LEADING THE FUTURE OF AUTONOMOUS AND CONNECTED TRANSPORTATION

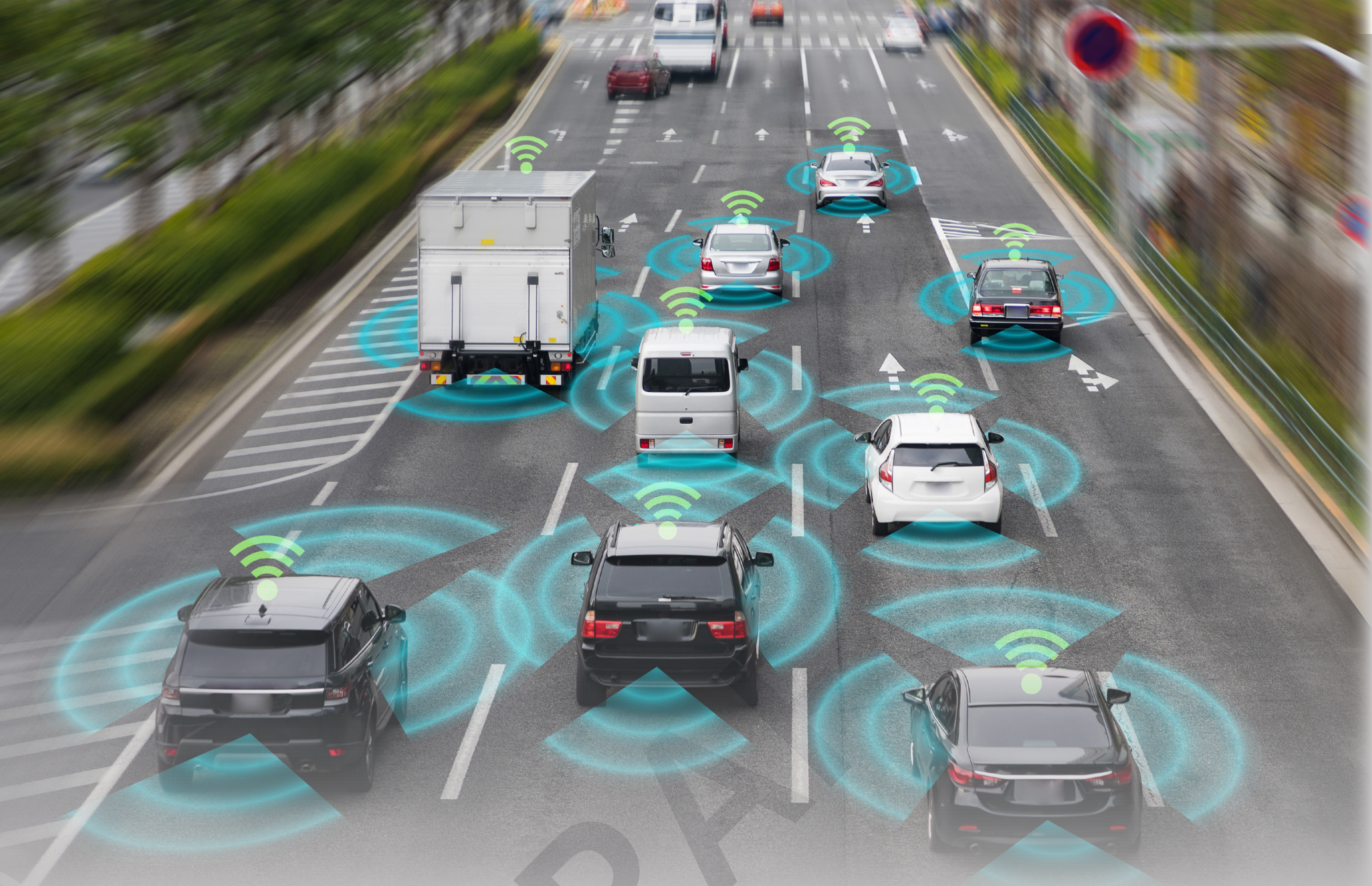
Illinois Autonomous and Connected Track (I-ACT)

S T I I

Smart Transportation Infrastructure Initiative

www.stii.illinois.edu

The Smart Transportation Infrastructure Initiative (STII) is poised to **lead the rapidly-growing field of smart mobility** by expanding the thriving research facility in Rantoul, Illinois into a full-fledged, state-of-the-art **research testing arena** for the development, testing, and commercialization of smart, autonomous, and multimodal transport.



