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Welcome

5G, the Internet of Things (IoT), and Facility Life Cycle Management (LCM)

09 September 2020

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 - Please mute your microphones during the meeting
 - Please use the Zoom “Q&A” function to ask questions during the event
 - You will be able to “up-vote” questions that pertain to you
 - Questions from the Q&A will be answered after the Featured Speaker





Pledge of Allegiance

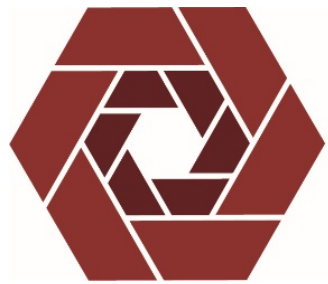
by President Kathy Stewart



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ICP has assembled today's most advanced line of products for professional environmental restoration.



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40+ YEARS OF EXPERTISE

- Remediation Viruses
- Contaminated Spaces
- Mold & Water Damage

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- Fiberlock And Benefect
- Leaders In The Marketplace

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- Avian Influenza
- SARS
- H1N1 Influenza
- Ebola
- Norovirus
- Legionella
- Many More

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ICP is a 40 year provider of class-leading, field tested disinfection products. With both CONVENTIONAL and BOTANICAL disinfectants, we lead the industry with product options that fit all buying preferences and application methods.

CONVENTIONAL



ShockWave has been formulated, and tested on more surfaces, in more situations, and to kill more organisms than any other product.



BOTANICAL



Decon 30 is the first & only authentically botanical disinfectant technology on the market today.



Application & Delivery Methods

Facilities are facing an urgent need to undergo aggressive disinfection protocols in order to reopen and reduce the risk of further spread. These protocols involve professional cleaning and disinfecting on weekly and even daily basis. ICP's EPA registered products make this task more manageable through their compatibility with ALL of the following disinfectant delivery methods:

- Disinfectant Wipes
- Trigger Spray Bottles
- Compression Sprayers
- Backpack Units
- Foaming Applicators
- Electrostatic Sprayers
- Cold Misters / Foggers
- Airless Spray Units



Fiberlock Technologies is the leading manufacturer of products used to remedy environmental, safety, and health hazards offering a full set of solutions to address the many needs in the abatement and remediation industry.



For over 35 years, Fiberlock has lead the field creating an advanced suite of restoration products to address the full spectrum of environmental health and safety issues. No other product line has as diverse a range of solutions or such complete systems to meet the demands

faced by today's environmental restoration pros. Whether it's disinfection, asbestos, lead, mold, fire damage, dust control, or containment systems, Fiberlock has tested and proven products that mitigate hazards and provide safety and assurance to affected businesses, homes, and families.

Fiberlock has supplied environmental control products to the Pentagon, Disney World, IBM, Mobil, Amtrak, Dupont, The National Gallery of Art, Harvard University, NASA, General Electric, AT&T, General Motors, and thousands of private homes.



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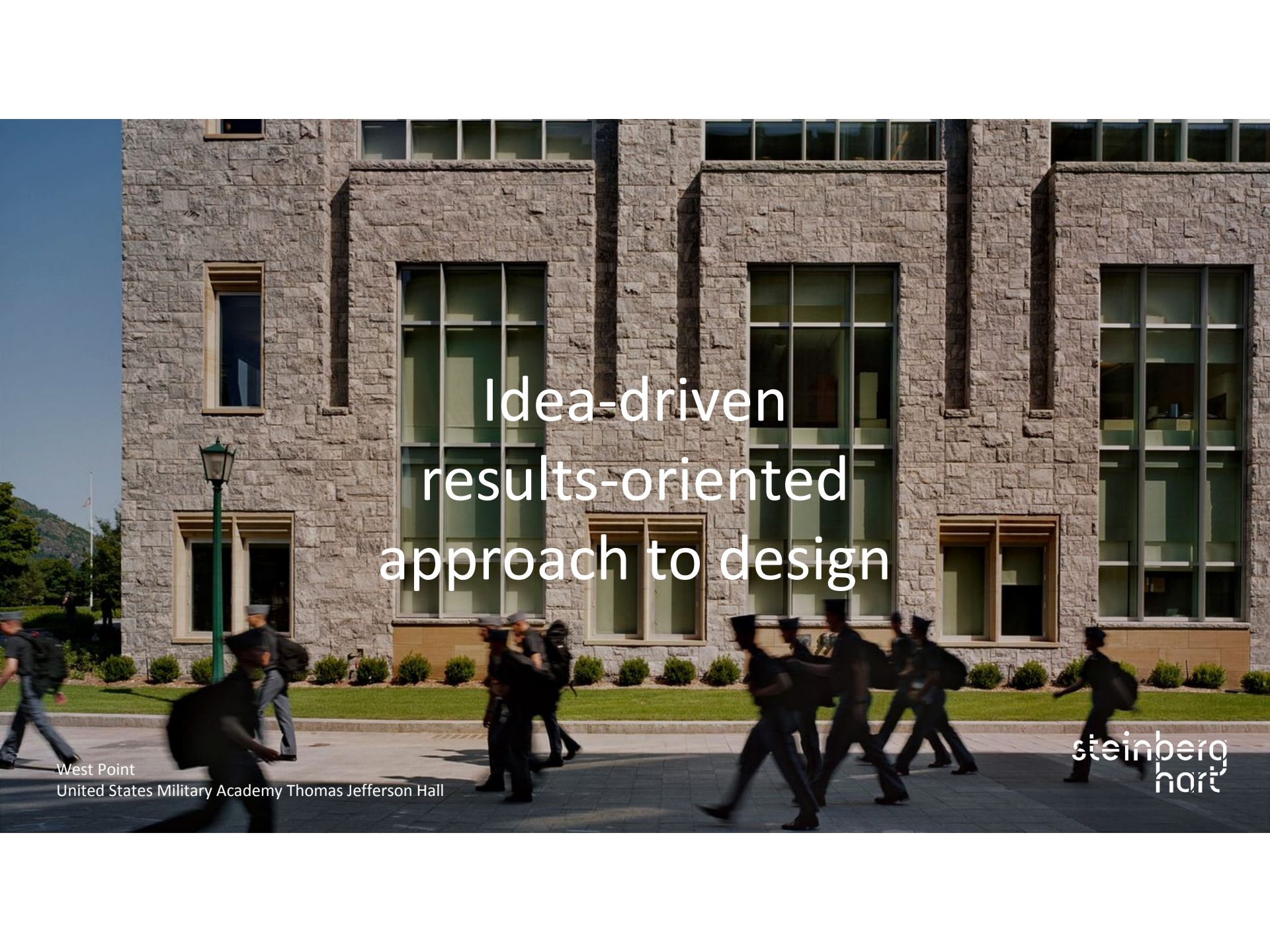
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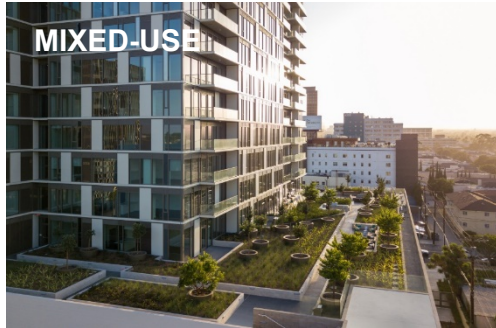
LA Air Force Base Fitness Center

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Naval Base
Coronado Coastal Campus

