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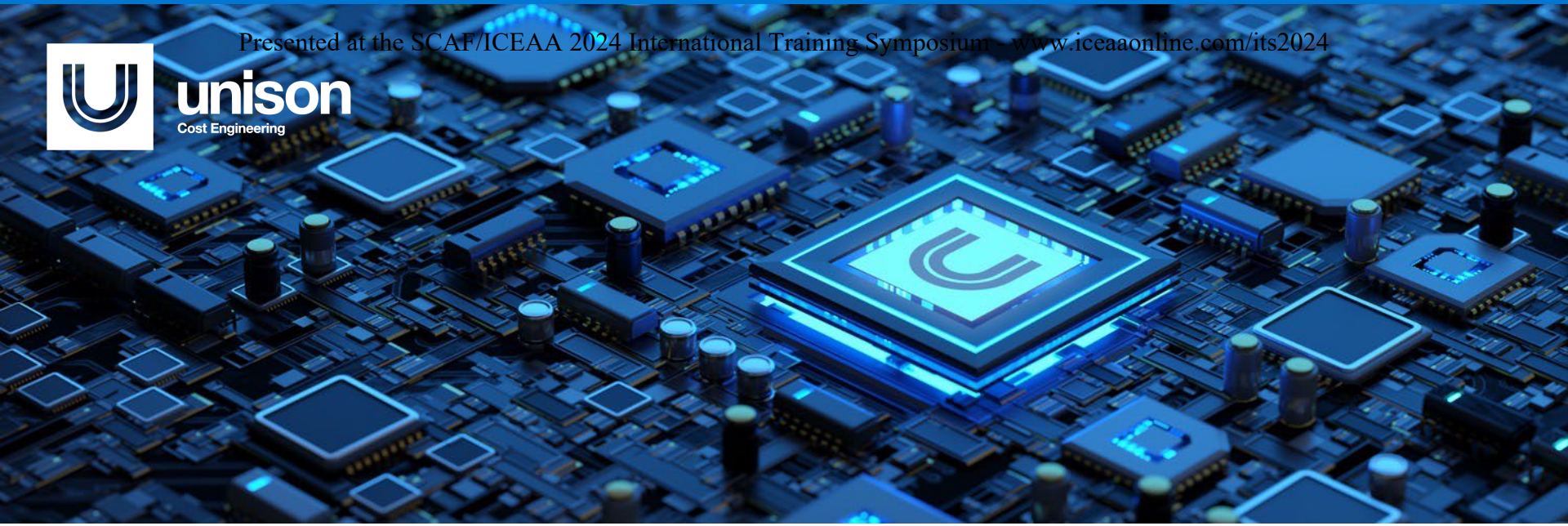
Cost Engineering



Cost Modeling for IT Deployment Projects

Gurney Thompson

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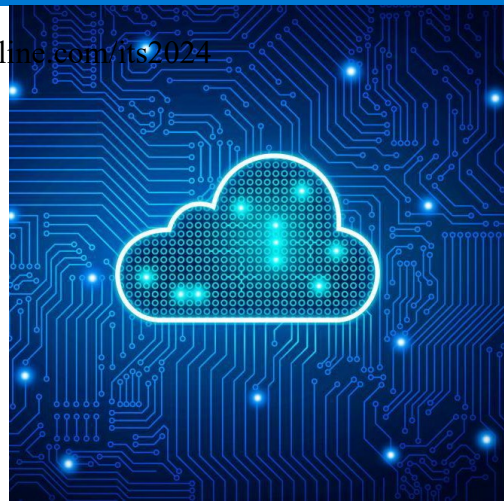
Introduction



- Distributed IT/Electronic Systems consist of multiple devices performing a variety of tasks that are spread across a network.
- Examples: Smart Homes, Smart Manufacturing, Smart Cities, Air Traffic Control, Mission Control Rooms
- Goal is to estimate cost/effort for configuring all equipment to be deployed, development of supporting software, surveying deployment sites, and physical deployment of the system through achieve full operational capability.
- Estimating starting point: Bill of Materials available

Smart City Use Case

- The term ‘Smart City’ describes a technologically modern urban area that collects and leverages data to better manage its resources and services.
- May include equipment to monitor and manage traffic and transportation systems, utilities, water supply networks, emergency services, information systems, community services, etc.
- Supported by an IT infrastructure that enables communication between the distributed systems above, as well as providing administration environments.
- Generates, processes, and distributes enormous quantities of data.

