4th Industrial Revolution as a Vehicle for Enhanced Industry-Academy Collaboration

INDUSTRY 4.0

College of Engineering, Peking University
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Invited Talk

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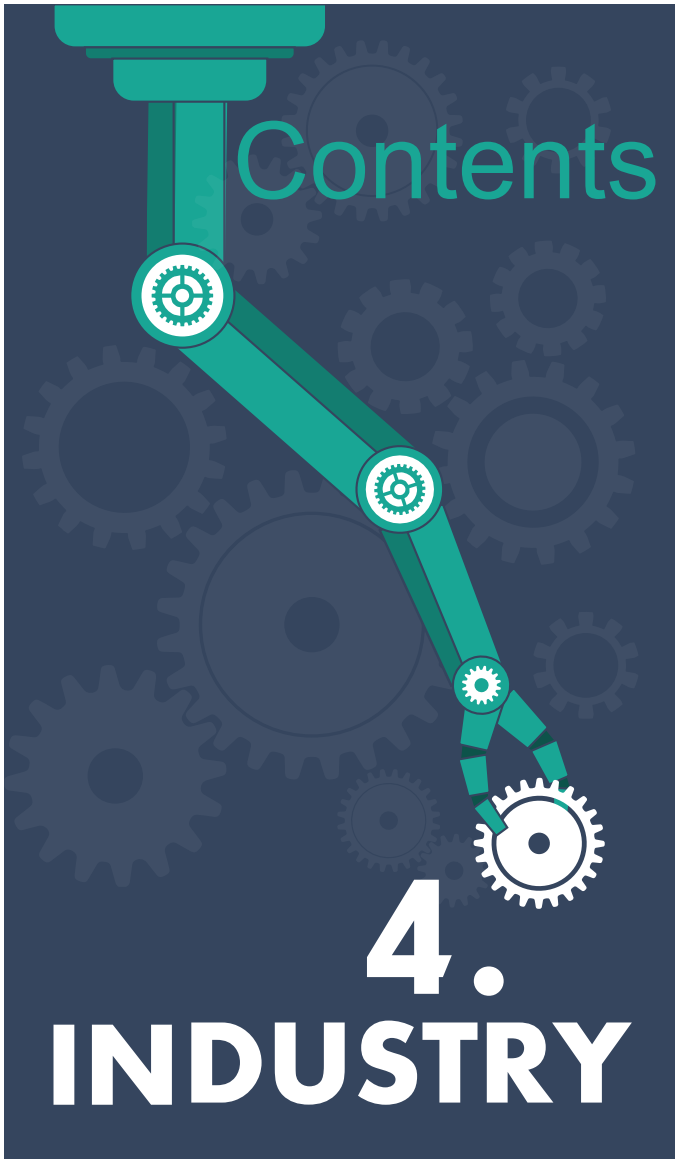

Introduction

- The current competitive environment requires **industry** to innovate at a fast pace to deliver new products and services to meet the demands of consumers.
- **Some Industries** are struggling to attain a competitive edge in this global market fostered by new economies of scale.
- **Academy-Industry Collaboration (AIC)** has become a pervasive topic as an imperative instrument to overcome these organizational challenges.
- The influence of the **Digital Revolution** at the personal and organizational levels is changing socioeconomic aspects and the way of interoperation and collaboration among individuals and enterprises.

https://www.emerald.com/insight/content/doi/10.1108/JIUC-09-2019-0016/full/html

This presentation discusses the need and advantages of **Academy–Industry Collaboration (AIC)** and some possible ways to facilitate and establish this collaboration.

Key Aspects in a Successful Academy–Industry Collaboration (AIC)

From the **universities**' perspective: **1)** academic leadership, **2)** focus on long-term strategic partnerships with flexibility and **3)** shared vision and strategy to achieve the goal are important factors playing a role in the success of a collaboration with industry.

Universities must involve people with networking and managerial skills to attract industry partners.

Academics with industry background are an added advantage as they are expected to be more willing to cross boundaries and network with people beyond their area of expertise.

From the University perspective

Universities need to redefine their mission, and collaboration with industry needs to be included as an important part of the role of research universities.

There is an emphasis on **universities**' actions at the administrative level to overcome the barriers related to university–industry collaboration and improve their potential to succeed.

For **universities**, importance of policies in sustaining collaboration is recognized, and four 'policy targets' have been identified to overcome some of the barriers to AIC: **1)** long-term development of industrially relevant academic R&D resources, **2)** improvement of communication between university and industry, **3)** reduction of the financial/material costs of interaction and the resolution of institutional conflicts and **4)** filling role gaps at the university–industry interface.

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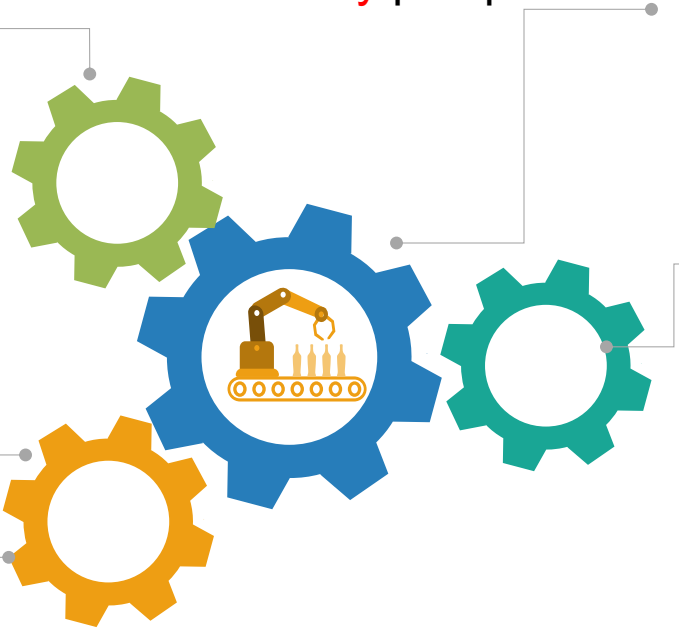
Key Aspects in a Successful Academy–Industry Collaboration (AIC)

From the industry perspective

- On the **industry side**, a strong commitment leading to a continued interest in the project during its development stages and in its results is a significant factor for fostering successful collaboration.
- It is expected to result in extensive participation from **industry** personnel in establishing the research agenda followed by reviewing the research progress and results.
- Consideration of projects by corporate as highly useful in practice. The confidence of the **industrial partner** in the expertise of the academic team and strong interest of the corporate in utilizing the outcomes of the project are conclusive factors for the success of a collaboration.