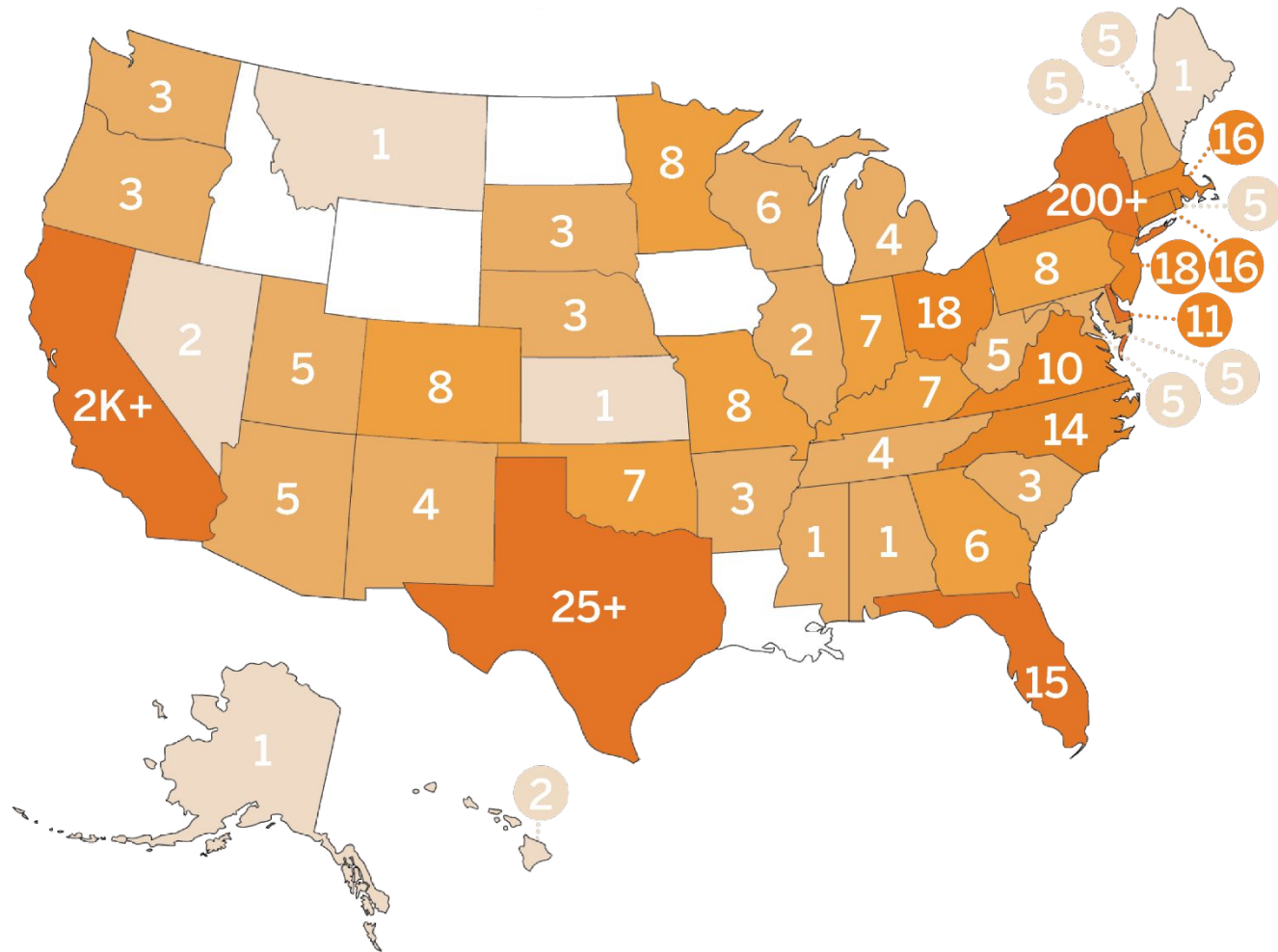
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Mark Tomassoni



BIO

- Former Chairperson, SAME Facility Asset Management COI
- 40+ years large-scale facility asset management (FAM) for U.S. federal and international facilities
- Consults on domestic and international government proposals
- Expertise in architecture, engineering, construction, large scale facility operation and maintenance
- Led 200+ proposals resulting in 62 new contracts exceeding \$5.0 billion.
- Supported the US\$50 billion Saudi Arabia Royal Commission for Jubail and Yanbu new towns
- PhD Classes, Public Finance, Johns Hopkins; MS Urban Planning, Johns Hopkins; MA Organizational Communication, University of Georgia; BS Organizational Communication, Penn State.

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5G, the Internet of Things (IoT), Facility Asset Management and the Future of the A/E/C/O&M Industry

Mark E. Tomassoni

Former Chairperson SAME Facility Asset Management (FAM) Community of Interest (COI)

mark@mark-consult.com, 301-875-5839

July 2020

Agenda

- Background to Facility Asset Management (FAM)
- Property Condition Assessment (PCA)
- Life Cycle Management (LCM)
- The Future of FAM and LCM with 5G, Spectrum, and the Internet of Things (IoT)

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Key Terms

- 5G. Next generation of wireless information transmission. Generally tied to discussions involving “spectrum”
- Assets. Tangible equipment that are moveable / removable, i.e., furniture, vehicles, tools.
- Facilities. Buildings and equipment permanently attached to buildings, i.e., mechanical/electrical systems permanently tied to buildings.
- Facility Asset Management (FAM). Caring for buildings, fixed equipment, and moveable equipment
- Life Cycle. Time period beginning with purchase, erection of facility or asset throughout entire lifetime of use until final disposition.
- Life Cycle Management (LCM). Means to control facilities or assets over long-period of time.
- Internet of Things (IoT). Major component of 5G wireless information movement allowing assets to communicate with each other
- Real Property. Fixed property, principally land and buildings.
- Spectrum. Portion of electro-magnetic spectrum being used for 5G upgrades

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Background to FAM



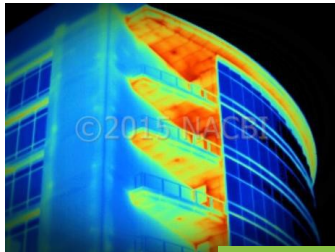
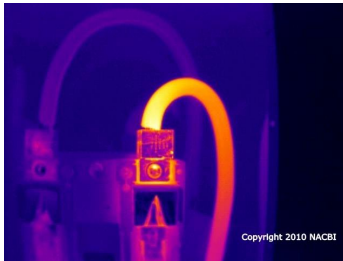
- Need to maintain assets at strategic points in normal life cycle to extend [service life](#).
- How? Through scheduled preventive maintenance (PM), i.e., scheduled vs. and unscheduled maintenance.
- Requires multiple interventions, daily, weekly, monthly, quarterly
- Operating costs decrease with PM rather than unscheduled maintenance.
- Balance must be found between scheduled and unscheduled maintenance. Strategically timing scheduled maintenance extends an asset's life cycle.
- Cuts across organizational boundaries: operations, finance, engineering

Property Condition Assessment (PCA)

- PCA process to determine the causes and solutions to problems in buildings.
- Holistic data collection, inspection, analysis, and future prediction of faults/abnormality/defects in the condition, internal environment and performance.
- Three main types of PCA: include *commissioning*, *monitoring*, and *investigation diagnostics*.
- How perform PCA: advanced technology such as infrared thermography, ultrasound, radar, vibration, lasers, drones.
- Lead to prediction of likely causes of defects/faults in building and recommendations for remedial actions.