Work Breakdown Structure for Distributed IT/Electronic Systems

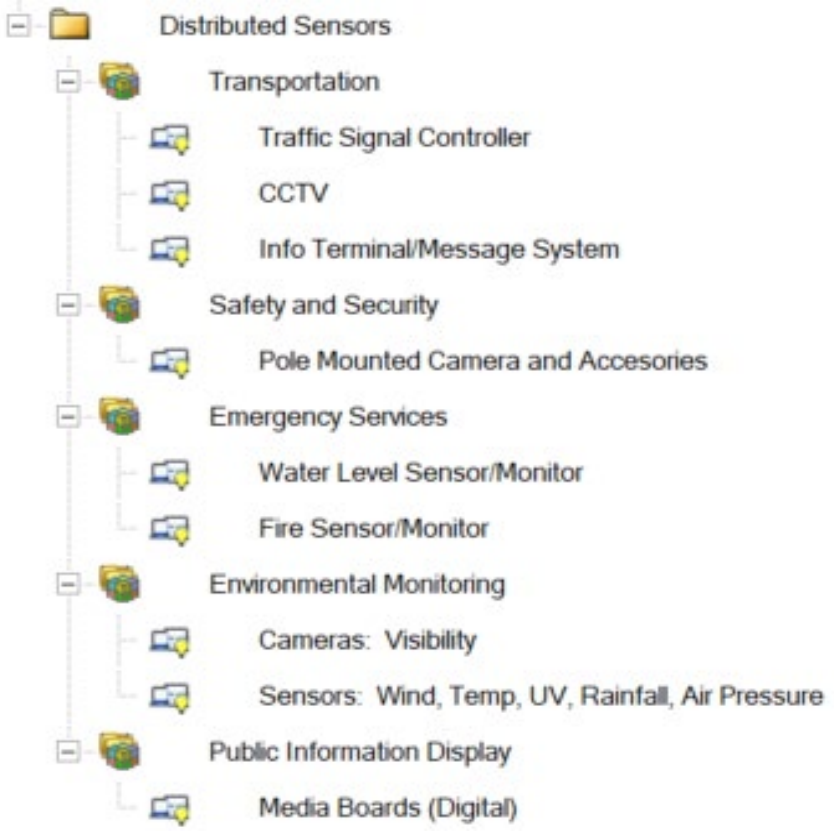
- Interface to Distributed Sensors and Devices (IoT)
  - Describes the configuration of equipment to be deployed across multiple locations as well as the underlying supporting infrastructure.
- Integrated Operations and Control Center (IOCC)
  - Describes the design and creation of software to be installed and operate on the servers found in IoT branch
- System-Wide Integration Testing (V&V)
  - Describes the verification and validation of the hardware and software outlined in the IoT and IOCC
- Operational and Site Activation (Site Survey + Deployment)
  - This branch describes the deployment and installation of hardware and software from the IoT and IOCC

Interface to Distributed Sensors and Devices (IoT)

- Describes the configuration of equipment to be deployed throughout the smart city as well as its underlying supporting infrastructure.
- White-collar work performed by engineers who create and document scripts for the deployment team that automate the configuration process during site installation.
- Includes Distributed Sensors and Information Transport branches

