Critical Thinking in Construction Engineering for Developing & Managing Underground Space

Critical thinking is the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating *information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action.*

PURDUE UNIVERSITY | Construction Engineering and Management | BAMI-I Buried Asset Management Institute - International | ISI | International Infrastructure Solutions, LLC (IIS) | WORLD TRADE CENTER® INDIANAPOLIS

CONSTRUCTION TECHNOLOGY

15, 2021 | Music City Center | Nashville, TN

- *Professor Tom Iseley, Ph. D., P.E., Dist. M. ASCE, PWAM*
- Beavers Heavy Construction Distinguished Fellow
- Professor of Engineering Practice
  Construction Engineering and Management
  Purdue University
- Chair, BAMI-I Board of Director
- President, International Infrastructure Solutions, LLC
- Adjunct Professor, Xi'an Jiaotong University, China

Purdue University
The Beavers Heavy Construction Distinguish Fellow
Honoring Donn E. Hancher

THE BEAVERS
A HEAVY ENGINEERING CONSTRUCTION ASSOCIATION

The Beavers, Inc. (The Beavers) is a heavy engineering construction association. It is a social, honorary organization formed in 1955. It was organized and continues to be managed by construction companies and individuals who are or have engaged in heavy engineering construction. They conduct two major events each year. The Beavers Awards Dinner is conducted mid-January in Los Angles with over 2,200 attendees. The mid-year meeting (The Beaverdilly) was held in August at the Silverado Resort in Napa, CA with over 1,600 attendees.

The goal of the Beavers supported Construction Engineering and Management (CEM) program at Purdue is to build an educational experience, responsive to the needs of Heavy/Highway contractors.

Creative utilization of underground space becomes more critical as we face the challenges of increased population density in urban areas.

- ❑ Space is needed for:
  - Commercial
  - Industrial uses
  - Transportation
    - ➢ Freight
    - ➢ People
    - ➢ Products
      - ✓ Oil & gas
      - ✓ Water & wastewater
      - ✓ Storm water

- ❑ Examples:
  - Big-Dig in Boston
  - Bertha Tunnel in Seattle
  - CSO Tunnels in Indy & Fort Wayne

The Challenge: A major component of doing anything in underground space is knowing what is down there.

- Just like outer space.

- We need to have technologies that will allow us to remove as much uncertainty as possible before the development process begins.

Major Areas of Uncertainty (What do we need to know?)

I. Soils & groundwater

- Geology
- Geotechnical properties of the soils
- Potential behavior of the soils & groundwater

II. Underground utilities

- What is beneath our feet, roads, buildings, etc.
- Where are they?
- What kind of condition are they in?
- What are we going to do with them?

CGA – Common Ground Alliance (DIRT Report)

- Impact to construction projects: 70% of construction project experience budget and schedules overruns due to encountering unexpected UU
- Safety: The 2019 CGA Technical Report cited an upward trend in total damage from 509,000 in 2018 to 532,000 in 2019, representing a 4.5 percent increase.

Dealing with UU is serious business!!

In response to the global challenges:

- *The Buried Asset Management Institute – International (BAMI-I)*
- *Subsurface Utility Engineering (SUE)*
- *Utility Engineering and Surveying Institute (UESI) | ASCE*
- *Latin American Society for Trenchless Technology (LAMSTT)*
- *UCA of SME, Purdue Student Chapter*

BAMI-I
Buried Asset Management Institute - International

Board of Directors (BOD) & General Membership Meeting

DATE: **Tuesday, July 13, 2021**

TIME: **2:00 PM – 5:00 PM**

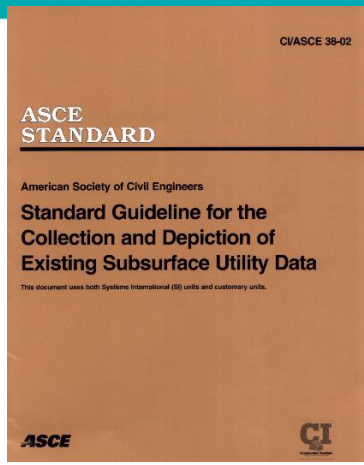
Music City Center
Nashville, Tennessee
201 Rep. John Lewis Way S, Nashville, TN 37203
Room 106A

Industries' Response to This Global Challenges

- Late 1980's the ground work was established to create a new professional practice in Civil Engineering call:
  - ❑ SUE: Subsurface Utility Engineering

- During the early 1990's, I served a 5-year term on the EXCOM of Construction Division of ASCE (now CI)
  - ❑ Liaison to ASCE Codes & Standards Council

- Established committee to develop ASCE 38-02



What does ASCE 38-02 teach?