10 Major Areas for Property Condition Assessment (PCA)

1. Building site (topography, drainage, retaining walls, paving, curbing, lighting)
2. Building envelope (windows and walls)
3. Structures (foundation and framing)
4. Interiors (stairways, hallways, common areas)
5. Roofing systems
6. Mechanical systems (heating, ventilation, and air conditioning)
7. Plumbing
8. Electrical systems
9. Vertical transportation (elevators and escalators)
10. Life safety, ADA, code compliance, air quality (fire codes, accessibility, water intrusion, mold)
11. Optionally: site-specific testing, like infrared thermography for energy loss, air leakage, roofing and building envelope moisture intrusion



Non-Destructive Testing

FAM & Property Condition Index (PCI)

- PCI provides benchmarks to compare relative condition of different facilities.
- Primarily used to support asset management
- Can be tracked over time to maximize benefit.
- Good (under 0.05), fair (0.05 to 0.10), and poor (over 0.10)
- National Research Council, "Stewardship of Federal Facilities." Performance indicators used to evaluate effectiveness of facilities maintenance and repair.
- [PCI can be used in developing Building Information Modeling for existing buildings.](#)

Maintenance, Repair, and Replacement Deficiencies of

Facility PCI =

Current Replacement Value of the Facility

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One Other Concept

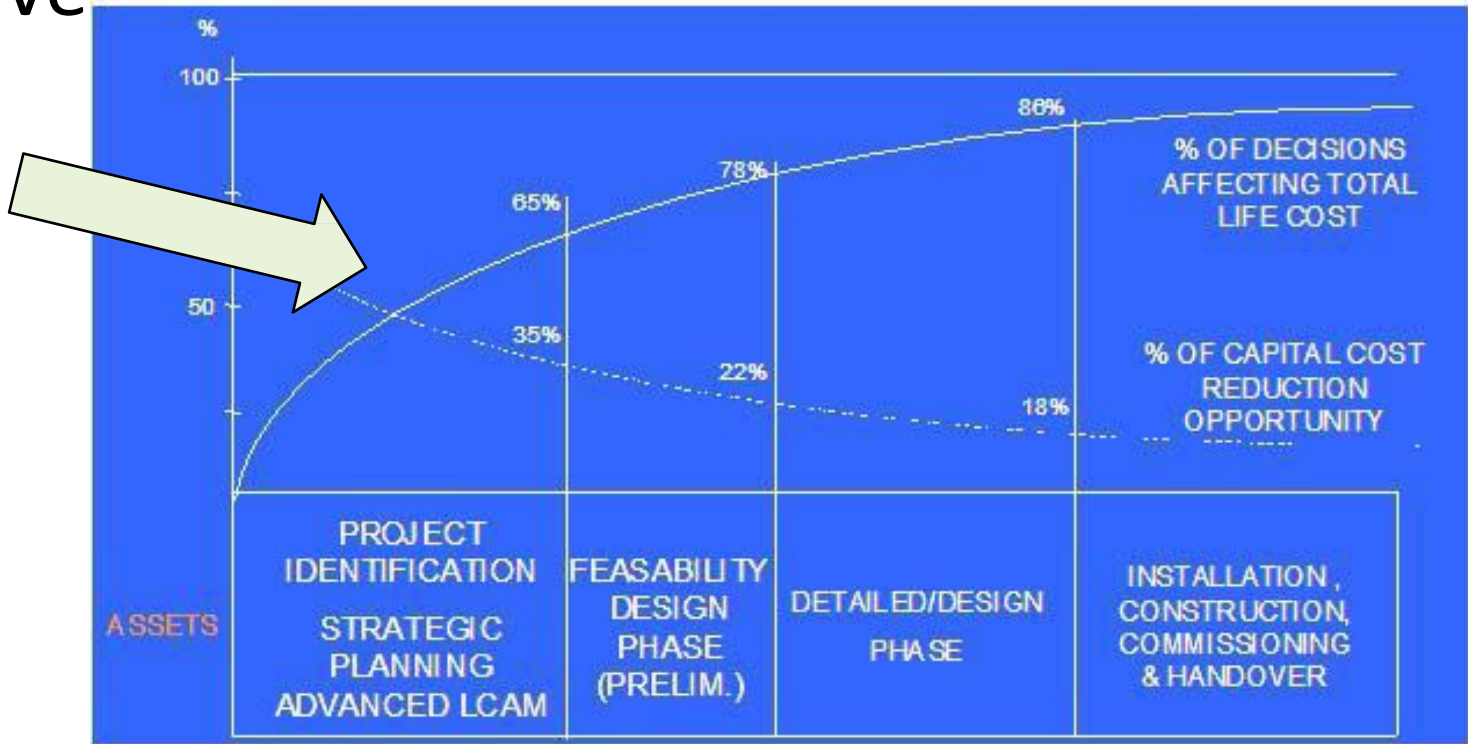
Life Cycle Management (LCM)

FAM and Life Cycle Management (LCM)

- LCM, also known as Whole-Life Cost, Total Cost of Ownership, Life-Cycle Cost (LCC), Lifetime Cost
- LCM determines most cost-effective option to purchase, own, operate, maintain and, finally, dispose of an object or process
- Example of highway pavement repair/replacement:
 - \$\$ initial construction cost
 - \$\$ user costs during construction
 - \$\$ future maintenance and rehabilitation
 - \$\$ discounted to a present-day value, i.e., net present value (NPV)

Building Cost Development

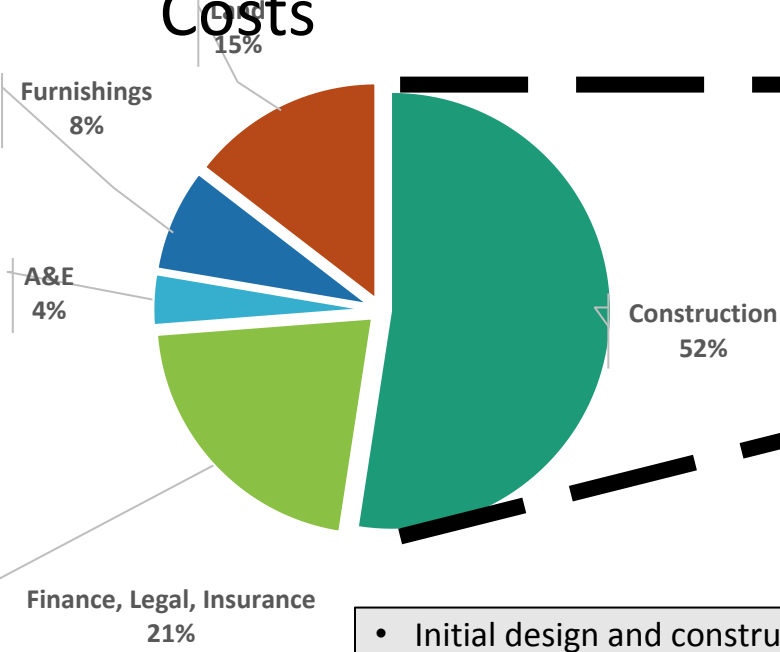
Most building costs are defined in project identification and strategic planning stage