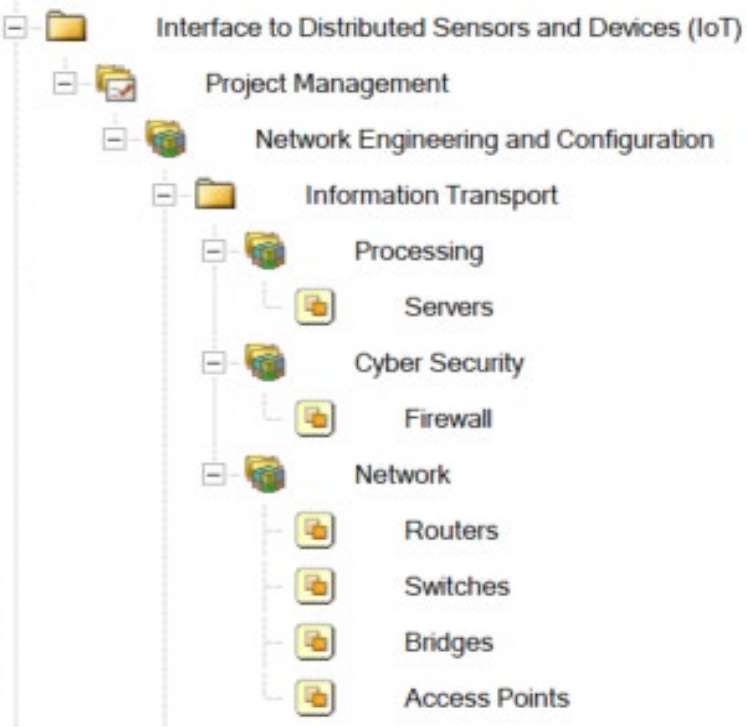
Distributed Sensors

- Contains the front-line equipment to be deployed throughout the city.
- Involves developing configuration scripts for each device (sensor thresholds, timing settings, power management, etc.) as well as network configuration (connecting to LAN/WAN, data transmission intervals, etc.)
- Size is based on the unique equipment types and number of system architectures
- Complexity based on the level of integrations with the wider network, network/connectivity considerations, and security considerations.



Information Transport

- Contains the supporting IT infrastructure
- Involves setting up active directory to manage permissions and access to network resources, VM and performance management processes.
- Currently estimated using software estimating models, with size based on function point counts.
- Developing simpler estimating methodologies based on information about the distributed equipment it will support.

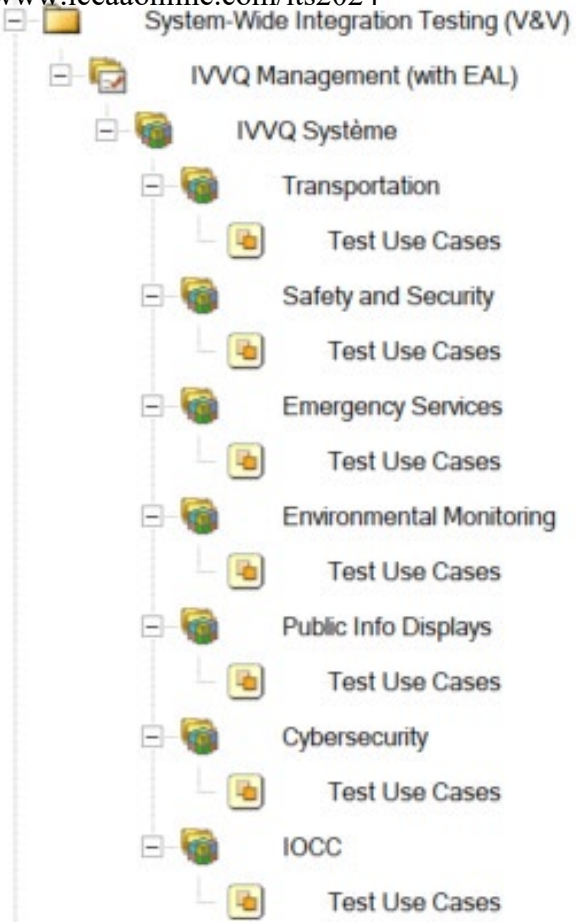


Integrated Operations and Control Center (IOCC)

- Describes the design and creation of software to be installed on the servers in the IoT
- This software is used to manage the connections between the control room and the distributed devices as well as to process, store and display incoming data. It also functions to protect the system from cyber-attacks and other external threats.
- Includes Applications and Cybersecurity branches.