- For the successful transfer of knowledge and technology, **industrial partners** should have the internal capability to absorb the research fully and transform it into marketable products. It is further facilitated by the presence of industrial personnel having a level of research sophistication matching with that of the university.
- Another perspective to efforts for effective collaboration is the identification of **1)** problem selection, **2)** teamwork, **3)** process management and **4)** information dissemination as the key elements in building effective relationships between the **university** and the **industry**.

University and Industry contribute as complementary elements to the collaborative venture.

https://www.emerald.com/insight/content/doi/10.1108/JIUC-09-2019-0016/full/html

Collaborative Framework - 1

This framework considers several aspects of the variety of interactions between University and Industry.

Understand the Variety of Interactions

It is very important to understand the various kinds of interactions or relationships that are possible between universities and industry.

Identify the Stakeholders

Observing the bigger picture of collaboration indicates the presence of several stakeholders.

Understand the 'Why' – Identify the motivation

Universities and industry have invariably different motivations for collaborating. It varies from problem-solving, resource-sharing or information/people access to skills development through education. It is important to identify motivations and common areas.

Identify & Appoint Suitable People & Involve Leadership

Universities should identify key university staff & faculty suitable for interactions.

Ensure Basic Partnership Characteristics

Stakeholders should identify a win-win situation and agree upon it and work under an agreed framework, ensure a long-term commitment.

Establish Efficient Communication

Interpersonal communication is a critical factor in the success of a relationship.

https://www.emerald.com/insight/content/doi/10.1108/JIUC-09-2019-0016/full/html

Collaborative Framework - 2

This framework considers several aspects of the variety of interactions between University and Industry.

Strengthen the Dissemination Strategy

Universities must work towards strengthening their dissemination strategy and to using elements of marketing for sharing the research results.

Address IP Concerns

It is advisable that the value of a partnership should be seen in terms of other benefits rather than getting hung up on intellectual property (IP).

Adopt Policies to Encourage/facilitate Collaboration

Successful collaborations need to be encouraged and supported by policy interventions.

Focus on Social Capital Resources

Social capital resources include trust, mutual obligations, common understanding, access to information and opportunities.

Setup Rewards and Incentives

A new system of incentives should be created in universities to recognize the efforts of the academics participating in partnerships with industry.

Alumni Association

Universities need to maintain connection with their graduating students who would work in industry or become an entrepreneur in future.

Roles of Organizations (e.g., IEEE) and Industrial Revolution (IoT, VR, AR)

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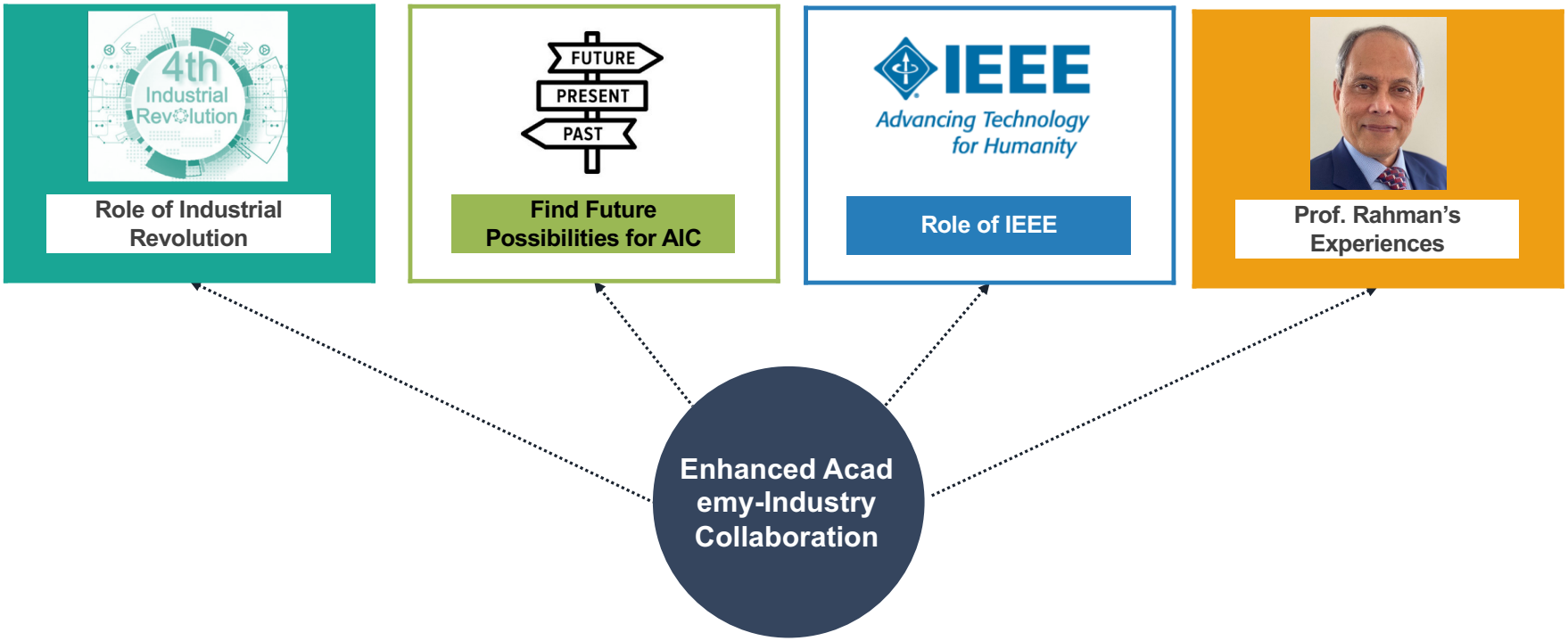
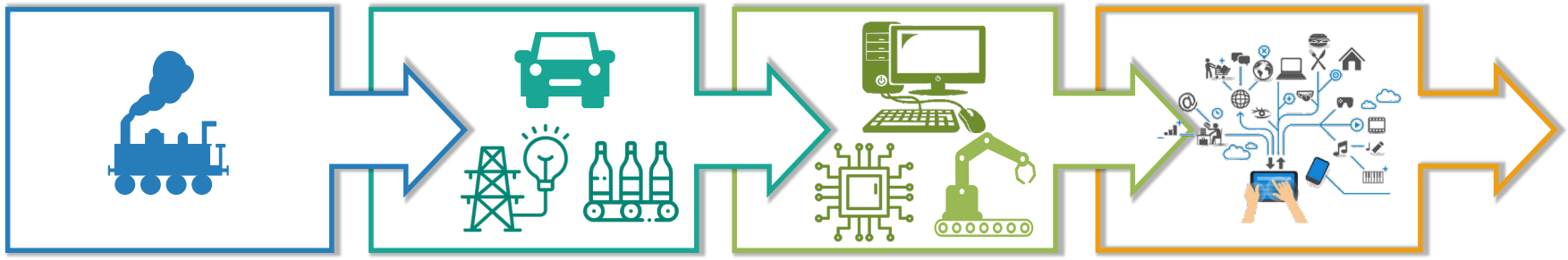
Approaches to Enhance Academy-Industry Collaboration (AIC)



