022. **94%** of crashes are due to human error. AVs have the potential to remove/reduce human error and decrease deaths

AVs have the potential to reduce crashes by **90%**, potentially saving approximately **$190B** per year

Center for Sustainable Systems, University of Michigan. 2024. “Autonomous Vehicles Factsheet.” Pub. No. CSS16-18.

Our Project at a Glance



Initial Assumptions

Our work began with understanding the previous team's efforts which provided a grounding for goal setting, refined scope, and new insights

Data Availability Was the Primary Risk: Obtaining access to high-quality, relevant data would be a challenge

Long Routes Were Most Valuable: We initially prioritized finding the longest continuous routes under the belief that longer routes = stronger connectivity

Tool Governance: The tool's end users would be engineers

Backend integration should be accessible and flexible with everyone's Features

Database caching: initial model was using the OSMnx library to get all features from the internet

Timeline feasibility: Possibility of implementing all 3 main ODD elements of environmental, scenery, and dynamic elements

Where We Are Now

Our work began with understanding the previous team's efforts which provided a grounding for goal setting, refined scope, and new insights

Working Visualization Tool: Identified phased approach to implementing visualization tool beginning with High priority Scenery mapping out the road networks within the defined ODD. ODD elements can have parameterizations, so the visualization tool should be able to take input from users and dynamically update the corresponding road network

Data Access Is Readily Available: We've confirmed that data can be fetched efficiently and can be manipulated actionable insights

Value in Route Complexity Over Length: Through stakeholder engagement, we now recognize that routes with more nodes or strategic connectivity (not just length) may offer greater value

Caching & Backend Infrastructure Established: We've implemented MongoDB for Data Storage and Flask Caching

Findings & Implications

Findings & Implications

The following **Focus Areas** have been identified to build a visualization tool to map out the road networks within defined ODD

FOCUS AREA	FINDINGS & IMPLICATIONS
Location Specific ODD	Geo-specific ODD → Limits scaling
ISO Standards	Data gaps → Weakens standard design
Automandering	State-level policy push → Lowers safety in test zones
Road Networks	ODD compliance gaps → Breaks network coverage

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Our Solution

Visualization Tool Current State and Future Work

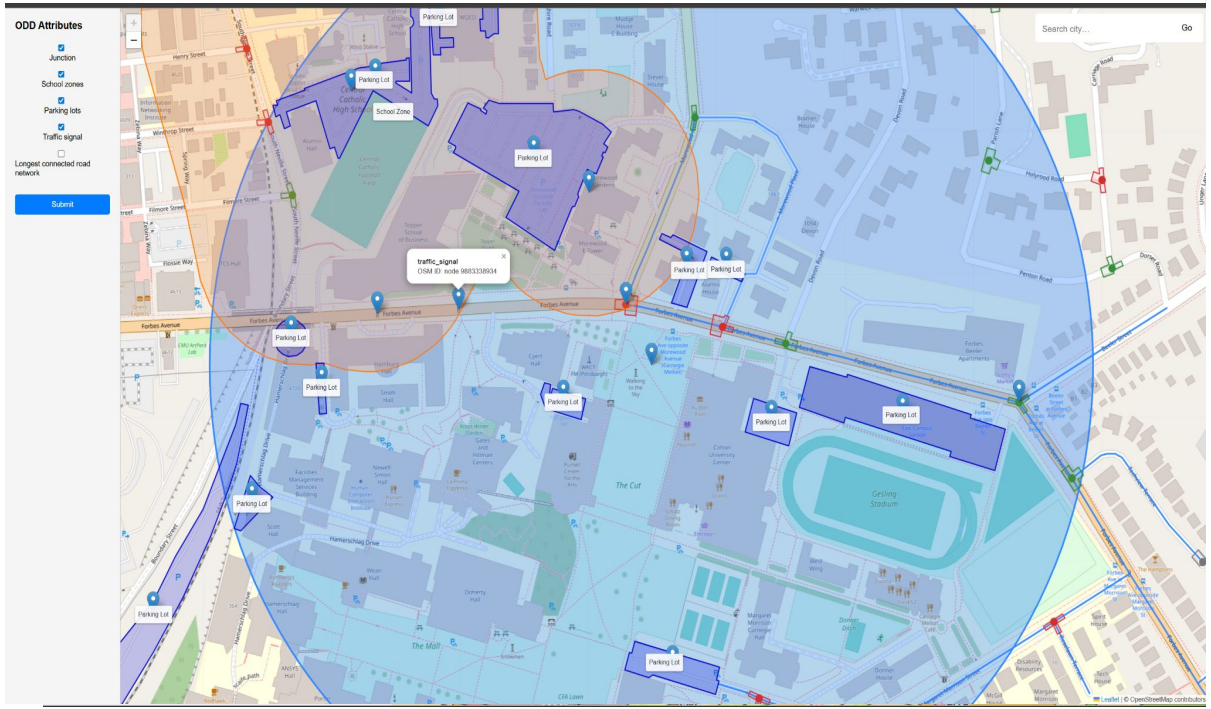
User interaction with visualization tool sifts through **9.1 billion nodes** via osmnx to retrieve relevant Phase One ODD elements