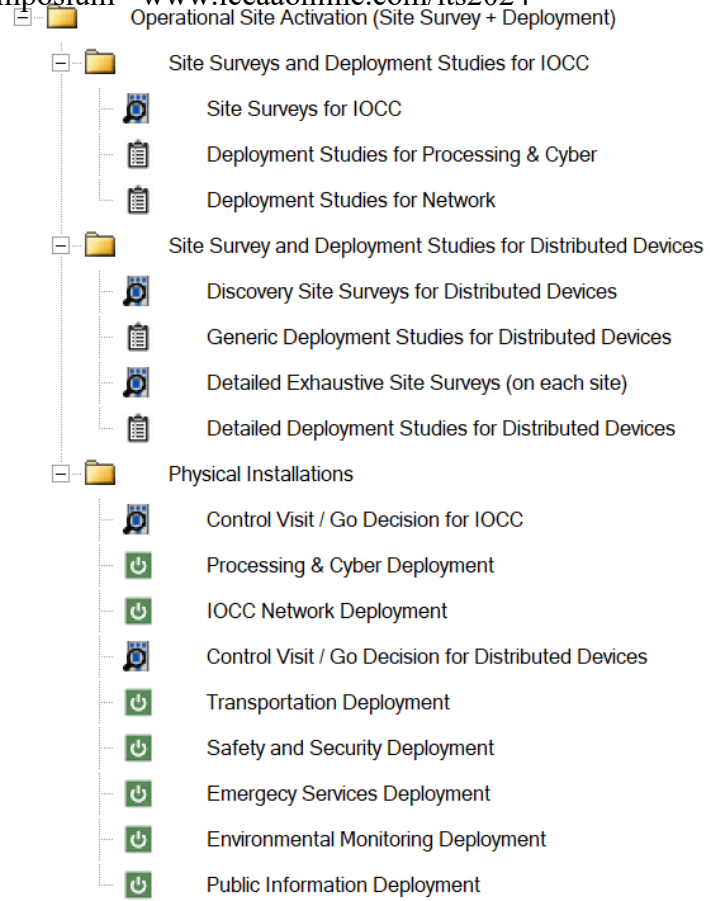
System-Wide Integration Testing

- This branch of the WBS describes the verification and validation of the hardware and software outlined in branches 1 and 2.
- Test cases are run to detect and prevent issues from arising during deployment that may cause delays.
- Efforts sized using Use Case Conversion Points (UCCPs)



Operational and Site Activation

- Describes the deployment and installation of hardware and software from branches 1 and 2
- Takes into account all of the complexities you'll encounter deploying the system in the real world
- Includes
  - Site Surveys
  - Deployment Studies
  - Physical Installations



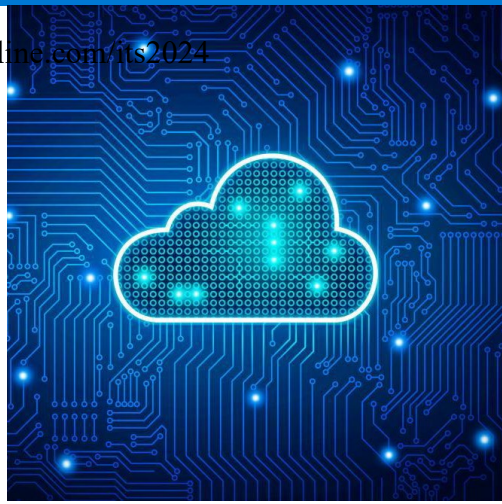
Operational and Site Activation – Site Surveys and Deployment Studies