Industrial Revolutions



1st Mechanization, Steam Power

2nd Mass Production, Assembly Lines, Electrical Energy

3rd Automation, Computers, and Electronics

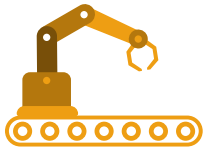
4th Cyber-Physical Systems, Intelligent Production by IoT, Cloud Technology, Networks, Big Data

What is 4th Industrial Revolution

- Automation of traditional manufacturing and industrial processes, using modern smart technology.
- Large-scale machine-to-machine communication (M2M) and the internet of things (IoT) help with increased automation, improved communication and self-monitoring.

4th Industrial Revolution Components

Sustainable Development Through Technology

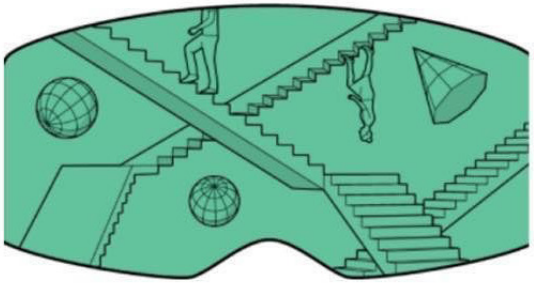


Applications in **AI (Virtual Reality, AR, MR)**, advanced computing, robotics, electronic chip manufacturing, energy production and delivery systems, telemedicine, electrification, can provide immense opportunities for **industry-academy** collaboration for meeting targeted national needs in China and other countries.

The Roles of Virtual, Augmented, Mixed reality (VR, AR, MR) and Extended Realities (XR) in Future Academy-Industry Collaboration (AIC)

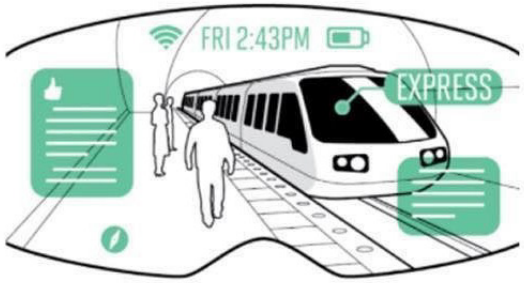
Virtual Reality

VR places the user in another location entirely. Whether that location is computer-generated or captured by video, it entirely occludes the user's natural surroundings.



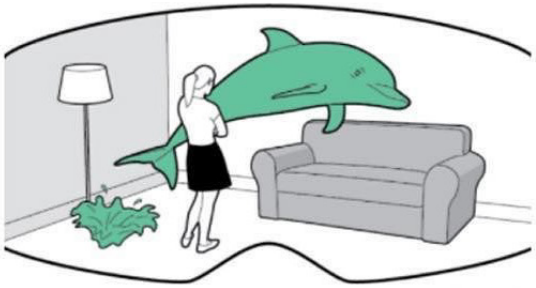
Augmented Reality

In augmented reality—like Google Glass or the Yelp app's Monocle feature on mobile devices—the visible natural world is overlaid with a layer of digital content.



Mixed Reality

In technologies like Magic Leap's, virtual objects are integrated into—and responsive to—the natural world. A virtual ball under your desk, for example, would be blocked from view



@mixed_reality_hub

VR, AR, MR, XR

- **VR** is a fully immersive technology, secluding the user to visualize and interact with purely digital content with sight, sound and gestures. Using a screen-enabled headset, VR creates a completely artificial environment that removes the physical context around the user.

- **AR** combines the physical and virtual words together by overlaying digital information into the user's environment, typically through the two-dimensional display of a tablet or mobile phone. AR is like a digital "window" that displays digital content overlaid on the physical surrounding the user occupies.