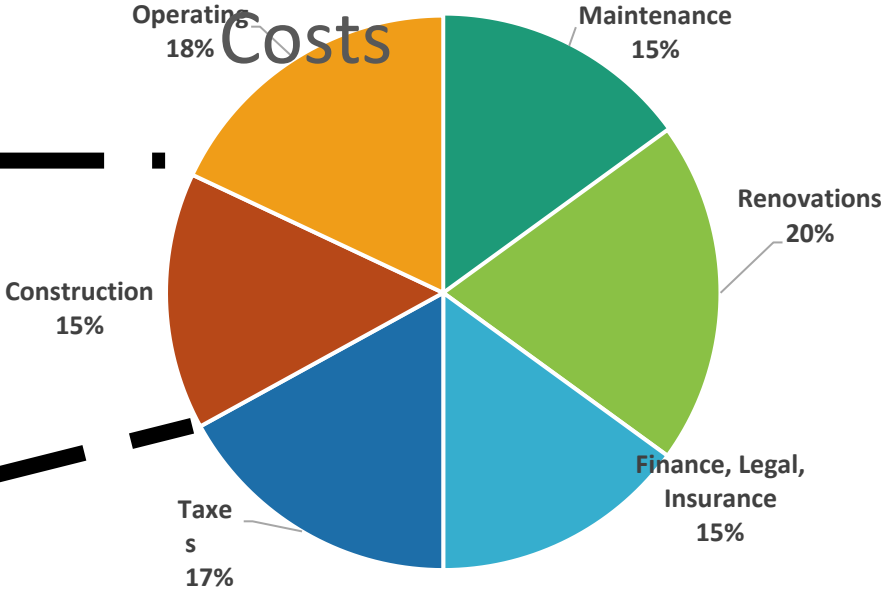
First Cost vs. Life Cycle

Costs

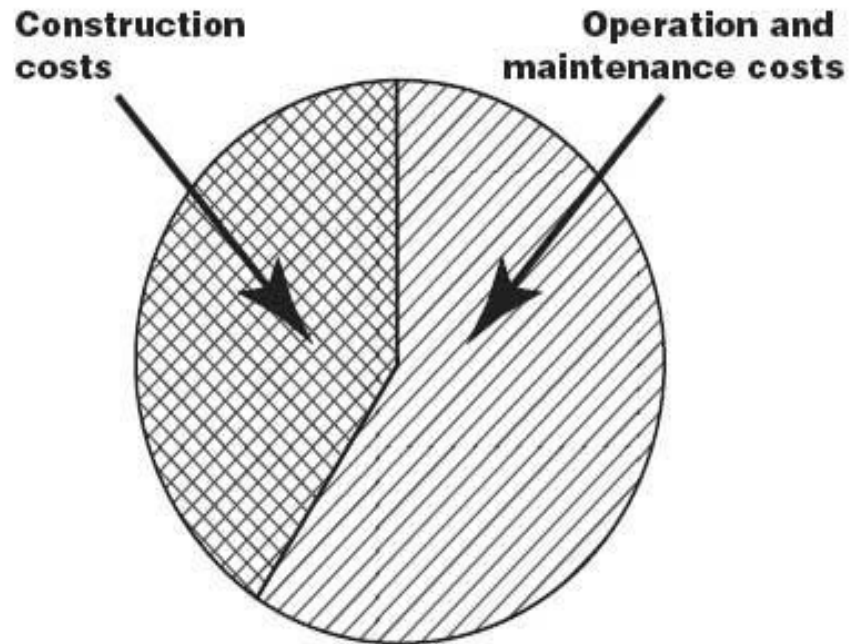
% First Costs



% Life Cycle Costs

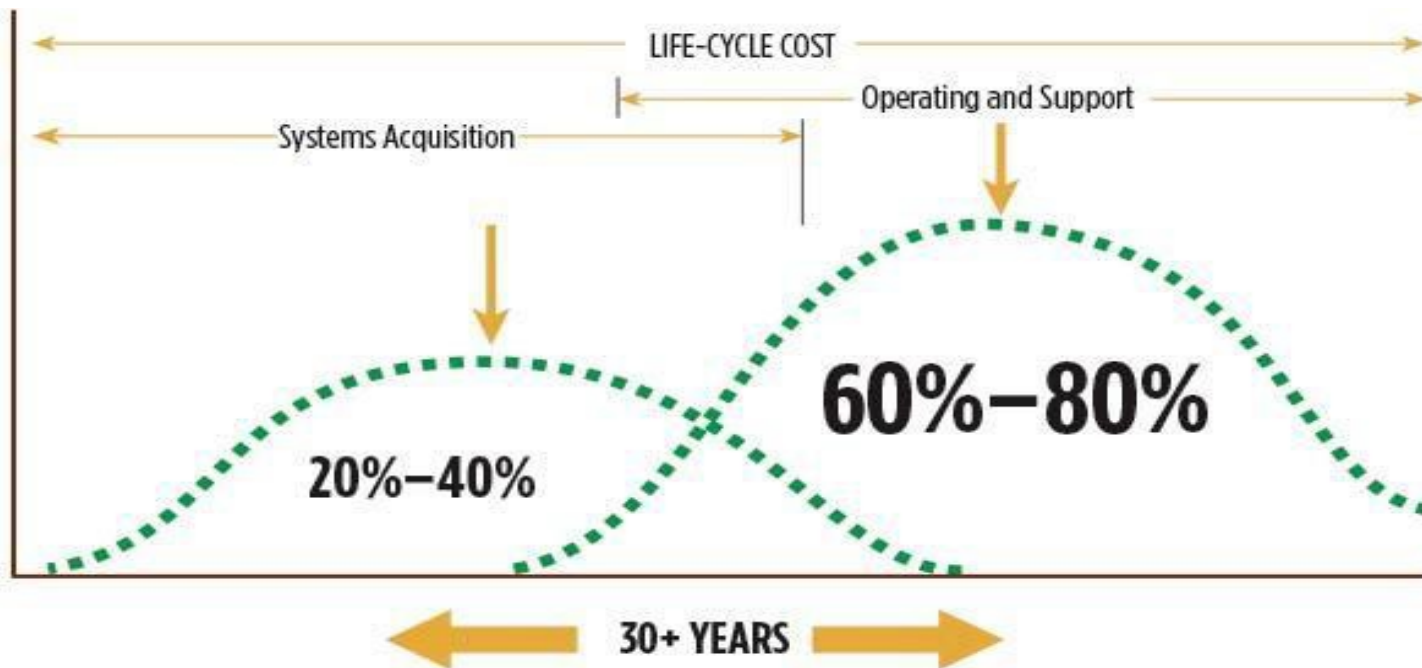


- Initial design and construction ~15-20% of total life cycle cost over 30-years
- 55-60% of buildings cost over 30 years for O&M, repair and retrofit initiatives and replacements



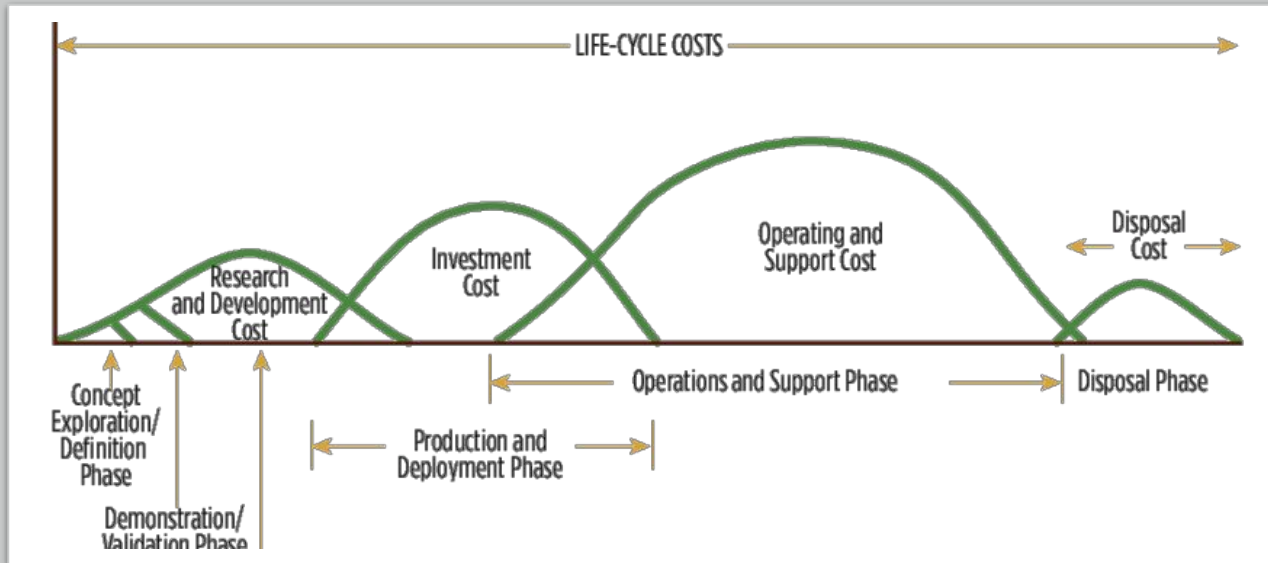
Numerous LCM
Tutorials,
Studies,
Research