	Current State	Future Work	
ODD Elements	**Phase One (High Priority)**	**Phase Two**	**Phase Two or Three**
Main Category	Scenery	Environment	Dynamic
Sub Category 1	Zones, Driveable Areas, Junctions	Weather, particulates, illumination, connectivity	Traffic agents, subject vehicle
Sub Category 2	Parking lots, traffic management zone, driveable area signs, driveable area type, roundabout, intersection etc.	Wind, rainfall, natural illumination	Agent type, presence of special vehicles, specification
Sub Category 3	Highway types, Speed limits, Lane dimension	Daytime, nighttime, low ambient	Motor vehicles, ambulances, police vehicle, work vehicle

Holistic Visualization Tool (Phase One)

The **Heinz Team** is solving the **mapping problem** from the ODD definition to real-world geographic regions

Tier IV ODD Safety Checker - Pittsburgh



We are developing a **cross functional tool** that can be used by both **Business** and **Autonomous Driving** personas

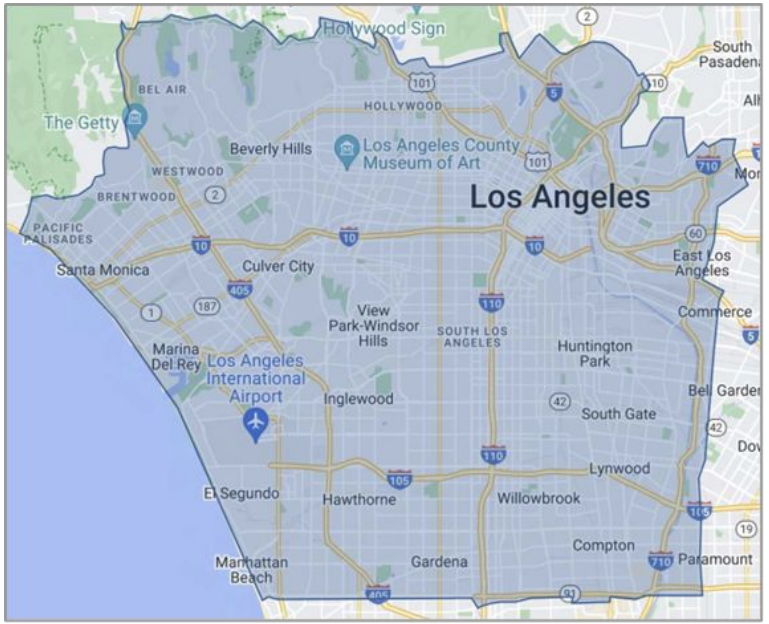
Business Exec

AV Engineer

Visualization Tool Features

Safety Checker Tool will incorporate **Operational flexibility** from anywhere to prevent scaling issues

- Location Agnostic ODD
- ISO Standards
- Automandering Mitigation
- Road Networks



***ODD Specification of Waymo**, via cpuc.ca.gov*

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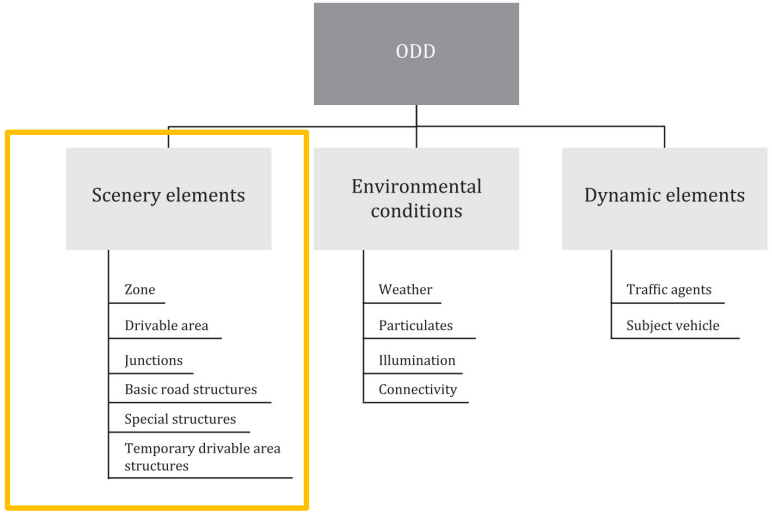
Visualization Tool Features