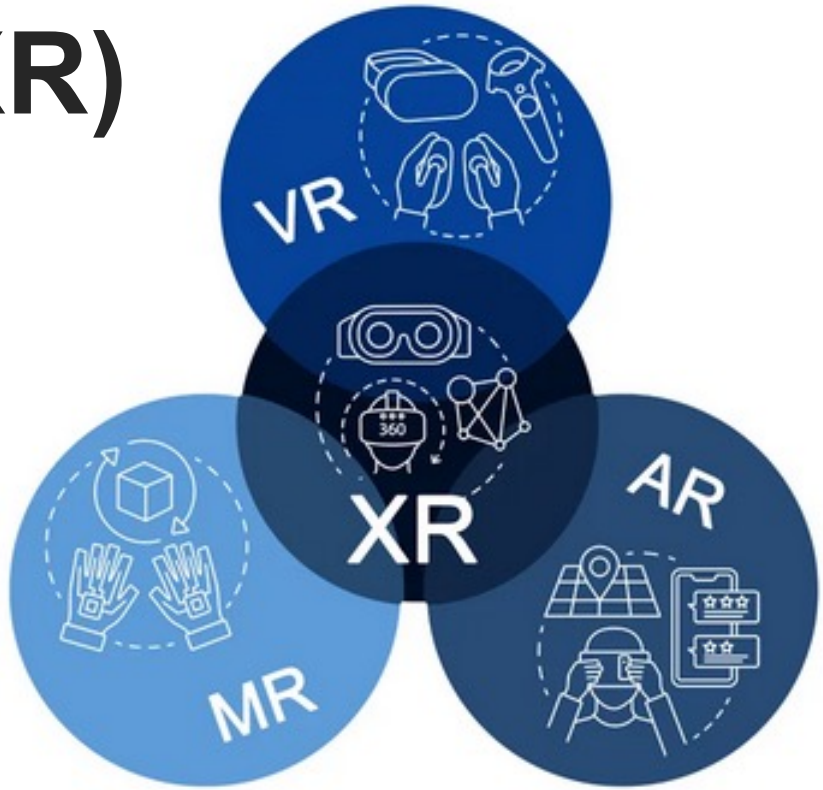
- Like AR, **MR** recognizes its surroundings and allows the digital content to interact with the real world in a three-dimensional display. MR also relies on a headset device, but in this case, the user is immersed in the digital content while still aware of his or her physical surroundings and able to interact with both physical and digital objects at the same time.

- Extended Reality—or **XR—is** a catch-all phrase commonly used to refer to all of these reality-bending technologies.

https://www.constructionexec.com/article/virtual-reality-mixed-reality-and-augmented-reality-in-construction----the-future-is-now

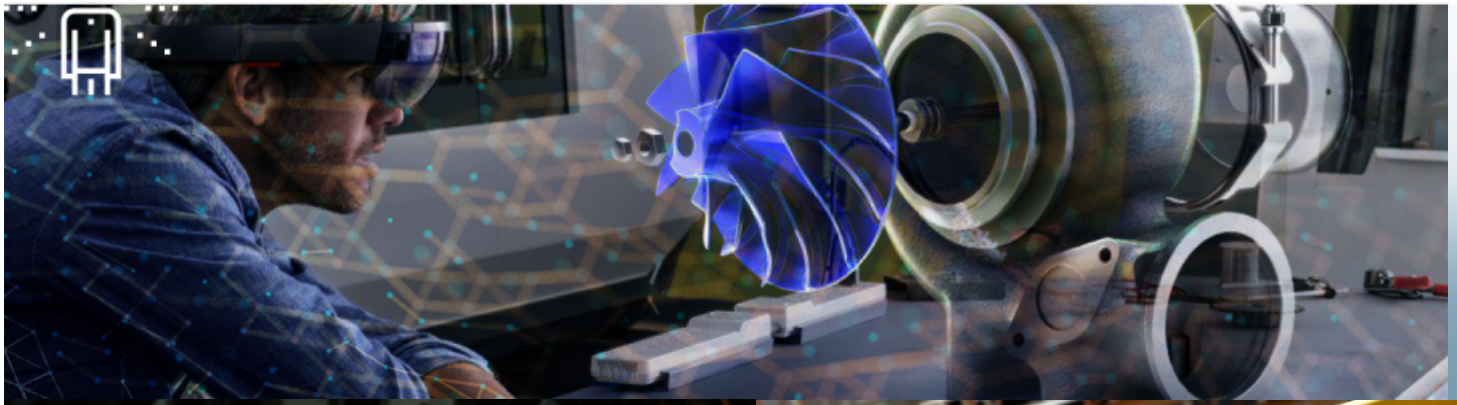
eXtended Reality (XR)

- eXtended Reality (XR) is the family that includes Virtual Reality (VR), Augmented Reality (AR) and Mixed Reality (MR) either utilized individually or together.
- Envision is at the forefront of delivering platform-agnostic and collaborative XR services for training, simulation, real-time maintenance, situational awareness, or any other practical use case that can enhance the capacity of the organization.
- XR solutions can maximize bottom-line revenue while reducing the cost of doing business. This is made possible by the increase in organizational productivity via collaborative immersion.