Building LCM



Source: OneClickLCA

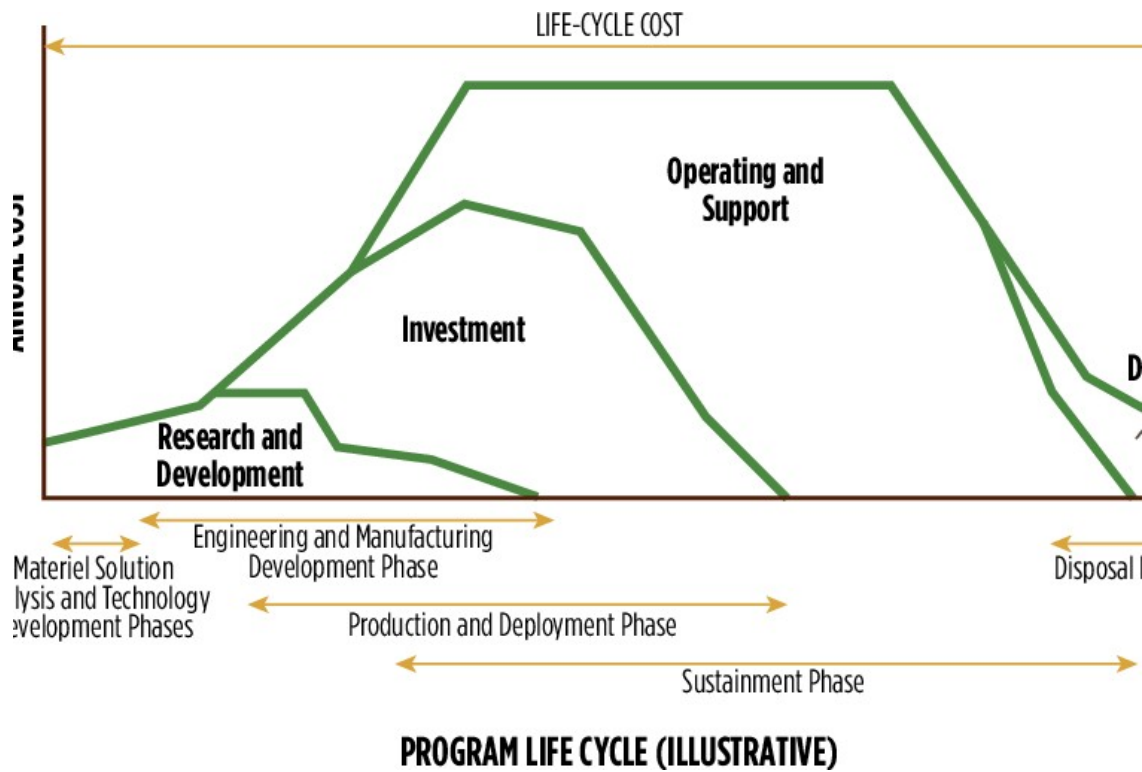
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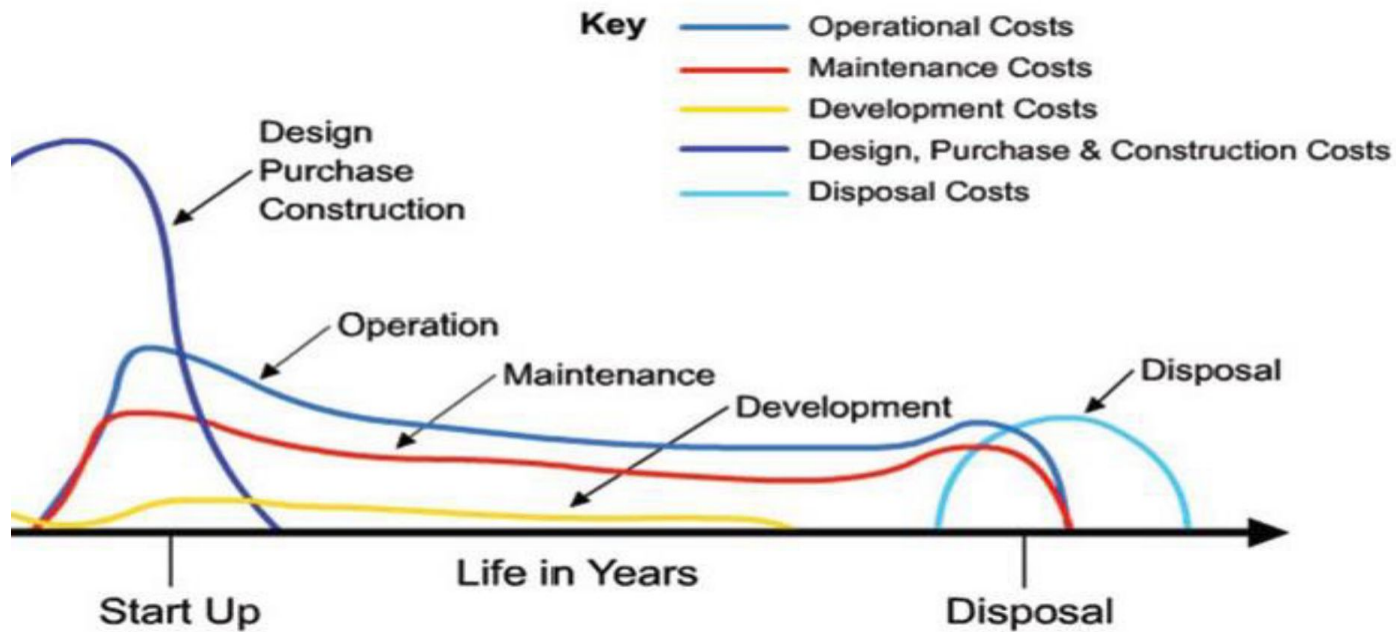
DoD Weapon System LCM

Source. Capt Gary Jones, USAF, Edward White, Lt Col Erin T. Ryan, USAF, and Lt Col Jonathan D. Ritschel, USAF, "Investigation into the Ratio of Operating and Support Costs to Life-Cycle Costs for DoD Weapon Systems," Defense ARJ, January 2014, Vol. 21 No. 1 : 442-464

DoD Life Cycle Costs



Building Operation and Maintenance (O&M)



Types of FAM Information Management Systems

Type of System	Name	Advantages	Disadvantages
Computerized Maintenance Management System	Maximo, Maintenance Connection, eMAINT, Fiix, Asset Essentials, UpKeep, ViewSpace, FMX, Q-Ware, dozens of others	<ul style="list-style-type: none"> Preventive maintenance (PM) Service order response 	<ul style="list-style-type: none"> Not geographic based No visuals No linkages to asset inter-connections
Building Information Modeling (BIM)		3D model to plan, design, construct, and manage buildings	
LCM to assist in repair or replace decisions	Builder Sustainment Management System (SMS). Developer. USACE ERDC CERL	Defines when, where, how to maintain buildings. Create Condition Index (CI) measures for assets	<ul style="list-style-type: none"> Limited PM and service order response capability. Not geographic Not visual
LCM Data Bases	Generic data to track all assets	Complete inventory of all assets with details on OEM, value, dates, useful life	<ul style="list-style-type: none"> Not geographic based No visuals No linkages to other systems
Property Condition Assessment (PCA)	SmartCSM, Insparisk	Full assessment of physical plant for future investment. Visually links assets with location and linkages	<ul style="list-style-type: none"> Geographic Visual Show asset linkages

Industry Trade Groups Focused on FAM and LCM



Asset Management Council



Building Owners and Management Association (BOMA)



Gulf Society for Maintenance and Reliability (Arabian Gulf)



Institute of Asset Management (IAM)



International Facility Management Association (IFMA)



ProFM. New organization offering training and certification.



Society for Maintenance and Reliability Professionals (SMRP)



World Partners in Asset Management (WPIAM)

ISO 55000. Asset Investment Planning and Management

ISO in the Game

- Introduced in 2014
 - ISO 55000:2014 Asset management – Overview, principles and terminology
 - ISO 55001:2014 Asset management – Management Systems – Requirements
 - ISO 55002:2018 Guidelines for the application of ISO 55001
- Four Fundamentals of AM: Value, Alignment, Leadership and Assurance.
- September 2019 ISO/Technical Specification 55010:2019. Defines alignment between financial and non-financial functions and how realize value from assets.



