Hotel 2040
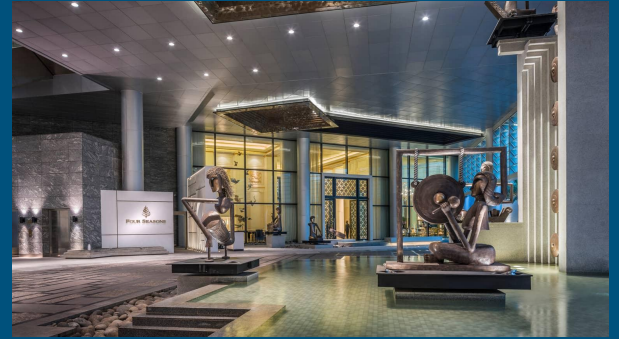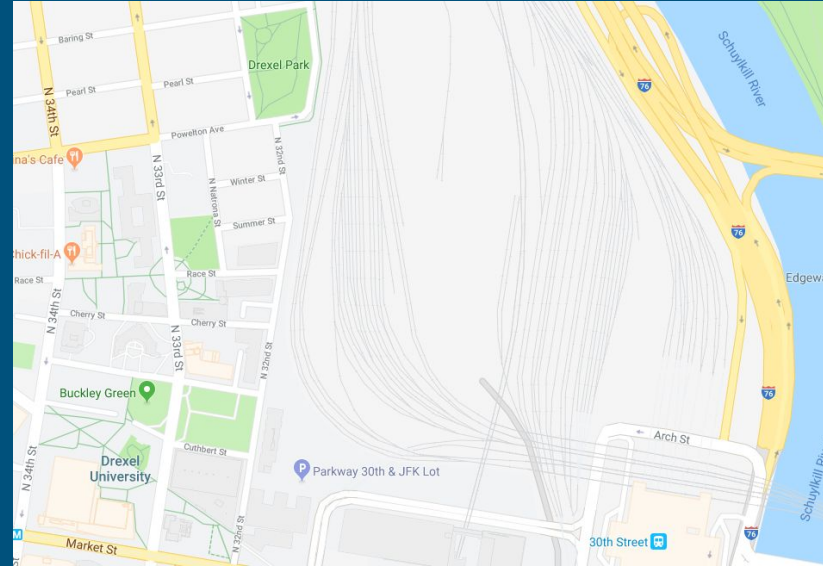
The Story of a High-Tech Hotel throughout its lifecycle

J. Mitchell - 3/2020

Assumptions

- Time 2040 - About 20 years ahead
- Location - Schuylkill Yards Technology Center, Philadelphia
- Target Market
  - Entrepreneurs & Bankers
  - Luxury

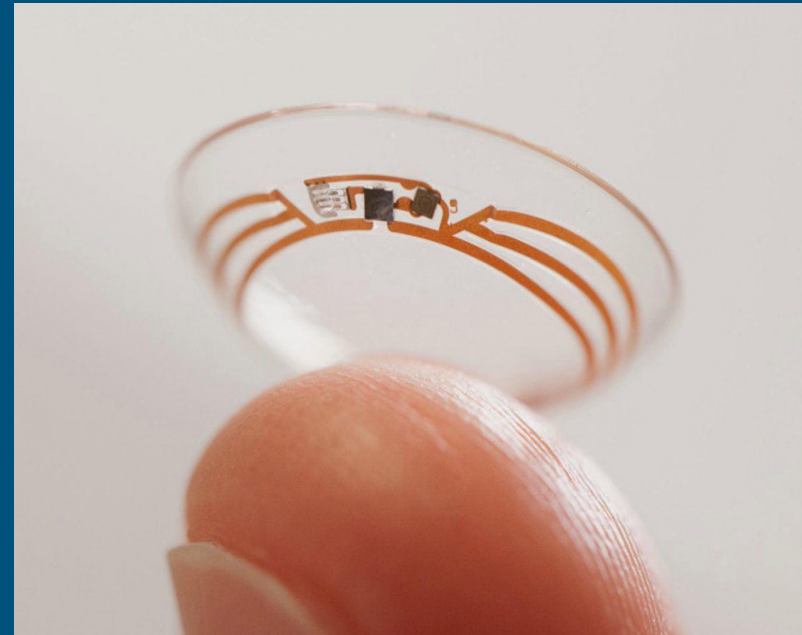# Personal Technology - Generally in Use

- Google Glass Successor
  - Invisible to others
  - Mixed Reality+
  - Multiple networks simultaneously
- Personal AI Integrated with Cloud
  - Emotion recognition
  - Object recognition
  - Thought commands
- Super-Evernote
  - Continuous access
  - All relevant content

Hi, how can I help?
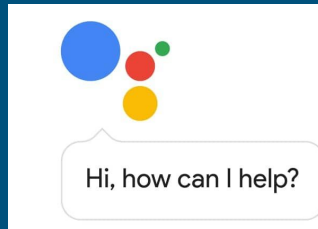
Construction Industry Technology
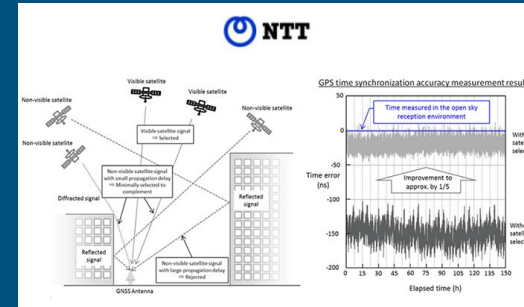