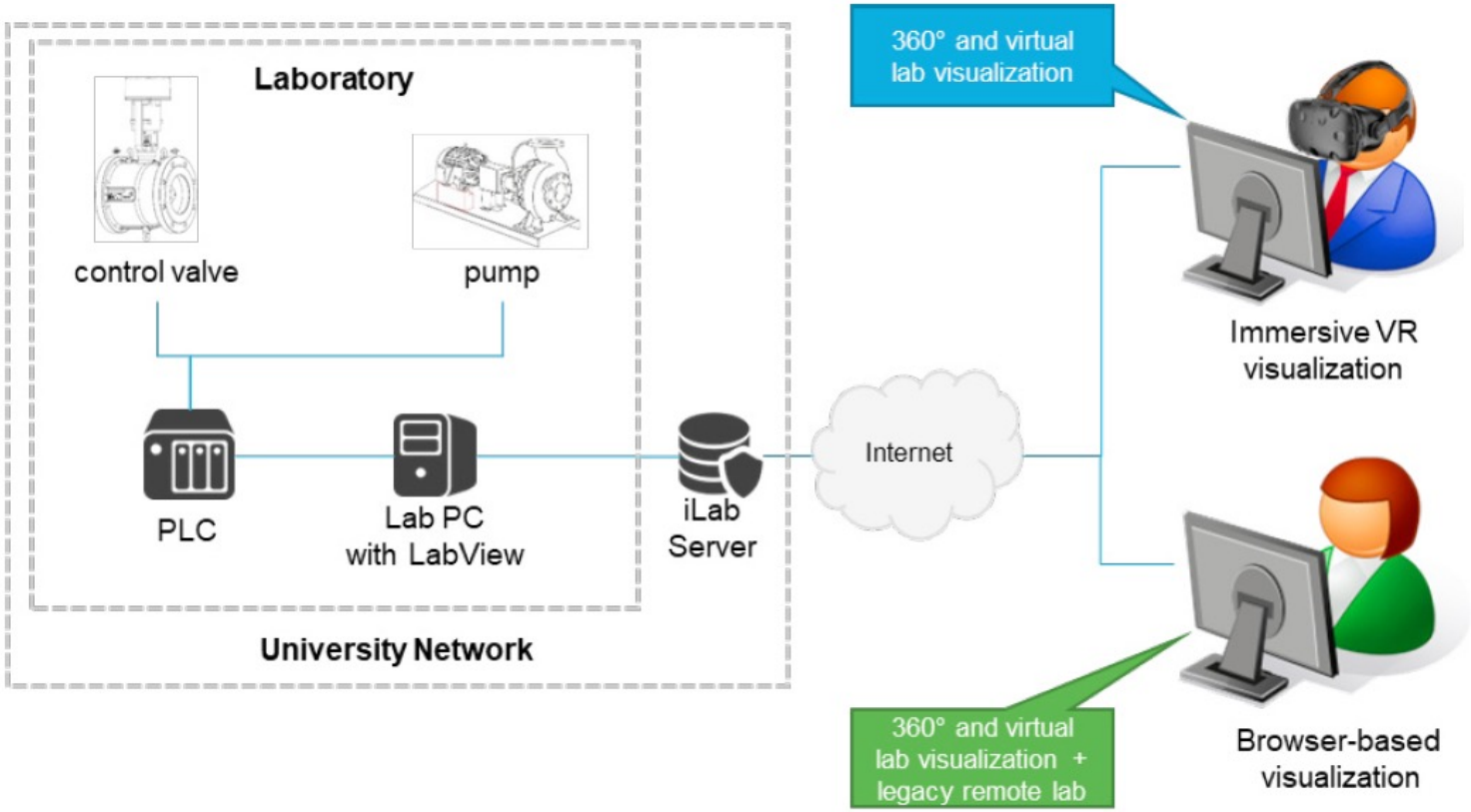


https://envision-is.com/xr/

Application of VR, AR, MR, XR in AIC



Remote Lab with Virtual Reality



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Real Example: Virtual Reality Anatomy Lab at Colorado State University

You can go in any Laboratories that you like! Interesting!!!

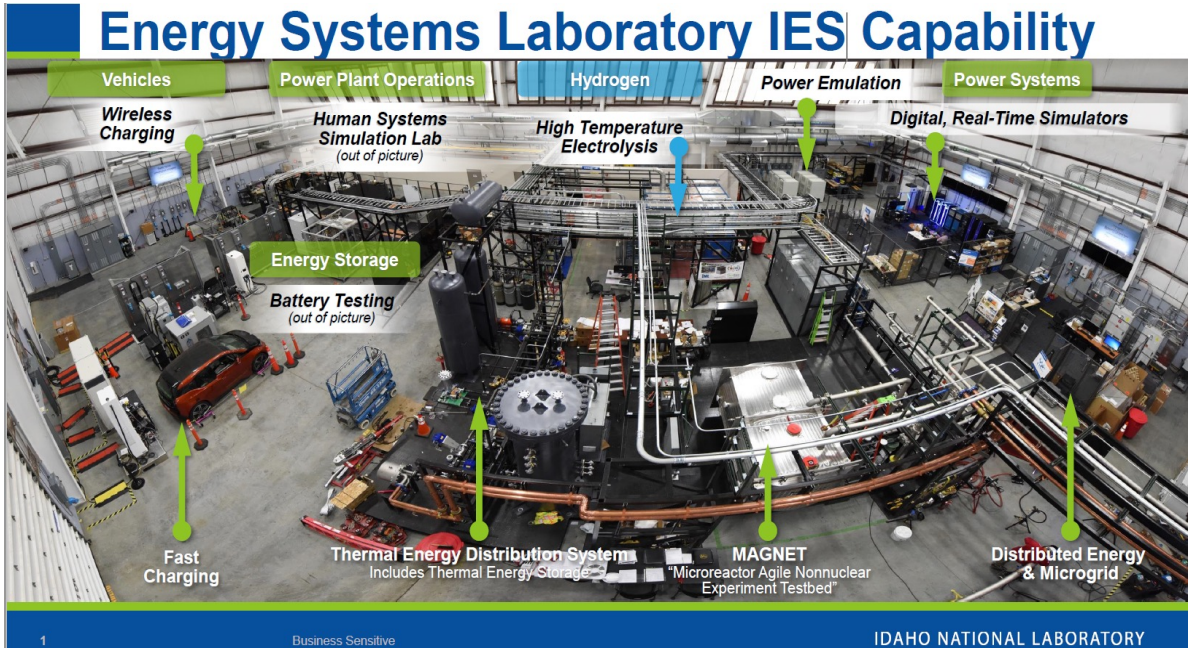
Grab any device or structure, Remove it,

Manipulate it and look at it at any direction!

Application of VR, AR, MR, XR in AIC

Possible Example For Power System Field (Future)

- Students can test and evaluate their developed methods/techniques via Industrial/National laboratories (e.g., INL) and equipment via eXtended Reality.
- They may visit the laboratory weekly, see the real and practical problems, try to address them in their research.
- As a result and after graduation, students can easily find a job, continue their research in the industry



- After joining the company, they are entirely familiar with the company people, culture, projects and … It can save money and time for the industry
- Onsite Training Time will be reduced

Virtual Tour and Meetings by VR, AR

Augmented Reality Can Strengthen the Collaboration between Academy and Industry

Visit Industrial Labs

- Students can visit industrial labs
- Get familiar with real problems
- Address those problems in their researches

Test

- Test and evaluate their developed methods and techniques via industrial laboratories and equipment by Virtual Reality

How the 4th Industrial Revolution Helps Academy-Industry Collaboration (AIC)