How to identify & manage UU risks utilizing 4 QL (Quality Levels)

Results: Global increase in R&D to locate UU with non-destructive technologies such as geophysics

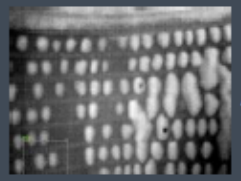
Examples:

- ❑University of Birmingham, UK: Mapping the underground
- ❑Hong Kong Polytech University

The Hong Kong Polytechnic University

Specifications for Nondestructive Testing, Surveying, Imaging and Diagnostic (NDTSID)

01: 6 NDTSID technologies



Infrared Thermography
Active or passive infrared thermography method to identify in-pipe defects

CCTV
Visual inspection method to investigate pipe condition and identify surface damage and source of water seepage

Leak noise correlation
Acoustic method to source water seepage and locate leak points

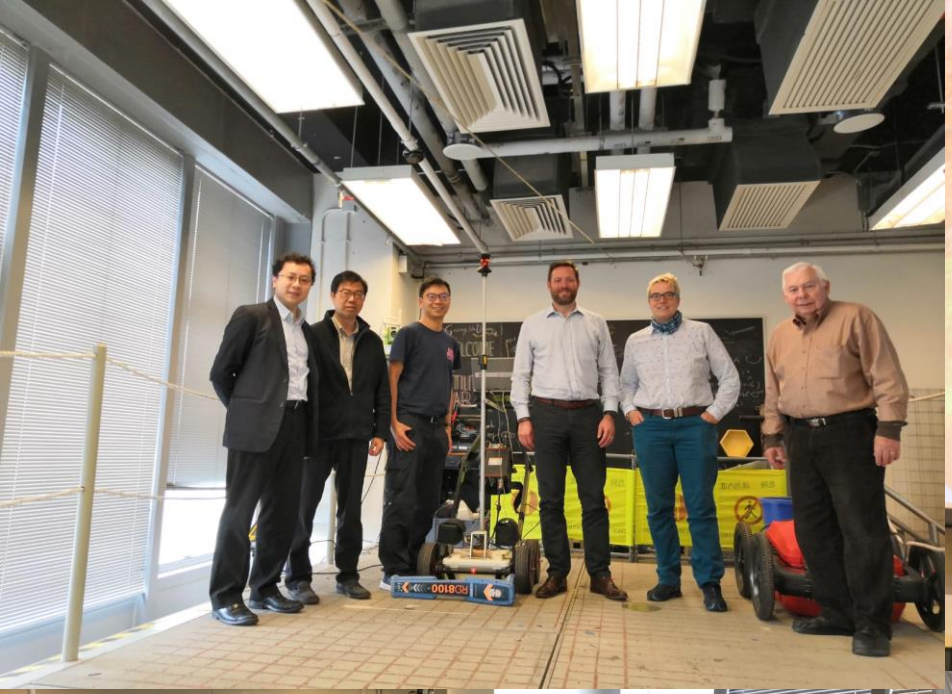
Pipe Cable Locator
EM method to trace and locate buried UU alignment using passive or active method

Flow Survey
Measure flow velocity and depth of fluid in pipe

Ground Penetrating Radar
EM method to located buried objects and detect abnormalities like voids and water seepage

Solutions based on technologies analogous to medical imaging

"Stop, think and See the Unseen Before Drill."



- ASCE 38-21 defines SUE as:

"The specialty practice of Civil Engineering's Utility Engineering branch that includes the investigation, analysis, judgment, and depiction of existing utility networks."