Combines public and proprietary data will be used to ensure **ISO-34503 ODD Elements compliance**

- Location Agnostic ODD
- ISO Standards
- Automandering Mitigation
- Road Networks



Overview of ODD, via ISO 34503

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Visualization Tool Features

Improves accuracy **to State-level** policies through safety standards incorporating ODD elements

- Location Agnostic ODD
- ISO Standards
- Automandering Mitigation
- Road Networks

Promote Fair Regulation

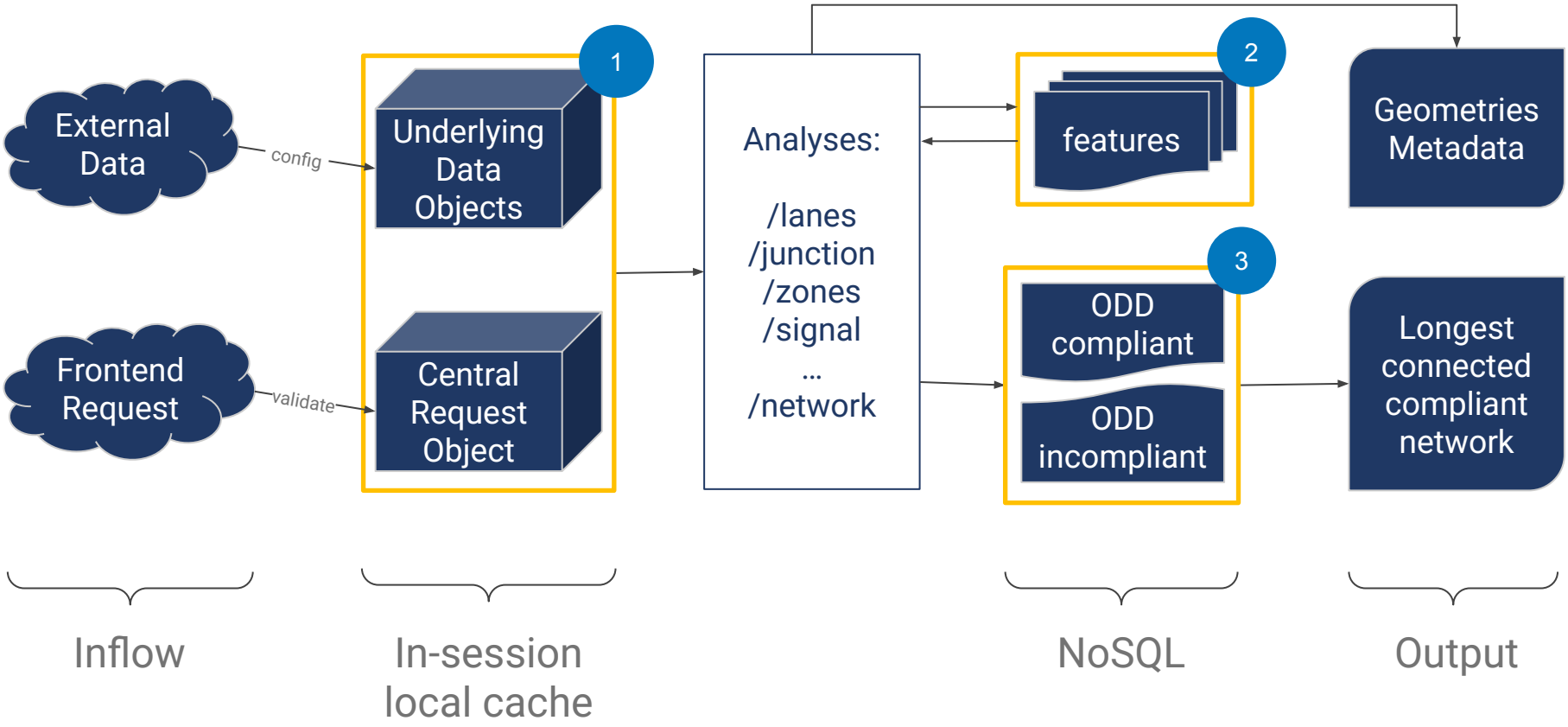
Visualization Tool Features

ODD compliance impacts **network connectivity** for unmapped geographic regions

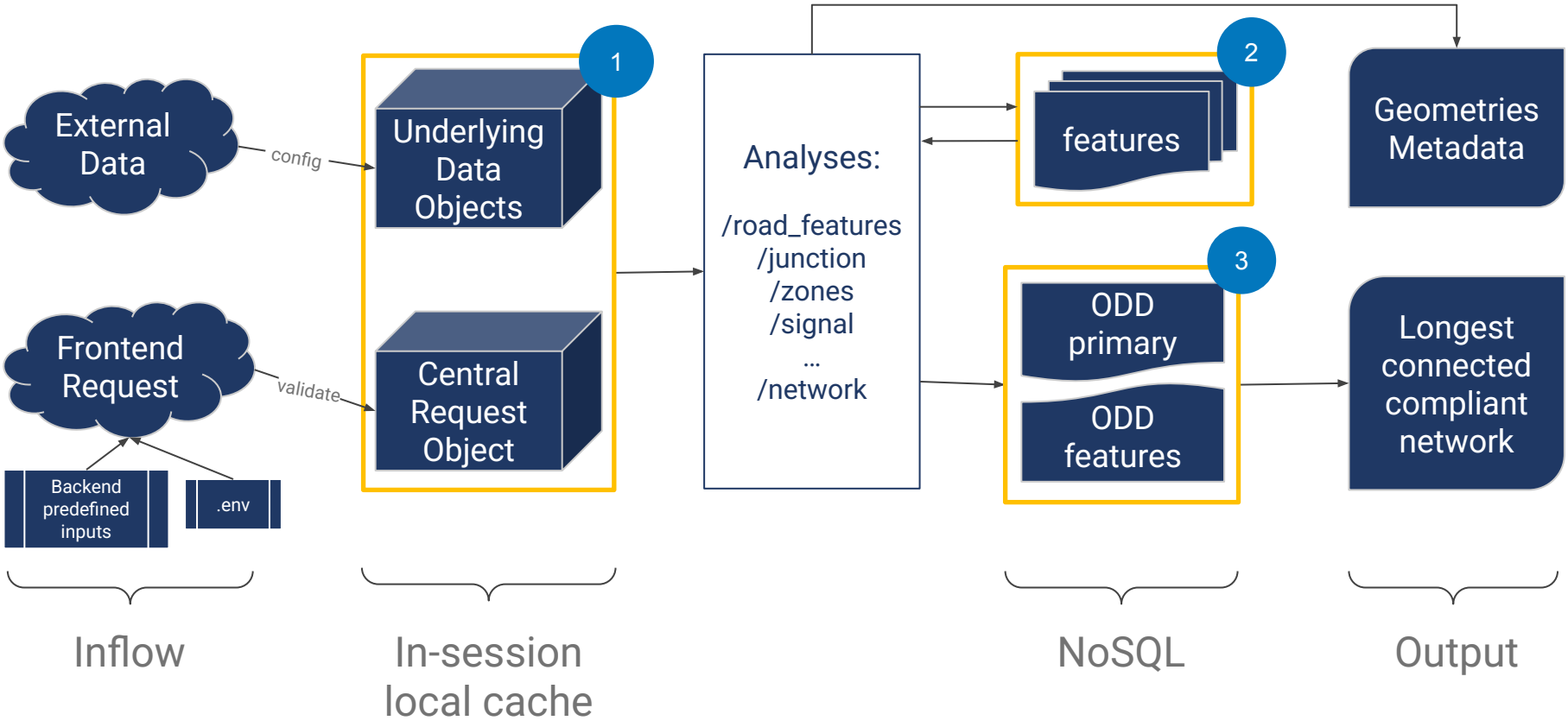
- Location Agnostic ODD
- ISO Standards
- Automandering Mitigation
- Road Networks

5 Minute Demo

App Workflow



App Workflow



Scope of Work

Scope of Work

Business Objectives

- Visualize Market Reach
- Ensure Safe Scaling
- Increase Transparency
- Aid Fundraising