Find Future Possibilities for AIC

Find the updated areas and cutting-edge development for collaboration

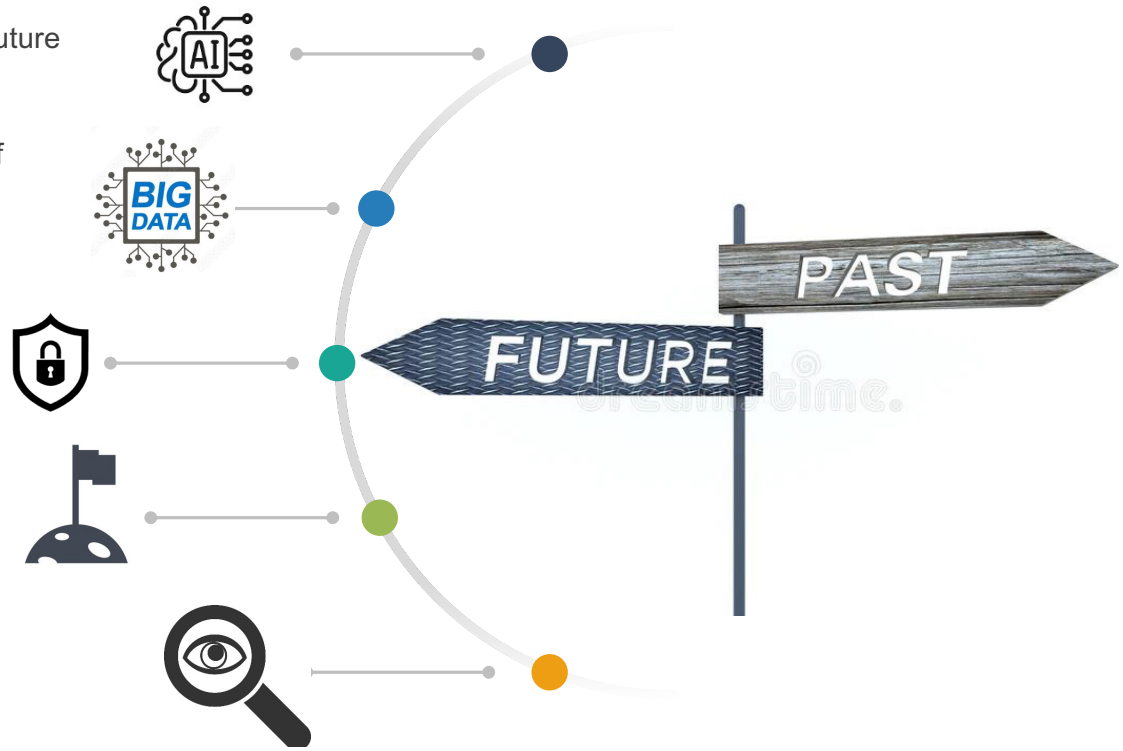
Artificial Intelligence (AI)
AI is a powerful tool that will change and shape future

Big Data
In the recent years we are facing with a large volume of data that contains greater variety, arriving in increasing volumes and with more velocity

Privacy and Cyber-Security Issues (e.g., Fraud Detection)
Address challenges related to Authentication, Fraud detection, …

Colonization of Space and Related Issues
Challenges Related to Settling in the Space or other related issues such as Space Microgrid Challenges, …

Explore the Ocean Floor
Develop new technologies to explore the ocean floor



Find Future Possibilities for AIC, contd.

Find the updated areas and cutting-edge development for collaboration

IoT Platforms

IoT describes physical objects that are embedded with sensors, processing ability, software, and other technologies that connect and exchange data with other devices and systems over the Internet or other communications networks.

Cloud Computing

Employ cloud computing to address challenges in the industry

Unmanned Vehicle

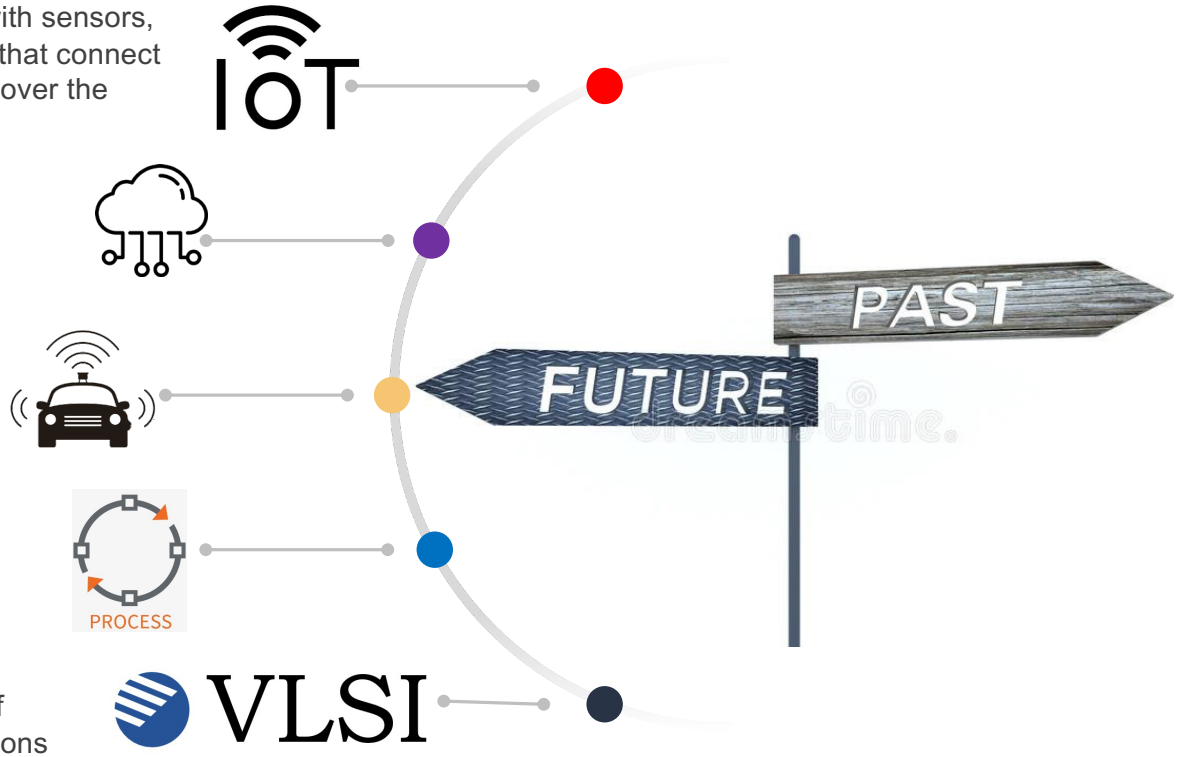
Propose New Ideas related to Unmanned Vehicle

Image Processing

Use of a digital computer to process digital images through an algorithm.