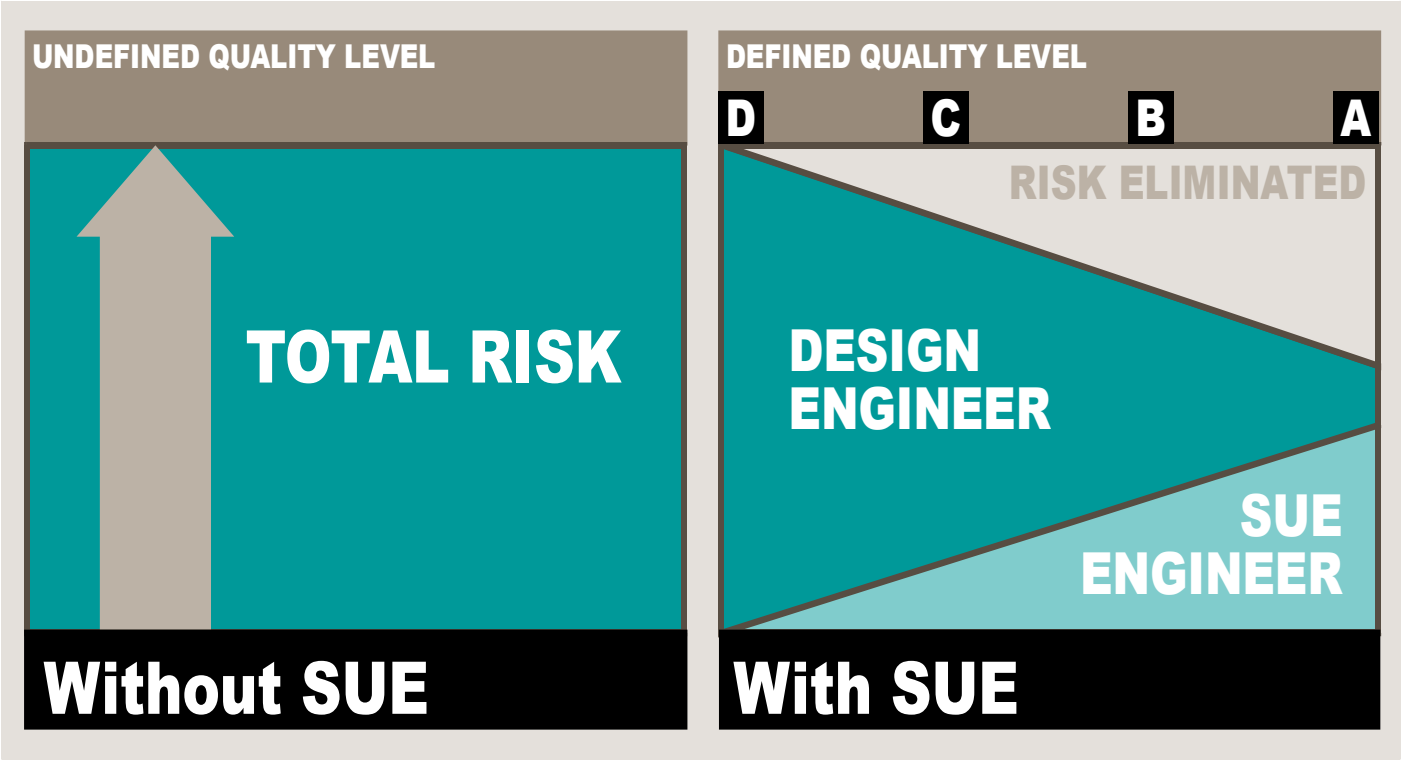
- SUE is a proactive **RISK MANAGEMENT** tool Used predominantly to provide Savings and Safety in:

  - **Urban areas,**
  - **Significant underground utility plants, and**
  - **Any where that more information is needed to avoid costly relocations**

- For every $1 spent on SUE, a project could see a minimum quantifiable savings of $4.62

"Cost Savings on Highway Projects Utilizing Subsurface Utility Engineering," Purdue University