■

The Future of FAM and LCM

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5G, the Internet of Things (IoT) and the Future of FAM and LCM

What is 5G?

1. 5G wireless networks to advance data speed, volume, and reduce latency (delay in data transfer) over 4G and 4G LTE networks.
2. New technologies to change standard public and private operations from autonomous vehicles to smart cities, virtual reality, and battle networks.
3. Lead DoD Agency: DoD GIO, Spectrum Policy & International Engagements Office
 - Internet-connected machinery with advanced analytics.
 - Wireless sensors, equipment controllers and cloud-based software delivering predictive, proactive building automation

How 5G Will Advance A/E/C/O&M Industries

- Improve asset life, use, availability, reliability, and safety
- Reduce energy use
- Allows for inter-asset communication
- Allows for easier ownership change
- Optimize asset retirement



Key 5G

Takeaways

What 5G brings:

- Ultra-reliable, ultra-low latency communication between self-driving cars.
- Sensors that add intelligence to city infrastructure.
- Multi-gigabit per second mobile broadband speeds.

By 2035 . . .

- 5G's full economic benefit should be realized.
- \$12.3 trillion in new goods and services.

Major Issues – Security and Spectrum Sharing

Source. By [Cristiano R. Amon, Executive Vice President, Qualcomm Technologies](#)

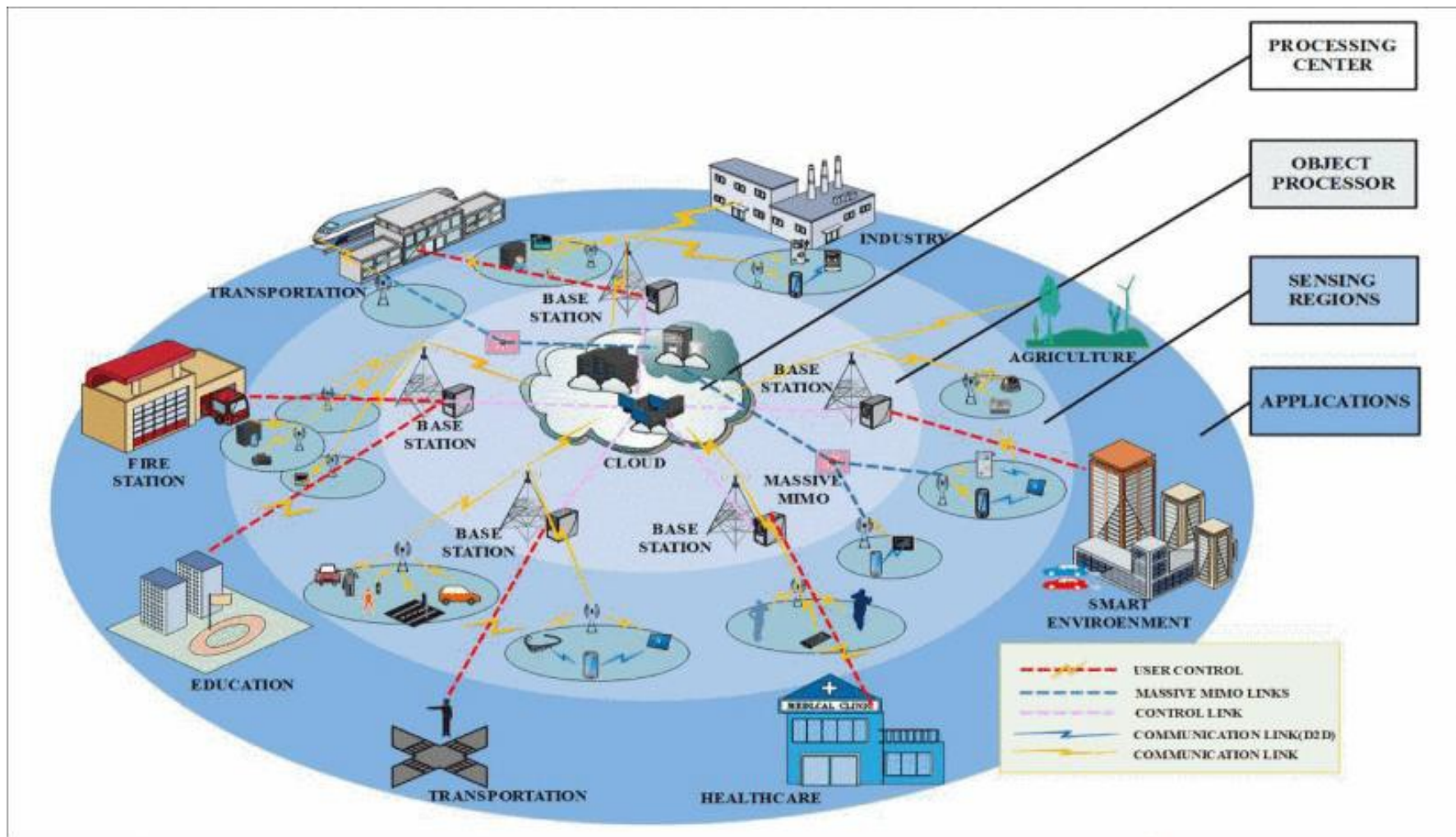
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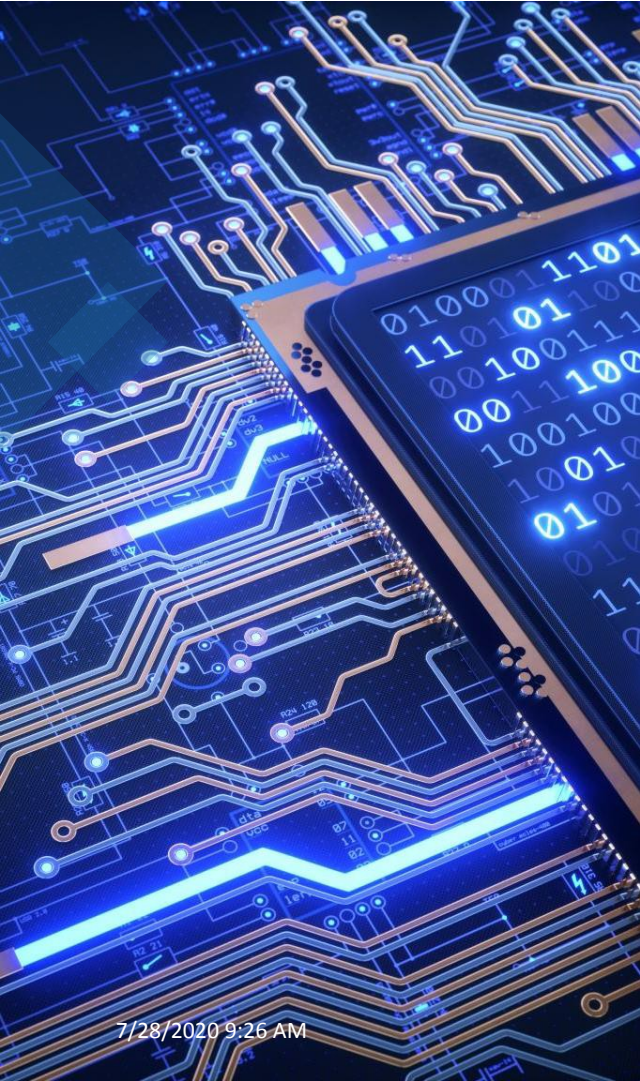
“5G is a revolution enabled by evolution. It’s the next step along the 4G path .

..”