VLSI

Very large-scale integration (VLSI) is the process of creating an integrated circuit (IC) by combining millions of transistors onto a single chip.



Find Future Possibilities for AIC, contd.

Find the updated areas and cutting-edge development for collaboration

Data Mining

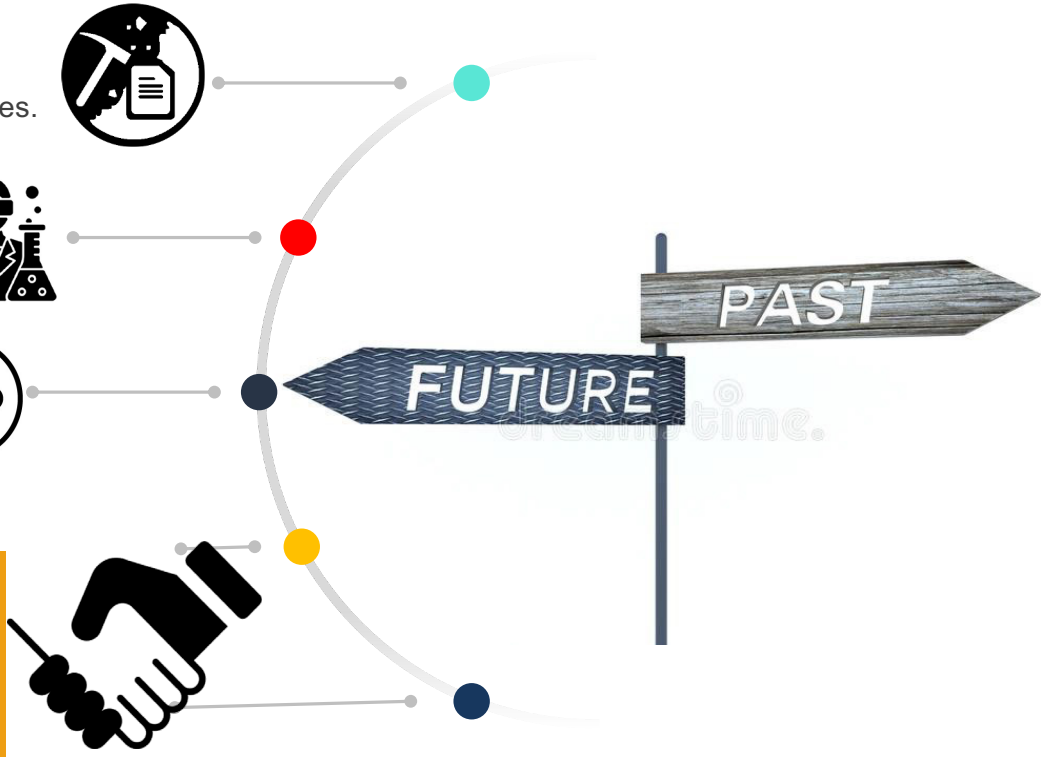
The process of finding anomalies, patterns and correlations within large data sets to predict outcomes.

Biomedical

a set of sciences applying portions of natural science or formal science, or both, to develop knowledge, interventions, or technology that are of use in healthcare or public health.

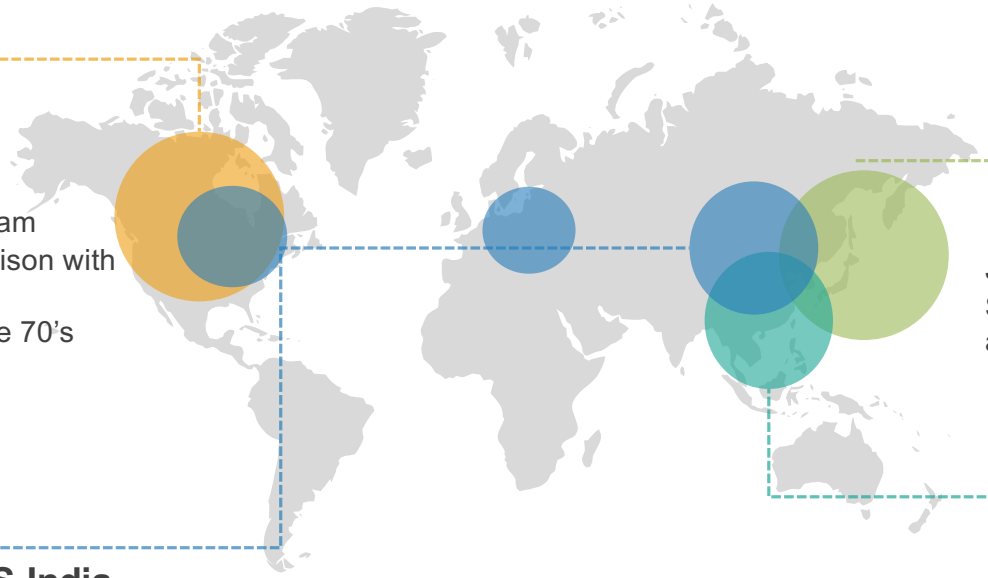
Other Possibilities

Antenna, Smart Cities, Robotics, Smart Sensors, Transportation, Telecommunication, Energy, Aerospace



For all of these, **University** can negotiate with the **Industry**, understand their challenges, come up with new ideas, develop the related platform or toolkits and related training courses for the industry.

Examples of Focused Research Programs



US

US National Foundation GOALI program (Grant Opportunities for Academic Liaison with Industry)

US Government RANN Program in the 70's (Research Applied to National Needs)

Japan

Japan Society for Promotion of Science (JSPS) supports for industry-academy collaborative work

US, EU and UK run the US-India, US-China, EU-China, UK-India

US, EU and UK run the US-India, US-China, EU-China, UK-India joint research programs with industry participation.

India

GIAN program in India works with scholars/researchers in developed countries.