INVESTMENT MINIMUM QUANTIFIABLE SAVINGS



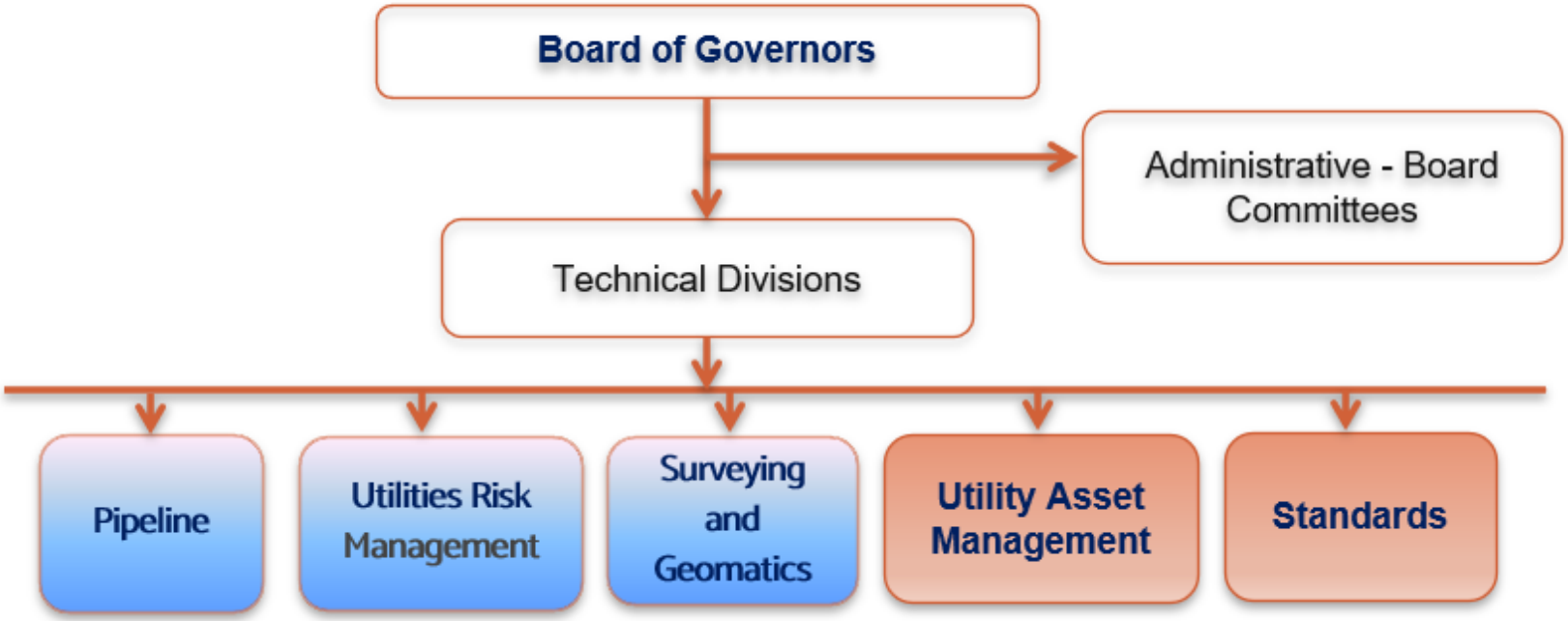
TOTAL ENGINEERING RISK POOL

ALLOCATION OF RISK WITHIN ENGINEERING POOL

UESI

- UESI is the newest Institute, starting in October 2015
- The Institute focuses on two separate but related aspects of civil engineering practice: Utility Engineering and Surveying
- We have defined Utility Engineering and Engineering Surveying and placed these definitions in the Strategic Plan and on the UESI website.
- The Survey aspect of the Institute is not limited to utilities. It is focused on all aspects of Engineering Survey and Geomatics practice.

UESI Organization Chart



UCT

UNDERGROUND CONSTRUCTION TECHNOLOGY

The Underground Utilities Event | July 13-15, 2021 | Music City Center | Nashville, TN

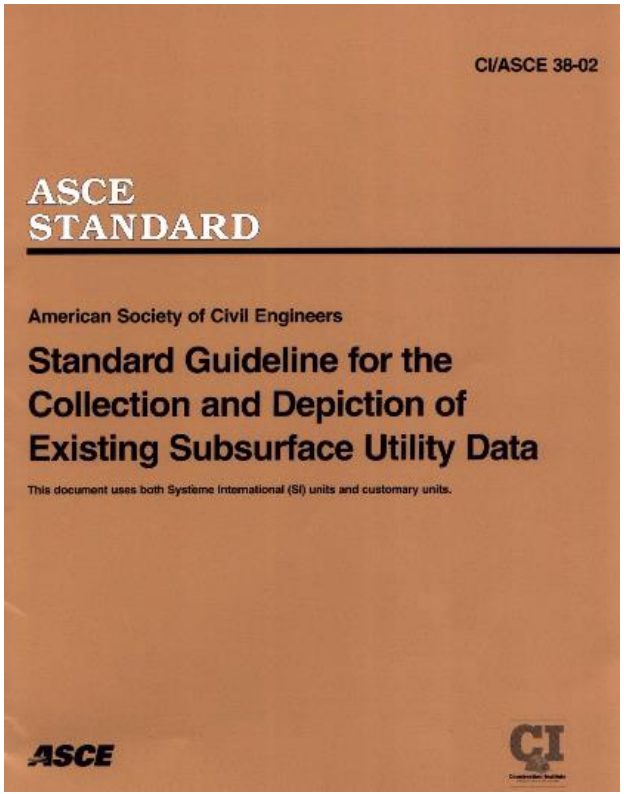
The 8th Utility Investigations School (UIS)
May 24-28, 2021