Economies of Scale Advantage

From Ambiguous Expansion to **Strategic Deployment**

BEFORE *[Expensive, trial-and-error]*

1. Blind investment decisions
2. Unpredictable ROI
3. No expansion strategy

AFTER *[Strategic, data-driven]*

1. Deploy in order of ODD complexity/ROI
2. Predictable returns - Data-driven expansion
3. Systematic expansion strategy to optimize cost

Economies of Scale Advantage

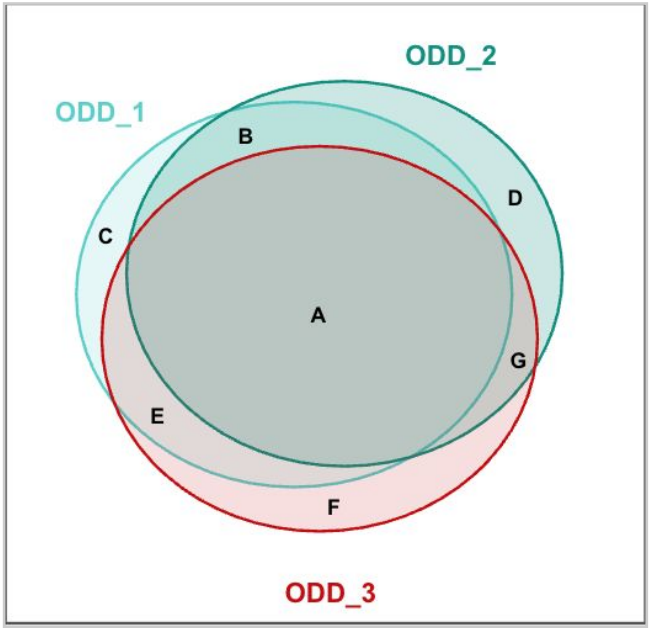
Business Impact: The ODD tool creates economies of scale in deployment validation

Assumptions:

- **Engineering validation time (cost) of a given OD is proportional to the ODD area**
- **Deployment order 1 > 2 > 3**

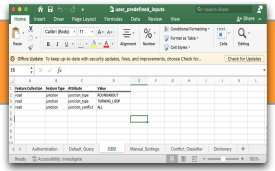
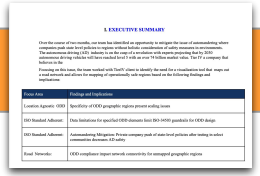
Settings:

- **Engineering time of ODD_1 (A+B+C+E): t**
- **Engineering time for ODD_2 is reduced by a factor of (D+G)/(A+B+D+G)**
- **Engineering time for ODD_3 is reduced by a factor of (F)/(A+E+F+G)**



Artifact Preview

A glimpse into selected artifacts and their purposes, offering insight into their functional significance

Artifact	Description
Executive Summary	A high-level overview of the project's goals, achievements, and key takeaways (what we built, why it matters, and where it's headed)
Excel (Two Documents)	Features default query settings, analysis parameter setting, prioritized odd Elements
GitHub Documentation	Code, commits, and collaboration.
Future Roadmap	Next steps, high level roadmap across Governance, Technology Management, and User Enablement
Artifacts	   

Project Management

Timeline	26 May	01 June	9 Jun	16 Jun	23 Jun	7 Jul	21 Jul	30 July
Environment Discovery								
In- Development Tool (Front/BackEnd	Done							
ODD Review/ASAM Opendrive	Done							
ODD Open Street Maps Data Collection	Done							
Visualization Tool								
Workshop for ODD Prioritization		Done						
Develop BackEnd				Done				
Develop Front End				Done				
Back/Front end Tasking in Jira		Done						
Abstract Representation								
Generalized ODD Schematic	Done							
OpenStreetMaps API Integration				Done				
Data Gathering Parameters	Done							
Documentation Development								
Midterm Presentation								Today
Final Presentation								Ongoing
Final Prototype, System Components								Ongoing
Updated Github Artifact								Ongoing
Executive Summary								
Other Feature Developments								
Risk Feature Development			Done					
Boundary Set and Provide coordinates (Region Diameter)				Done				

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Risks, Issues and Timeline

Project Risks and Issues

Potential impediments and limitations

- **Time constraints**
- **Prioritized ODD elements**
- **Static map & limited data, lacking dynamic conditions**
- **Tool performance reliant on third-party APIs**