- Site Surveys - Visits to prepare for deployment of a system on-site. Occurs before deployment studies.
  - Identify any issues that may arise at the time of deployment.
  - Identify any site-specific adaptations that may affect the configuration
- Deployment Studies - Estimates non-recurring design work and preparation for deployment.
  - Technical studies (System diagrams, study interfaces to existing systems, migration plan, etc.) Includes development of any site-specific system adaptations.
  - Working Groups (Coordinate deployment team, various end users, customer, etc.)
  - Installer Tools and Training
  - Qualification of the process, resources, deployment skills
  - Management

Operational and Site Activation – Physical Installation

- Deployment work performed onsite
  - Identify/Document initial state of site configuration
  - Installation and Configuration of equipment for the new system, and their connections to pre-defined interfaces (network, radio, energy, etc.). Includes testing in “stand-alone” mode.
  - Implementation of operational software and system configurations, full system testing.
  - Acceptance of system in fully operational environment with client/users.
  - Migration of previous configuration data.

Summary



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Questions?

Backup

Smart City Use Case

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- May include the monitoring and management of traffic and transportation systems, utilities, water supply networks, emergency services, information systems, community services, etc.
- Generates, processes, and distributes enormous quantities of data.
- Enabled by an information and communication technology infrastructure that satisfies the following:
  - Automated and Simplified Network Management
  - Automatic security threat isolation and remediation
  - Internet of Things (IoT) enabled
  - Robust and scalable
- Same estimating approaches applicable to many kinds of electronic system development and deployment projects

Sensors

1. Accelerometers
2. Air quality sensors
3. Cameras (Image sensors):
4. Electric current sensors
5. Gyroscopes
6. Humidity sensors
7. Level sensors
8. Motion sensors
9. Pressure sensors
10. Proximity sensors
11. Temperature sensors
12. Optical sensors
13. Electricity current sensors
14. Infrared sensors

Deployment Studies - Size Drivers

- "Size" based on 4 drivers
  - Number of System Architectures

    Number of system architecture diagrams, describing the hardware and/or software components and how they integrate with each other.
  - Number of Alternative Configurations

    Minor adaptations of the system architecture.
  - Max Number of Equipment Types

    Unique equipment types defined in System Architecture diagram
  - Number of External Interfaces

    Power, networking, satellite datalink, sensors, etc.

Deployment Studies – Complexity Drivers

- Operating Specification
  - Ground-Stationary, Ground-Mobile, Ship, Aircraft, etc.
- SW and System Configuration
  - Use provided installation guide? Adapt the installation guide? Create new?
- Cabling/Mechanical
  - Simple cabling/wiring requirements? Complex? Lots of site-specific adaptations required?
- Systems
  - SW/IT, Command and Control, Weapon System, Optronic/Radar, Complex Multi-Equipment
- Communication Technology
  - LAN, WAN, WiFi, Bluetooth, Radio, Complex Mix
- Processing/Analysis/Computation Equipment
  - SW/IT only, PC/HD, Servers
- Software
  - Simple COTS? Complex COTS? Simple New Dev? Complex New Dev?
- Power Distribution
  - Power provided on-site, ready to go? Write start/stop procedures? Site-specific adaptations?
- Foreign Language Complications

Site Survey and Deployment – Cost Drivers

- "Size" based on
  - Number of System Deployments
  - Percentage of Sites Surveyed
  - End User Workspaces per Site
- "Complexity" score based on 13 different areas of complexity
  - Many of the same from Deployment Studies, plus:
  - Number of Deployment Site Locations
  - Country Access Complexity
  - Danger Level
  - Installation Environment

    Indoor/Outdoor, Install in Building/Vehicle/Ship/Aircraft

    Quantity/Weight of Equipment
  - End User Workspace Complexity
  - Migration Complexity