PURDUE UNIVERSITY | Construction Engineering and Management

TRENCHLESS TECHNOLOGY CENTER

UESI ASCE

BAMI-I Buried Asset Management Institute - International



NUCA REPRESENTING UTILITY & EXCAVATION CONTRACTORS

THE HONG KONG POLYTECHNIC UNIVERSITY 香港理工大學

LSGI DEPARTMENT OF LAND SURVEYING AND GEO-INFORMATICS 土地測量及地理資訊學系

The Sixth BAMI-I/UESI Utility Investigation School

Dec 16-19, 2019

22 Attendees

BAMI-I
Buried Asset Management Institute - International

UESI
ASCE

COLORADO SCHOOL OF MINES

The 9th Utility Investigations School (UIS)

Aug 9-13, 2021

BAMI-I UESI

The 9th UESI/BAMI-I Annual Utility Investigation School (UIS)

Lawrence Tech — Possible is everything.

OBJECTIVE:

The Buried Asset Management Institute – International (BAMI-I) & the Lawrence Technological University in conjunction with the ASCE'S Utility Engineering and Surveying Institute (UESI) have teamed to hold the 9th ASCE UESI / BAMI-I UIS School in 2021. This short course will give practitioners the knowledge and tools to provide competent utility investigations in accordance with accepted national standards (ASCE 38) and to defend against claims through this knowledge and its documentation. In addition to the classroom lectures, practical sessions will be held where participants will be offered hands-on experience with the GPR, PCL, and etc. This 5-day school will be taught by the foremost experts in the geophysics and subsurface utility engineering field.

This 5-day school has been designed for

- Engineers and surveyors and project managers providing deliverables that include results and depictions of utility investigations.
- Consulting engineers, Employees of utility companies, state DOTs and local highway agencies, regulatory agencies, local governments, etc.
- Design engineers for infrastructure projects with significant expected utility congestion.

Registration Fee

$1,995

$1,795 EARLY REGISTRATION
(Ends Jun 18)

Additional 10% discount for
3 or more attendees from same company.

At the end of this short course, students will receive 4 CEUs /40 PDHs and a Certificate of Completion.

Date: August 9-13, 2021
Time: 8:00 am – 5:00 pm Daily
Location: Lawrence Technological University, MI

Organized by:

BAMI-I Lawrence Tech

Media Partners:

Benjamin Media · underground construction · A to B Publishing Inc. · dp PRO

Sponsored by:

UESI · Purdue University · NUCA · LAMSTT Latin American Society for Trenchless Technology · Nulca · NASTT Southeast Chapter · NASTT Midwest Chapter · NASTT Mid-Atlantic Chapter · Subsurface Utility Engineering Association

Course Directors

Tom Iseley, Ph.D., P.E., Dist. M. ASCE, PWAM
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Phone: (404) 386-5667

Course Developer & Primary Instructor

Jim Anspach, PG(r), Dist. M. ASCE
ASCE/UESI President 2018
Member-EJCDC, TRB Utility Committee
Chair ASCE -38
J.H. Anspach Consulting
Email: jim@jhanspach.com

Registration

For registration or having additional questions, please email Saleh Behbahani, sbehbaha@purdue.edu or Leonard Ingram, leonard@engconco.com, (334) 872-1012

The 10th Utility Investigation School
Sep 13-17, 2021

PURDUE UNIVERSITY | Construction Engineering and Management

BAMI-I
Buried Asset Management Institute - International

UESI
ASCE

Subsurface Utility Engineering Association

Th :1 | Music City Center | Nashville, TN

LAMSTT
Latin American Society for Trenchless Technology

ICTIS
Instituto Colombiano de Tecnologías de Infraestructura Subterránea

BAMI-I

INVITACION

Lanzamiento del curso:
Mapeo para la Gestión de activos
Conferencias y exhibición de equipos
Conferencista Internacional:
PhD David Thomas Iseley
Presidente BAMI-I