Phase One Roadmap: Looking Ahead

Governance | Technology Enablement | Process Optimization | User Enablement

Our work with Tier IV has surfaced high level roadmap recommendations in consideration of continuous and strategic implementation of the visualization tool in phase one

Engineering Business

Area of Recommendation	Description	Short Term	Medium Term	Long Term
Governance	Governance refers to the framework of policies, roles, responsibilities, and decision-making structures			
Technology Enablement	Technology Enablement is the provisioning and configuration of the right tools, platforms, and technical infrastructure			
Process Optimization	Process Optimization involves analyzing and improving business or operational processes to increase efficiency, reduce cost, and support system adoption			
User Enablement	User Enablement focuses on preparing end-users to adopt and effectively use the new system or technology through training, support, and change management.			

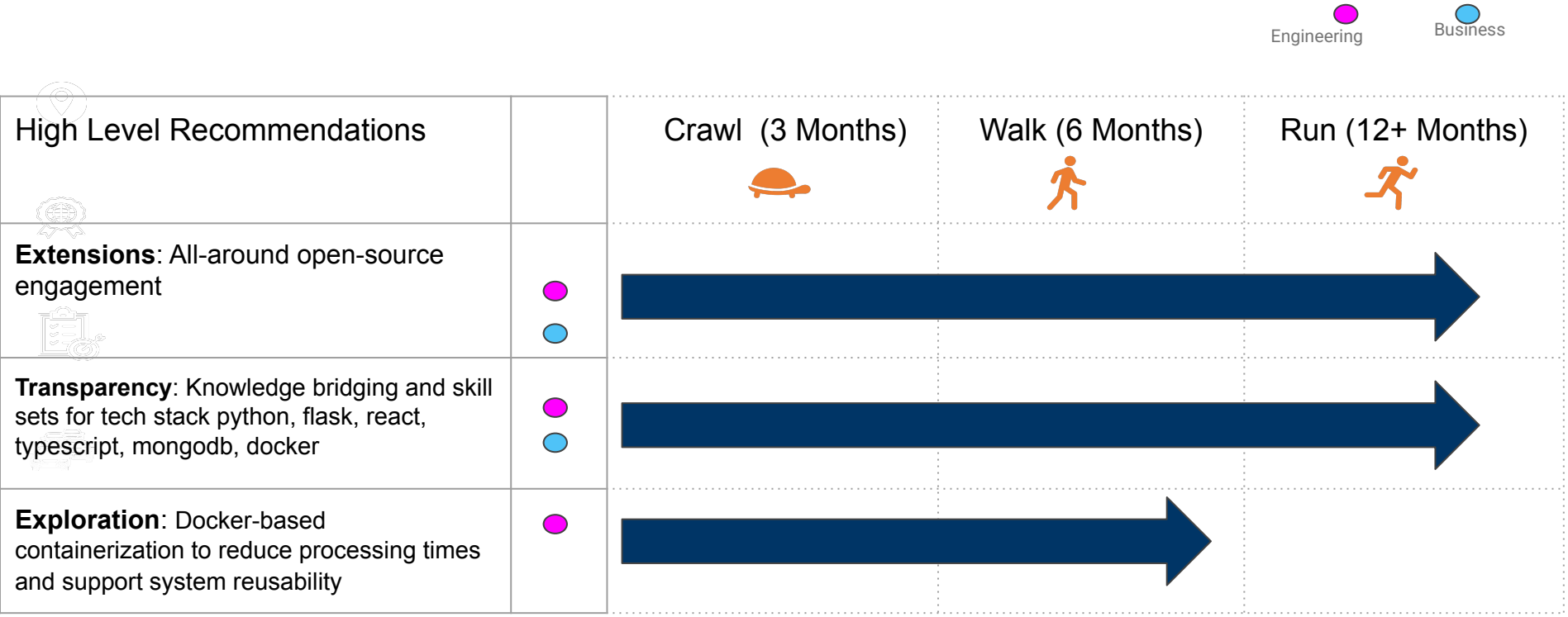
Adoption of recommendations will depend on organizational maturity, readiness , and preparedness for tool adoption

Ensuring proper governance of tool while orchestrating people, process and tools

High Level Recommendations		Crawl (3 Months)	Walk (6 Months)	Run (12+ Months)
Establish RACI (responsible, accountable, consented, informed) for data governance approach	● ●	→		
Build data governance process to update new operational design domains based on ISO 34503 standards	● ●	→	→	
Develop governance structuring for data sharing in OSMnx	● ●	→	→	→