The arena, called the Illinois Autonomous and Connected Track (I-ACT), will feature **smart freight and vehicle loops, a connected village, and agricultural lands.** It is slated to be the most advanced multimodal transportation facility of its kind, but more importantly, the only one that allows testing under conditions that imitate real-life environments and interactions of autonomous vehicles and smart infrastructure (Figure 1).

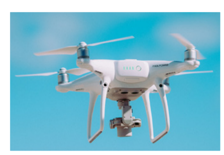
TEST SETTING

∴ Freight
∴ Highway (continuous loop, 75 mph)
∴ Highway interchange
∴ Agricultural land
∴ Airport
∴ Rural
∴ Suburban
∴ Commercial, micro-urban
∴ Residential
∴ Signalized intersections

ENVIRONMENT

∴ Controlled indoor
» Rain
» Snow
» Ice
» Fog
» Wind (speeds up to 40 mph)
» Variable lighting

∴ Outdoor
» All seasons
» Natural conditions



TRANSPORT MODE

∴ Freight (truck)
∴ Freight (loading and unloading)
∴ Smart containers
∴ Cars and light trucks
∴ Personal transport (bicycles and pedestrian)
∴ Mass transit
∴ Large drone
∴ Small drone
∴ Agricultural (land and air)

Figure 1. Future capabilities of the I-ACT testing arena.

Growth in population and rapid urbanization has caused an increase in e-commerce, economy, and mobility of goods and people that surpasses the capacity of the nation's existing infrastructure, due to the limited expansion of the aging transportation network as well as limited capital investment in rehabilitation. Additionally, vulnerable communities often feel disconnected due to lack of mobility options that influence their employment opportunities, safe travel, and economic prosperity. These challenges demand innovative solutions and collaborative efforts to meet the overarching goal of efficient, sustainable, resilient, and safe mobility for all populations. As the hub of the nation's transportation systems (air, rail, and freight), Illinois is well-positioned to **pioneer the cradle-to-market program of connected and autonomous vehicle technologies and their full integration into the transportation infrastructure.**

The Illinois Center for Transportation is a global leader in research and innovation, with more than 150 researchers and a 70-year tradition of cutting-edge developments. The initiative will combine Illinois' unique strengths and establish robust partnerships between the Illinois government, three world-renowned universities (University of Illinois at Urbana-Champaign, University of Illinois at Chicago, and Northwestern University) spearheading transportation research in Illinois, local and regional municipalities, corporate research and development arms, and startup ventures. Building I-ACT will leverage Illinois' current status as a connector hub for multimodal transit to **position Illinois as a global leader for testing and commercializing autonomous systems,** not only in freight but also in agriculture, aviation, urban, and suburban settings. Visionary leadership and commitment to robust technology and its implementation will create new jobs, improve mobility and public safety, and introduce new technologies to Illinois and the global community.

Building the World's Premier Development, Testing, and Commercialization Arena for Transport

Headquartered in the decommissioned Chanute Air Force Base in Rantoul, Illinois (Figure 2), I-ACT will be built at a uniquely advantageous and cost-effective location. It is less than one mile from interstate I-57, the Rantoul airport, a major north-south rail corridor, and a village committed to serve as an urban pilot for prototyping autonomous and infrastructure technology. The 250-acre controlled testbed pledged by the Village of Rantoul and the opportunity to immediately deploy products in real-world environments **distinguish I-ACT from other facilities in the US and the world**.

Figure 2. Plan view of I-ACT, detailing the testing arena boundaries (left) and proposed layout (right).