Fecha: 1 de agosto de 2019
Horario: 9:00am - 12m
Lugar: Pontificia Universidad Javeriana-auditorio Pablo VI

Inscripción sin costo alguno para:
empresas y emprendedores del mapeo de redes subterráneas

Confirmar asistencia al e-mail: asociacionictis@gmail.com

UCA of SME, Purdue Student Chapter

Purdue would be the 3rd UCA of SME Student Chapter (One is at the Colorado School of Mines and the other is at University of Illinois at Urbana-Champaign).

- **Faculty Advisor:**

✓ Dr. Tom Iseley, Ph.D., P.E., Dist. M. ASCE, PWAM

- **Chapter Counselors:**

✓ Mark H. Bradford, P.E., Geotechnical/Tunnel Engineer, Black & Veatch (Indianapolis, IN)
✓ David Mast, P.E., Sr. Project Manager, AECOM (Cleveland, Ohio)
✓ Philip J. Kassouf, P.E., Vice President & Treasurer, Triad Engineering & Contracting Co.

Purdue UCA of SME Chapter Officers for the 2021-2022:

- President: Chicoyah Hunt
- Vice-president: Matthew R Blount
- Treasurer: Jake Teegarden
- Secretary: Jade Woodson

PURDUE UNIVERSITY | Construction Engineering and Management

UCA Underground Construction Association
A Division of SME

Selected Topic in

Construction Engineering & Management (CEM)

Spring 2021

Course Title: Development of Underground Space (DUS) (3 credit hours)

Course CEM 597000 (24914) – TR – 9:00 - 10:15 am – Room 2579: Wang Hall

Development of Underground Space (DUS) - Industry Partners

BRIERLEY ASSOCIATES
Creating Space Underground

Stantec

AECOM

SHANNON & WILSON

COWI

ALDEA SERVICES LLC

TRAYLOR BROS., INC.

ARUP

KELLER

USI consultants

COLORADO SCHOOL OF MINES

UNIVERSITY OF BIRMINGHAM

STEIN & PARTNER GERMANY

citizens energy group

CITY OF FORT WAYNE INDIANA

Course Title: Underground Infrastructure Asset Management (UIAM) (3 credit hours)
Course CRN 27920 – TR – 12:00-1:15 pm
Fall 2020

BAMI-I UIAM (Underground Infrastructure Asset Management)

Course description: This course has been developed to be a project driven course to provide a unique opportunity to work with national subject matter experts (SME) to develop the next generation CTAM (Certification of Training in Asset Management) program.

Course strategy: (1) Obtain a solid understanding of the current CTAM program by successfully completing the 4-course online CTAM program, SME lectures, required readings, assignments, and class lectures, and (2) Develop the new CTAM program.

Current CTAM Program	New (Next Generation) CTAM Program
CTAM 100 - Fundamentals	CTAM 121 – Introduction & fundamentals
CTAM 200 - Developing an AMP	CTAM 221 – Inventory & mapping
CTAM 300 - Implementing an AMP	CTAM 321- Remaining life & extending Svc. life
CTAM 400 - Financing an AMP	CTAM 421 – Levels of service
	CTAM 521 – Criticality of assets
	CTAM 621 – Capital cost & life-cycle-cost
	CTAM 721 – Long-term financial planning
	CTAM 821 – Developing a risk-based AMP
	CTAM 921 – Conclusions & recommendations

NSF IUCRC
HEAVY CIVIL & UNDERGROUND SPACE DEVELOPMENT CENTER (HCUSDC)

IAB Members		IUCRC Sites
Companies, State/Federal/Local government and non-profits	+	*Faculty and students from different academic institutions*

IUCRC Research

Value to Industry

- Cutting edge research projects
- Investment leveraging
- Sector networking, learning from industry peers and customers
- Access to intellectual property
- Pre-publication access to research
- Center researchers & facilities
- Access to students

Value to Academia

- Understanding of industry needs
- New research and education program dimensions
- Student training recruitment and placement
- Trusted relationships with industry
- Ready partners for translation of discoveries
- Means to achieve institutional mission.

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Thanks for your attention!