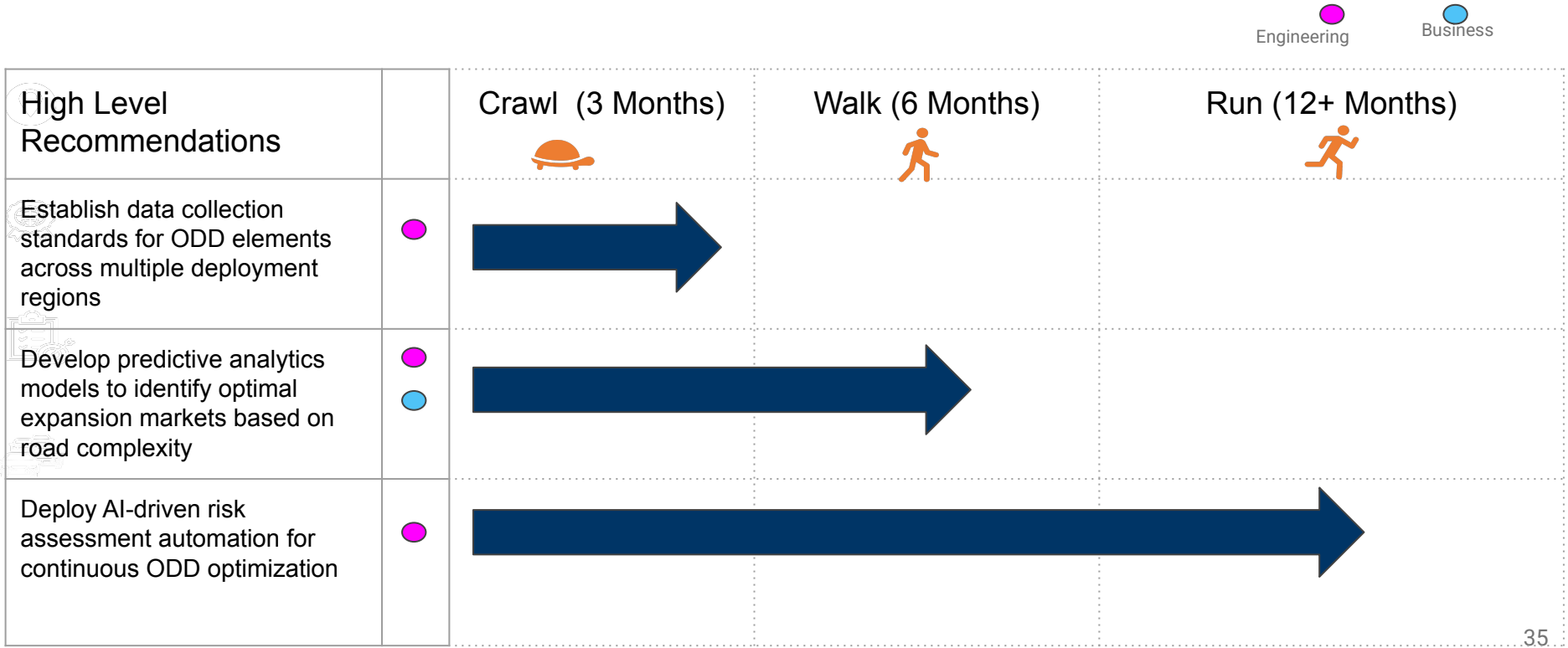
Adoption of recommendations will depend on organizational readiness and preparedness for tool adoption

Technology Enablement is the provisioning and configuration of the right tools, platforms, and technical infrastructure



