ENGINEERING CHANGE LAB USA

TECH INNOVATION STRATEGIES FOR ENGINEERING ORGANIZATIONS

CREATE Technological innovations and tools that catalyze a "phase change" in how engineering staff and teams work and/or how they create value?

- **Digital Twins**
  - › Predictive analytics for operations & maintenance
- **New Virtual Experiences**
  - › AR / VR for public / client engagement
- **Transformed Regulatory Environment/ Processes**
- **Emerging Convergences of Tech Innovations**
- **Transformation of Business Models to value creation rather than selling hours.**

ELEVATE Technological innovations and new tools that canbe used to significantly increase (raise) the performance and productivity of staff and teams.

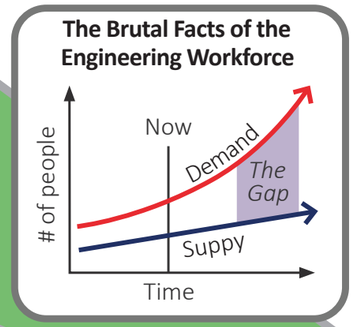
- **Cloud Databases** for Data mining past projects/work
- **AI for Heuristic Tasks**
  - › Analysis & Design – Voice to Design (SIRI for design)
  - › Diagnostic Coaching / Chatbots – Interactive Design Assistance, PM Insights
  - › Code / Regulatory Analysis – Code compliance 'on the fly'
  - › Risk Analysis & Mitigation
- **3-D Modeling & Visualization** (BIM)
- **Parametric & Generative Design / Optioneering**
- **VR /AR** for design, engagement, and input/feedback
  - › AR enabled smart phones for field work
- **Digital Twins** for design, decision-making, & operations
- **Virtual Collaboration Tools** for design & decision-making
- GITHUB for Engineering Design
- APPs for design, modeling, and analysis

AUTOMATE Technological innovations and new tools that can replace (substitute for) work that is currently being done by staff and teams.

- **Cloud Databases** Data collection (GIS, etc.)
- **AI for Algorithmic Tasks**
  - › Predictive analytics, tracking progress (PDF redlines)
- **Drones & Low-Level Satellites** for surveys, inspections, and site visits
- **Static/Remote Sensors** for monitoring & control
- **Digitization of Procedural Tasks**
  - › Report Writing, Design Checklists, Estimates & Quantity Take-offs
  - › Regulatory Approvals
- **Embedded Intelligence** in files/docs. /plans, etc.
- **AI Applications for Business Operations**

ELIMINATE Technological innovations and new tools that can be used to eliminate work that is currently done by staff and teams.

- **Cloud Databases** for historical data (GIS, etc.)
- **Remote/ Embedded Sensors/ Cameras** for data collection
- **Collaborative Document/Data Management**
- **Virtual Collaboration Tools** for reduced travel & sharing data
- **Virtual Collaboration Tools** that improve communication with regulators



- › Convergence
- › Cloud
- › AI & Machine Learning
- › VR & AR
- › Big Data
- › Internet of Things (IOT)
- › Ubiquitous Hi-Bandwidth Networks
- › Smart Phones

TECHNOLOGY FOUNDATIONS

TOWARD A HIGHER CONTRIBUTION AS STEWARDS OF TECHNOLOGY & NATURE

RE-IMAGINING BUSINESS / PRACTICE MODELS

- Value-based Models vs. Selling Hours
- Experience Economy Models
- Leveraging Cloud Data/Info
- Software / App Development
- Risk Arbitrage
- Digital Twin-Driven Lifecycle O & M Services

RE-ENGINEERING ORGANIZATIONAL INFRASTRUCTURE

- R&D
- Level of Technology Investment / Capital Structure
- Work Processes and Flows
- Partnering and Outsourcing to Tech Companies

RE-THINKING BOUNDARIES / COLLABORATION

- Interdisciplinary Practice on Steroids
- Collaborations with Non-Engineering Partners

RE-GENERATING TALENT

- Drawing expertise from outside traditional engineering boundaries
  - › Tech Expertise- Data Analysts, Coders & Tech Developers
  - › AI Enabled Comm. College & Non-STEM Univ. Grads
- Training & Development
  - › Re-Skilling- Coding for Non-Coders & Systems Dynamics
  - › From algorithmic to heuristic work skills
  - › Entrepreneurial mindsets & capacities

Challenges / Points of Resistance

- Assuring that engineering companies are fairly compensated for investments made, value created, and risks assumed in adoption of tech innovations.
- Overcoming inertia of existing business/practice models and mindsets.
  - › Procurement systems, contracting methods, & regulatory/review processes.
- Re-training of existing workforce to use/take full advantage of new technologies.
- Role of schools in educating a workforce capable of creating, applying, and using tech innovations.
- Data ownership & control of data in the CLOUD.
- Lack of alignment in standards and practices across disciplines & industries.
- Growing complexity of projects outpacing tech innovation adoption rate (arms race)
- Required 'step change' in IT investment.
  - › Applied Tech Innovations (hardware & software)
  - › Training, re-skilling workforce & organizational change initiatives
- Cybersecurity risks / exposures.
- Macro-ethical dilemmas.
  - › Licensure: Who is the "responsible engineer" for virtual engineering work products?
    - › More work done without a 'PE'
  - › Who owns the data in the CLOUD? Opportunities for open source data / platforms.
  - › Unintended bias built into data, analytics, and APs .

ECL-USA • Kyle Davy • March 2022

Map of the Future **Tech Innovation For Workforce Augmentation**