5G Impact on DoD / Federal Policy

- 5G introduces new DoD and federal policy complexity with new business models.
- Examples? Public safety, cybersecurity, privacy, spectrum allocation, public infrastructure, healthcare, and education, training, and development.
- What's Needed? Policies that safeguard firms to take risks, make investments, and continue the pursuit of innovation— particularly rules governing intellectual property





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5G and HVAC O&M

- HVAC to receive significant changes through 5G, IoT, embedding intelligence, and connectivity
- Predecessor IoT HVAC applications:
 - Supervisory Control and Data Acquisition (SCADA)
 - Direct Digital Controllers (DDC)
- Major OEMs. Honeywell, Johnson Controls, Siemens

5G and Construction

- Construction highly complex, unstructured, erratic work environment, remote construction sites, highly fragmented, multi-disciplinary.
- Will affect entire construction process by:
 - Communicating among offices and remote sites.
 - Interconnection of multiple devices in new/renovated buildings.
 - Remote equipment operations
- Key is “ultra-low latency” = less delay sending a package of information from one device to another.

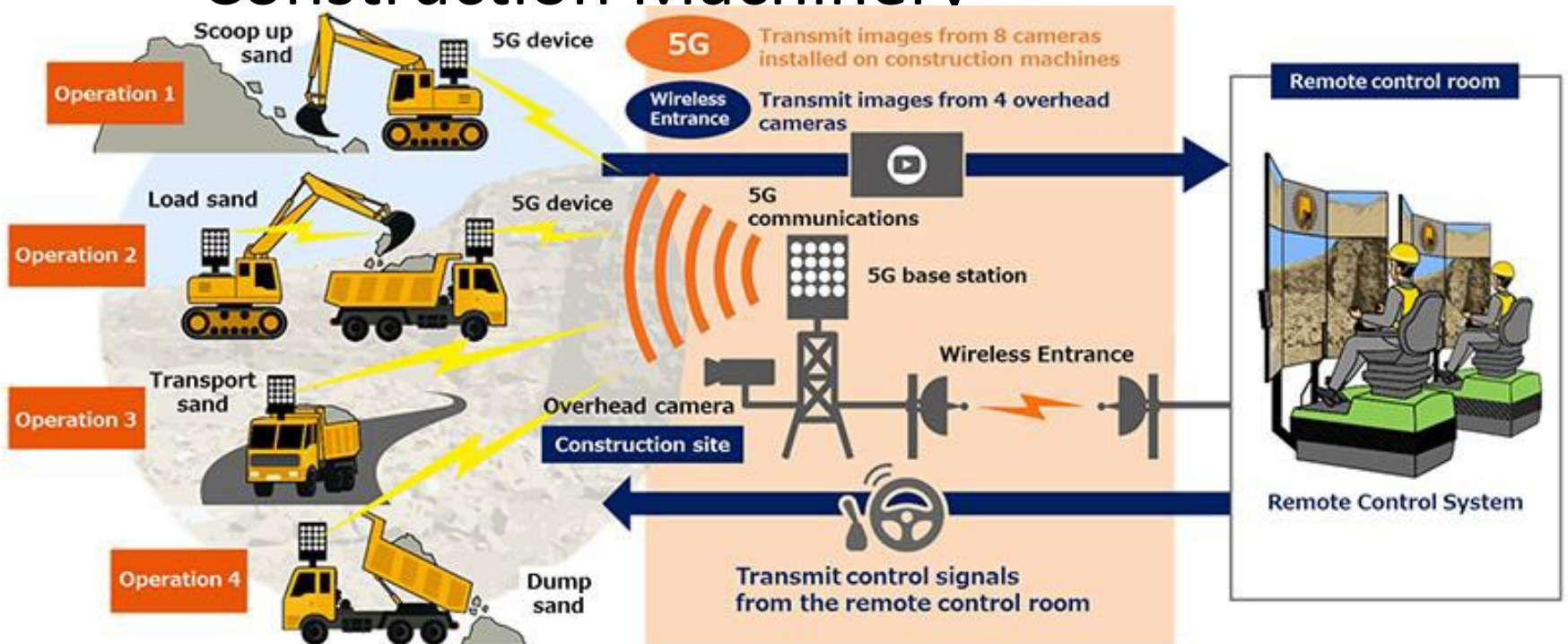


Doosan, Hyundai, Volvo Testing Underway . . .

- Tests in South Korea, Japan, Sweden, and Finland.
- OEMs collaborating with telcos, i.e., LG, SK Telecom, Nokia, and Ericsson.
- Doosan testing remote 5G on 40-ton crawler excavator located 5,000 miles away in Incheon.



. . . KDDI, Obayashi, and NEC Using 5G to Remotely Control Construction Machinery



5G and HAZMAT

- Suitable for excavators in HAZMAT sites.
- Useful for collapsed waste piles, buried mines, munitions, disaster-hit areas inaccessible to workers.



China Construction Launches First 5G Construction Site

- AI glasses to see what workers are seeing on site.
- Robotics, multi-dimensional, real-time monitoring
- Blockchain and IoT to verify supply and progress reporting
- Worker health by measuring 10 indicators, including blood pressure and electrocardiography, and issue physical examination reports.
- Monitor tower cranes.
- Multidimensional security
- Verify face masks

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5G Infrastructure?

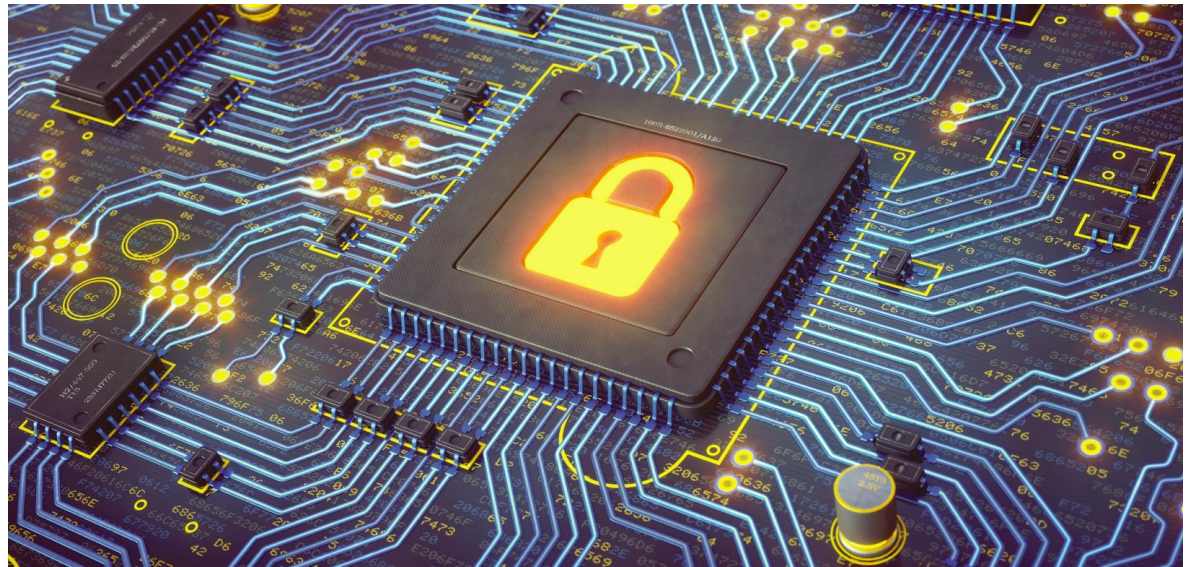
- Three major U.S. telcos installing: AT&T Mobility: 144 million subscribers, Verizon Wireless: 151 million subscribers, T-Mobile US/Sprint 86 million
- Up to 2 million connections per square mile compared to 20,000 with 4G.
- Need antennas, boosters inside buildings, on highways, optical, fiber-based cabling.
- Private carriers to request financial assistance from building owners and landlords, will request tax breaks from government agencies.

Federal Agencies Assessing 5G

1. Army Futures Command Army, Installation Spectrum Management Office (ISMO), frequency and authorization for RF spectrum allocation at White Sands Missile Range (WSMR)
2. Army COE, Engineering Research and Development Center
3. Department of Commerce (DOC), National Telecommunications and Information Administration (NTIA)
4. DHS, Cybersecurity and Infrastructure Security Agency
5. DoD Defense Advanced Research Projects Agency (DARPA)
6. DoD Defense Innovation Board (DIB)
7. DoD Joint Artificial Intelligence Center on aircraft maintenance improvements
8. DoD, Office of the Under Secretary of Defense for Research and Engineering
9. DoD CIO, Spectrum Policy & International Engagements Office
10. Federal Communication Commission (FCC)
11. National Spectrum Consortium (NSC)
12. Naval Information Warfare Center (NIWC)
13. Naval Information Warfare Systems Command (NAVWAR)
- 14.