The capabilities of I-ACT will include a robust network of laboratories, autonomous high-speed test loops, urban and metropolitan road courses, urban-rural boundary road courses, and an interstate corridor—an ideal setting for creating the next-generation technologies for nationally, autonomous freight, passenger, and agricultural vehicle transportation systems. The level of stakeholder engagement, broad funding sources, interdisciplinary contributions, unique location, contribution from premier academic institutions, and vested support from the surrounding communities—key elements in successful initiatives—all enable the development of a **comprehensive and overarching program** that will provide necessary resources and expertise to conduct cutting-edge research.

I-ACT Will Create Transformational Local Impacts and Advance Illinois' Global Leadership in Transport

As a state-of-the-art research facility, the I-ACT testing arena will lay the foundation for many mutually-inclusive benefits, focusing on connected and autonomous high-speed freight and multimodal mobility. It closely aligns with the vision of the Illinois transportation system as well as national programs for vehicle testing and many other research efforts beyond technology development. I-ACT will not only become a central location for new discoveries but will also lead significant changes in technology acceptance policies, compliance protocols, and comprehensive views of life cycle assessment for the deployed technology. As a result, I-ACT will assist lawmakers and other stakeholders to determine ideal mobility strategies for municipal, statewide, and nationwide communities. STII will provide innovative and equitable multimodal transit opportunities, thereby enhancing the lives of all populations and their communities.

Additionally, building the I-ACT testing arena in Illinois will not only accelerate the development and deployment of autonomous and connected transportation systems—and establish the state as a national leader in transportation best practices—but also promote local and statewide benefits[1] as **companies and partners invest an estimated $50 million per year on Illinois-based projects at I-ACT by 2025.**

Tapping Illinois' Best-in-class Technological and Corporate Expertise to Create Products and Companies

With more than 170 academic affiliates representing a wide array of disciplines—transportation, electrical, mechanical, and aerospace engineering; operations research; computer science; mathematics; cultural studies; business administration; physics; psychology; sociobiology; humanities; and disability research—this initiative will spearhead the development of intra-, cross-, and multi-disciplinary solutions to critical national problems. The award-winning University of Illinois Research Park (UIRP) will partner with STII to **pursue commercialization of the technologies created and transfer these technologies** to the private sector. The UIRP EnterpriseWorks Incubator provides resources, space, and expertise to support the launch of new companies based on I-ACT technologies.

The ambitious I-ACT project is cost-effective—due largely to local government support and available facilities on the decommissioned Chanute Air Force Base—and can be implemented over the next six years. New capabilities will materialize within three phases (Table 1).

[1]We will commission independent economic and environmental impact research when the design stages—currently underway in collaboration with potential partners—are at 95% completion. This is to ensure accuracy in these analyses. The analyses to be conducted: economic (Village of Rantoul, Illinois, and global), including investment attraction, indirect impact, and tax implications; environmental, including full life cycle assessment; and technological, including patent creation and IP allocation among partner institutions.

OPPORTUNITY

Our initiative is the nucleus for a consortium of the three universities who plan to collaborate with federal, state, municipal, and private entities **to develop the state and national research agenda in transportation for next-generation technologies.** We welcome collaborative and investment proposals. In addition, several sponsorship opportunities are available:

I. **Economic/Social Investment:** An entity invests in the testing arena development, which is motivated by long-term economical and/or social benefits.

II. **Performance Testing:** A private entity provides a developed product and tests its feasibility, commercialization, and deployment using the I-ACT testing arena.

III. **Team Research and Development:** The sponsor provides funds and collaborates with the STII research team. Involvement in research duties may include technologies and/or protocol development by government agencies.

IV. **Academic Research Sponsorship:** Sponsor involvement is strictly monetary, funding STII to perform all research.

V. **Technical Support:** A government entity or a company leases a portion of the track or the testing arena to use according to its needs. In this scenario, STII can provide technical support as needed.