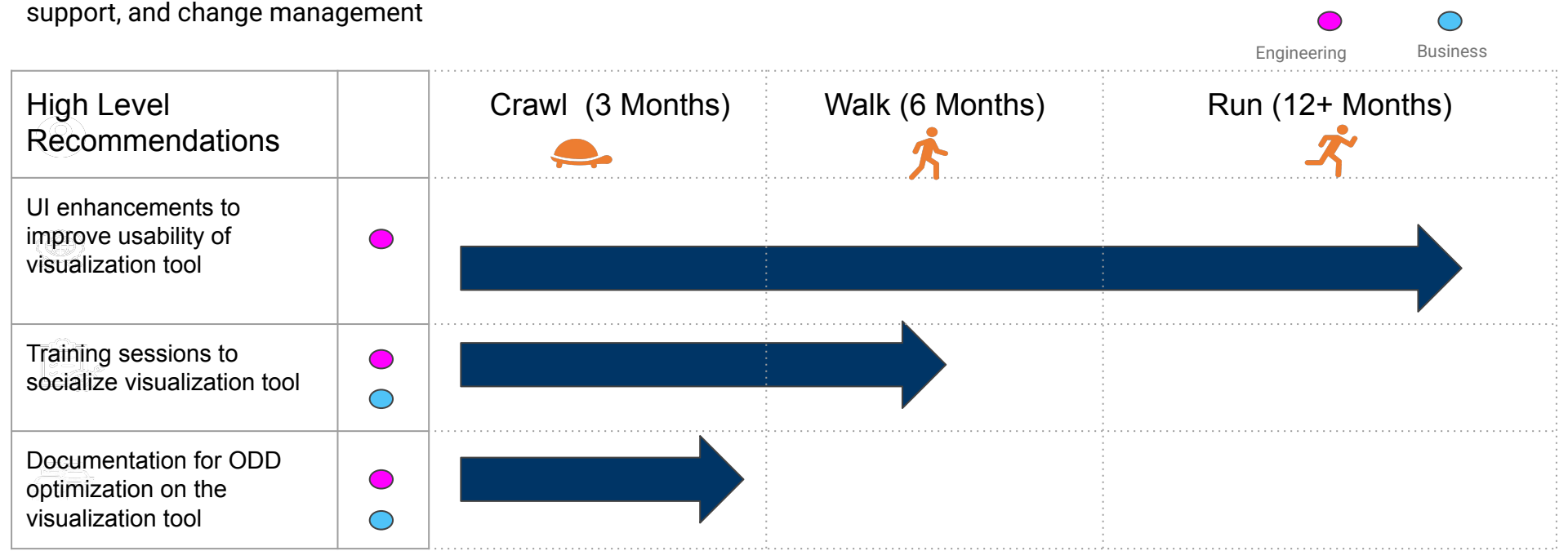
Adoption of recommendations will depend on organizational readiness and preparedness for tool adoption

Streamlining ODD deployment processes to accelerate market entry and reduce operational complexity



Adoption of recommendations will depend on organizational readiness and preparedness for tool adoption

User Enablement focuses on preparing end-users to adopt and effectively use the new system or technology through training, support, and change management



Adoption of recommendations will depend on organizational readiness and preparedness for tool adoption

Product Strategy

Product Strategy

TIER IV

TECHNOLOGY OPPORTUNITY OVERVIEW

Use Real-Time Road Network Analysis Combined With Tier IV's Proprietary Data To Identify The Safest And Most Connected Routes For Autonomous Vehicle Deployment

Apply Location-Independent Safety Criteria And Customized Risk Parameters To Reduce New Market Entry Costs And Accelerate Expansion Timelines

Incorporate Global Safety Standards With Proprietary Testing Data To Deliver Consistent Operational Recommendations Across Any Geographic Region

Strategic Decision Automation Transform complex ODD analysis from months of manual work to real-time insights that reduce validation costs and enable data-driven deployment decisions for both technical and business teams

Product Strategy

TIER IV

Geography			
			
Capacities			
Feature extraction	Geometric analysis	ODD compliance check	Most connected network
Risk Assessment			
Legal Risk	Model Risk	Reputation Risk	Operation Risk
H	M	H	H

Risk Assessment is based on approximation of consequences if the visualization

Product Strategy

TIER IV

	DATA GATHERING	MODEL BUILD	INTEGRATION
Activity	Collect OSMnx DATA	Build the ODD compliance logic to check every road segment against the defined safety criteria.	Built for future integration with Tier IV's Autoware ecosystem and deployment tools, enabling plug-and-play ODD analysis in real-world AV workflows.
Outcome	Car behavior dataset with contextual for ODD elements for safety zones, junctions, safety preferences	The longest, continuous, and safest drivable route for strategic deployment planning.	Positions the tool as a core decision-making engine within Tier IV's product suite, enabling data-driven AV deployment, reducing validation costs, and accelerating safe, scalable market expansion.

Thank You

Any Questions?

Image Generated with ChatGpt

References and Use of AI

Center for Sustainable Systems, University of Michigan. 2024. “Autonomous Vehicles Factsheet.” Pub. No. CSS16-18

We used ChatGPT to generate some content for the slides including some textual content to improve wording or make the overall text more concise