(Global Initiatives of Academic Networks)

Inter-university Microelectronics Center (IMEC)

- IMEC is an R&D hub for nano- and digital technologies. They combine talented people and a world-class infrastructure with industry support to develop new and innovative products

- HQ: Leuven, Belgium
- China office: Pudong Shanghai, China

A Role IEEE Can Play to Enhance Academy-Industry Collaboration (AIC)

IEEE

Advancing Technology for Humanity

IEEE

Advancing Technology for Humanity

IEEE Regions

IEEE Members

Over 400,000 members in more than 160 countries, more than 60 percent of whom are from outside the United States

IEEE Student Members

More than 107,000 Student members

IEEE Sections

342 Sections in ten geographic Regions worldwide

IEEE Chapters

2,562 Chapters that unite local members with similar technical interests

IEEE

Advancing Technology for Humanity

IEEE Technical Societies

Has 39 technical Societies and seven Technical Councils representing the wide range of IEEE technical interests.

IEEE Xplore® digital library

Has more than 5 million documents in the IEEE Xplore® digital library, with more than 15 million downloads each month.

IEEE Standards

Has an active portfolio of nearly 1,200 standards and more than 900 projects under development.

IEEE Transactions, Journals

Publishes approximately 200 transactions, journals, and magazines.

A Role IEEE Can Play

IEEE Society

IEEE society distinguished lecture program can support visits of industry/academic experts

PCCC
PES China Chapters Council
Power & Energy Society®

Women in Engineering Affinity Group
IEEE Beijing
WIE

IEEE in China

IEEE sections in China can organize workshops to build awareness and facilitate industry participation

IEEE Tutorials

Tutorials and other learning materials from IEEE sources can facilitate knowledge sharing

IEEE PES UNIVERSITY

IEEE PES University

You can simply impress your audience and add a unique zing and appeal to your Presentations.

IEEE
Chengdu Section

My Own Experience

Prof. Saifur Rahman

IEEE President-Elect

Experience

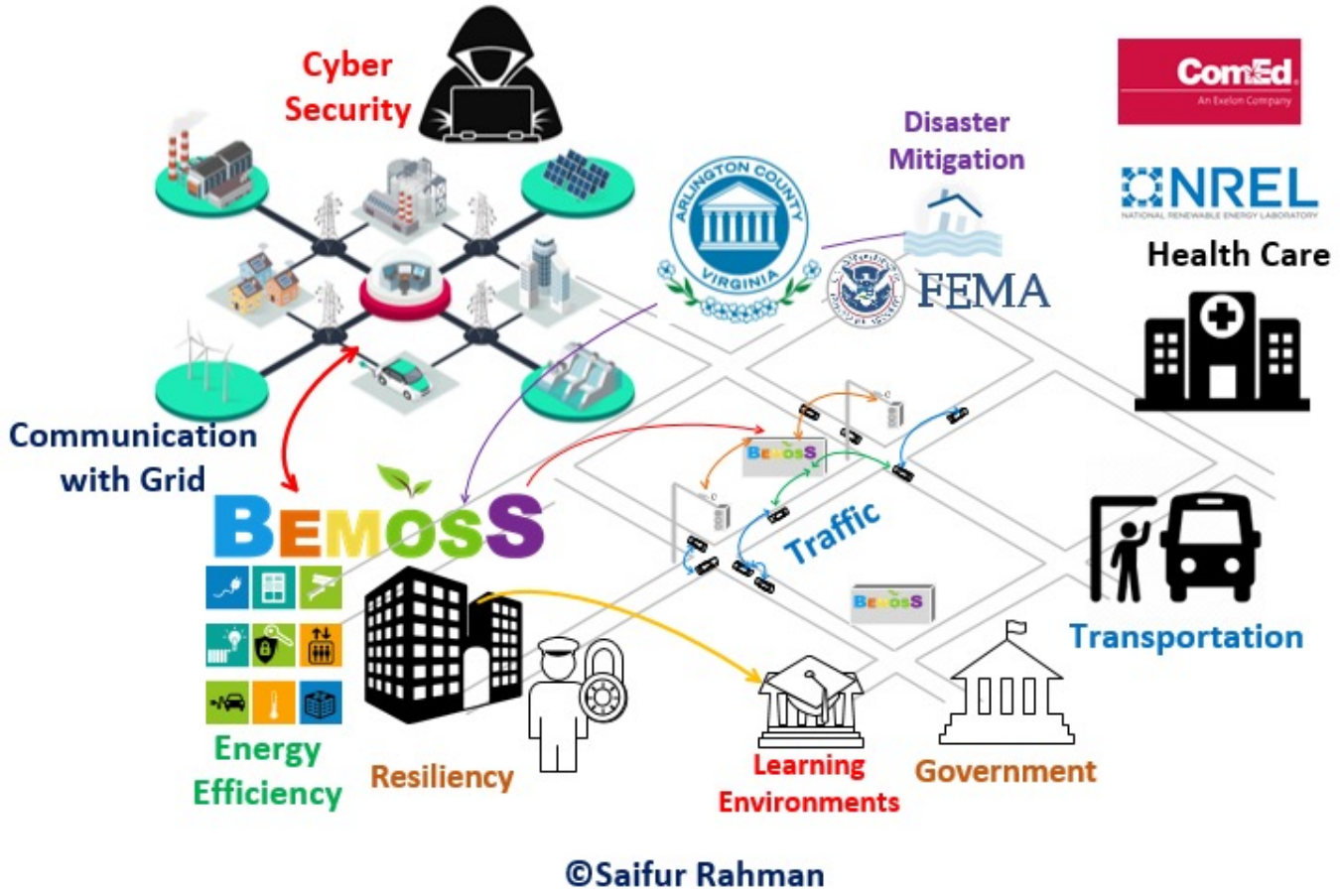
Industry-sponsored collaborative research projects in the US

Japan Society for the Promotion of Science (JSPS) fellow working as a research engineer at the Tokyo Electric Power Company

US National Science Foundation and India Department of Science and Technology-funded joint projects in India

An advisor to Global Energy Interconnection Development and Collaboration Organization (GEIDCO) in China

Industry-Academy Collaborative Research at Virginia Tech Advanced Research Institute




INDUSTRY 4.0
Thank You
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