For more information visit us at www.stii.illinois.edu or contact us at stii@illinois.edu

Proposed Project Budget

i) $50M buildout (including 25% contingency)
   a. $2M planning (survey, environment, and design)
   b. $2M additional land procurement
   c. $22M facility construction
   d. $7M control, computing, and operating center
   e. $5M instrumentation
   f. $2M construction of environment facility
ii) Land and real estate worth $15M, donated by the village of Rantoul
iii) $10M in annual facility revenue (20% fee on $50M in projects)
iv) Annual costs:
   a. $5M in Phase 1, dropping to $0 by end of Phase 3
   b. Can self-fund repairs and additional expansion based on cut of project revenue

Table 1. Potential New Projects Attracted to I-ACT

Facilities
Phase 1: 2019-2020 ✓Instrumented open space (15,000 ft^2) ✓Surrounding buildings for small-scale drone/vehicle testing
Phase 2: 2020-2024 ✓Instrumented two-lane freeway for 70 mph cruising, with varying grade/curvature and on-/off-ramps ✓Instrumented local streets, intersections/roundabouts, buildings, and a tunnel with various signs/signals ✓Short railway track with an at-grade crossing ✓Indoor control room and laboratories (vehicle-infrastructure instrumentation and human factor) ✓Pedestrian and bicycle facilities ✓Instrumented farmland ✓Off-road vehicle testing
Phase 3: 2024-2025 ✓Semi-controlled town district (including volunteer residents) with instrumentation for CAV testing (truck and drone), connected to Interstate I-57 ✓Autonomous transit/paratransit routes

Potential New Programs and Capabilities
Drone and drone-truck operations in suburban/rural settings
Autonomous truck and vehicle testing and driver training
Drone/vehicle/infrastructure telematics and data sharing
Drone design and operation
Auto agriculture machines (development and assessment)
Intelligent urban parking control and management
First- and last-mile delivery technology testing
Dynamic map update using CAV data
Airborne delivery system and personal vehicle testing
Safety protocols for transition to AV and mixed traffic with conventional vehicles
High speed, autonomous, and connected freight truck testing (e.g., platooning)
Extreme climate impact on CAV platooning
Multimodal freight/ passenger transport in simulated smart cities (V2V, V2I, V2H)
Impact of high-level CAV and shared mobility on traveler behavior and freight movement
Protocols for CAV and shared mobility data sharing for real-time operations and freight supply chains
Mix of autonomous and conventional vehicles and modeling impacts of increased penetration of AVs and shared mobility on infrastructure design
Pavement instrumentation and testing
Public transport in smart urban and suburban cities (V2H)
Optimized logistics for first- and last-mile delivery
Pavement service life estimation of existing structures loaded by CAV
Incorporating CAV into pavement design and analysis, existing standards, and standards-development processes
Autonomous pavement evaluation and network management
Urban and low air traffic service
Mobility solution and smart cities
Intelligent preservation and rehabilitation scheduling for smart cities
On-road safety improvement (signage, sensors, communication technologies, and software) for CAV and shared mobility
Parking facility access for auto vehicles and shared mobility in urban areas
Emergency response and resiliency in smart urban cities
Autonomous agricultural technology testing
Efficient crop harvesting and freight transport to storage stations
Fuel economy optimization considering CAV, infrastructure design, and shared mobility
Off-road autonomous vehicle testing
Impacts of CAVs and shared mobility on land use (and vice versa)
Measuring CAV safety and understanding potential crash scenarios
Energy harvesting and smart material development
Integration and use of harvested energy into infrastructure technologies (structural monitoring and transportation systems)
Renewable energy technology testing and integration into smart cities
Cybersecurity roadmap for CAVs and shared mobility
Adaptation behavior of conventional vehicle drivers to autonomous vehicles
Validation of autonomous vehicle technologies in real village and highway corridors
Application of autonomous public transport in connected village
Multimodal transport deployment in connected village
Demand-responsive transportation by autonomous vehicles
Pilot management and communication with drones in connected village
Technology development for vehicle and pedestrian safety systems
Paratransit services and shared mobility options for people with disabilities
Smart material and technology deployment in connected village
Implication of CAVs on transportation planning and modeling tools for municipal, regional, state, and national agencies
Socioeconomic and environmental impacts of CAV deployment and shared mobility
Policy framework for government intervention, regulation, and management
Impact of CAVs on law enforcement and first responders
Training protocols for all users of CAV and shared mobility technologies

Smart Transportation Infrastructure Initiative

www.stii.illinois.edu