5G Security?

- End-to-End System Security
- Three key components:
 - Device
 - Cellular infrastructure
 - Cloud



USAF and Verizon Bringing 5G to 10 Bases 2020-2022

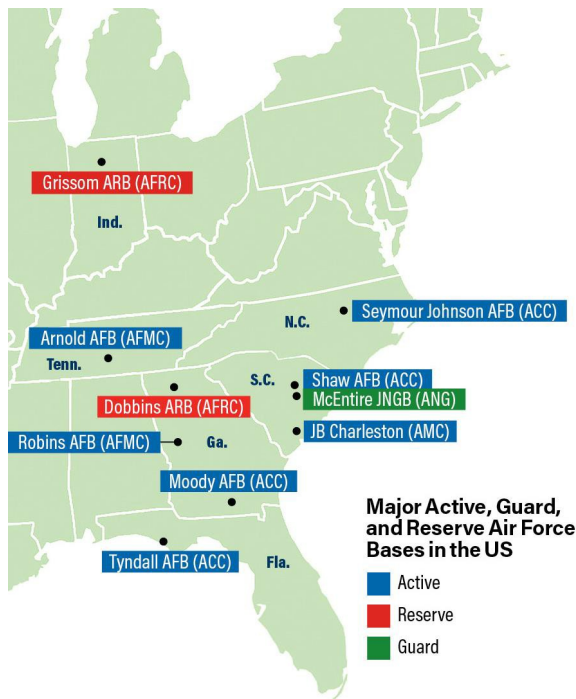
- Verizon installing 5G infrastructure under no-fee leases for 25-years.

- USAF installing devices on Verizon infrastructure

- AT&T also involved in western bases

- Applications:

- Aircraft maintenance, test equipment, VR/AR training, telemedicine, biometrics security, supply chain
- Replace fiber and hardware with totally wireless



Spectrum Sharing Issues



- Lack of national/federal spectrum strategy, goal, direction.
- Everyone's spectrum needs to grow exponentially.
- New innovative technologies continue to boom.
- Spectrum management remain reactionary vs. proactive.

Role of National Spectrum Consortium (NSC)

- DoD funded R&D agencies
- Membership open to private firms involved in 5G, spectrum issues
- Only members of NSC able to bid on new NSC solicitations
- Recent Request for Prototype Proposals (RPP)
 1. Dynamic Spectrum Sharing
 2. Augmented Reality (AR) and Virtual Reality (VR) Training
 3. Smart Warehouse Testbed
- Scopes of Work. Develop, mature spectrum-access for improved cognizance, protection of U.S. activity in electromagnetic spectrum domain, and ability to relocate/share spectrum anytime, anywhere.
- New technology, industry group standards under development across



DoD 5G Spectrum Testing

1. NB Norfolk, VA. Shipwide and pier connectivity.
2. JB Pearl Harbor-Hickam, HA. Aircraft mission readiness.
3. JB San Antonio, TX. Augmented reality and training.
4. Fort Irwin, CA and Camp Pendleton, CA. Wireless connectivity.
5. Tinker AFB, OK. Focus on bi-directional spectrum sharing between DOD communications systems and 5G.
6. Hill AFB, UT
7. JB Lewis-McChord, WA
8. NB San Diego, CA
9. MCLB Albany, GA
10. Fort Hood, TX. Augmented reality of non-aircraft maintenance

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5G and

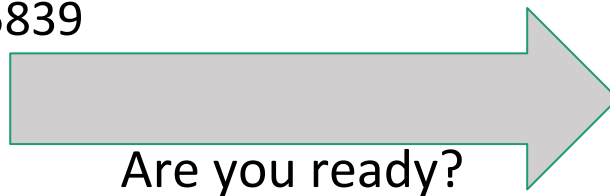
Pandemic

1. Smart workplace apps, i.e., IoT platforms to track occupancy, reduce density of use, monitor spaces.
2. Increase ventilation for more fresh air into workspace and regulate pressure differences.
3. Over-pressure and under-pressure to prevent contaminated air entering rooms.
4. Avoid air re-circulation of extracted, contaminated air

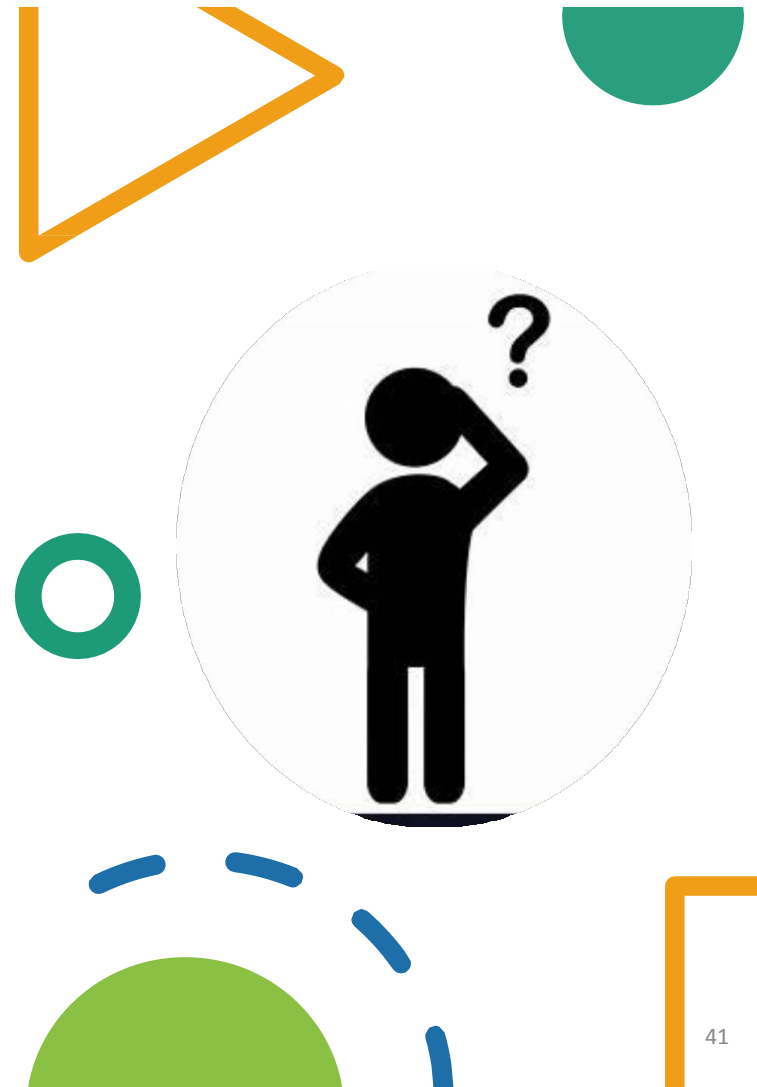


Whence the Future?

- Covered lots of territory: 5G, IoT, FAM, and LCM.
- All inter-related. Brave new world.
- 5G will change engineering, design, construction, LCM, facility operation, environmental sustainment.
- Contact. Mark@mark-consult.com
- 301-875-5839



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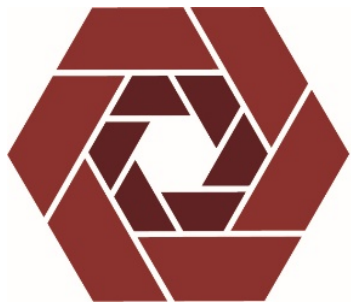
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by President Kathy Stewart

September 16th

Young Member Virtual Happy Hour



• **October 14th**

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