Source

Source

- Robotics - at all scales
  - Able to operate independently
  - Faster at mechanical tasks than most humans
- Pervasive Networks
  - Multi-Gigabyte speeds
  - Very low latency - no perceived delay
- Accurate Location
  - All object parts locatable in real-time
  - Accuracy to construction tolerances

Source

Technology-Life cycle Matrix

- My opinions
- Far from complete
- Link

Technology	Program	Design	Bidding	Construction	Commissioning	Operation	Revision	Demolition
BIM	Goals Establish	Concepts Alternatives Modeling Visualization Documentation Code Check	Quantities Comparisons Schedule Bidder's Models Compare	Schedule Fabrication As-Built Visualization	Testing Verification Training	Operations Maintenance Records Life Safety Efficiency	Goals Alternatives Modeling Scheduling As-Builts	Scheduling Safety Modeling
Robotics	Surveying	Remote Visualization		Fabrication Erection Grading Transport Monitoring Security	Testing Modifications Transport	Maintenance Cleaning Transport Security Service Monitoring	As in Construction	Demolition Transport Monitoring
AI	Alternatives Implications Standards	Alternatives Evaluation Modeling Manufacturing Selection	Assessments Alternatives Verification	Schedule Efficiency Monitoring Compliance Revisions	Verification Revisions Implications	Efficiency Security Comfort	As in Construction	Safety Efficiency
Additive Manufacturing		Manufacturing Selection Scheduling Design alternatives	Alternatives	Complex Forms Rapid Parts Large-scale (w/ robotics) Low Cost	Quick Fixes	Repairs	As in Construction	
Networks	Involve More Remote participation Cloud Computing	Cloud Computing Visualization on site Remote design	Detailed analysis	All parts locate Visualization Monitoring Coordination Security	Testing	Monitoring Security Operations	As in Construction	Safety Monitoring
Virtual Reality	Viewing Implications (w/ AI, BIM)	Modeling Visualization Acoustics Full sensory	Alternative Viewing	Training Efficiency Safety Coordination	Visualization compared to design	Emergency Efficiency Repair Visitors Entertainment	As in Construction	Safety Coordination Scheduling
Sensors	Data from users Site Data Emotional Sensing	Emotions Eye Movements Gestures in VR Site character		Location of all items Movement Loads Quantities ID	Systems behavior Applied loads	System behavior - all Security User actions User requests Locations	As in Construction	Loads Locations Behavior Security
Databases	All data - BIM coordinated	All data - BIM coordinated	All data - BIM coordinated	All data - BIM coordinated	All data - BIM coordinated	All data - BIM coordinated	All data - BIM coordinated	All data - BIM coordinated
Personal Technology	Individual behavior Eye motion, emotions Group interaction	Mobile design Implant Interface Augmented Reality Direct Sensor Access Visualization	Closer Subs Input	All workers connected Individual Instruction Enhanced safety Coordination Tracking	Coordination Visualization Individual Instruction	Coordination Visualization Individual Instruction Real time sensing	As in Construction	Safety Coordination
Energy	Key supply decisions	Incorporating renewable energy Enhanced modeling	Alternatives Analysis	Increased flexibility Sensors w/o batteries	Energy tuning	Massive sensor networks Easy additions and changes Renewable tracking	As in Construction	Energy source recovery Materials reuse

Programming Phase

We'd still have a programming phase, but the programming software would know about all our company's buildings and standards. The interview would be conducted by a person, but the input to the programming machine would by voice, with continuous feedback on a screen of the implications of each preference - visualizations, costs, interactions with other elements. Models of the potential building would be automatically constructed in several different "styles" with questions that would allow updating as the user answers the questions.

- Drone Surveying
- AI with Standards
- Automatic generation of alternatives
    - Sites
    - Masses
- 3D visualization
- Integration of emotional reactions
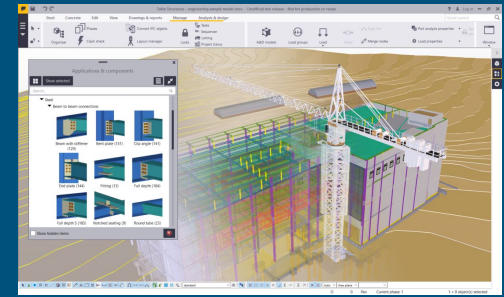- Data incorporated in BIM for future reference

Design Phase

Once the programming is complete the architect, engineers and contractor would work on the selected model, proposing enhancements or alternatives that the program would ensure meet the project constraints, keeping a continuous updated view of the alternatives on screen throughout, with construction, commissioning and operating costs all viewed as range for each option. The program would suggest optimizations for a given approach and also generate alternatives combining elements of multiple approaches.

- Unified BIM model
  - Allowing scenarios
  - Costs
  - Scheduling
  - Simulations
  - Goal comparisons
- Audience reactions incorporate
- Individual virtual walk-throughs
- Extensive simulations
- Goals comparisons
- Define commissioning tests
- Define Operating parameters

Construction Phase - (Revisions too)

The contractor, having been a partner throughout would have pre-ordered major components once design decision points have been reached. Order scheduling would be automated so that arrival on-site would minimize local storage. Most handling would be by robotics handlers with continuous updating of the BIM model of actual components. Dangerous and all completely routine installation will be by robots.
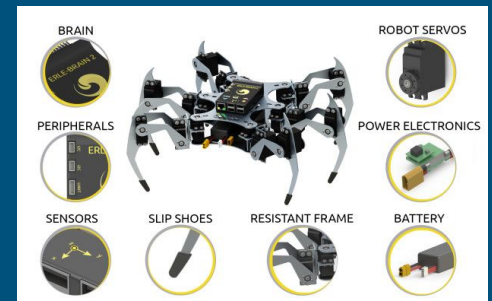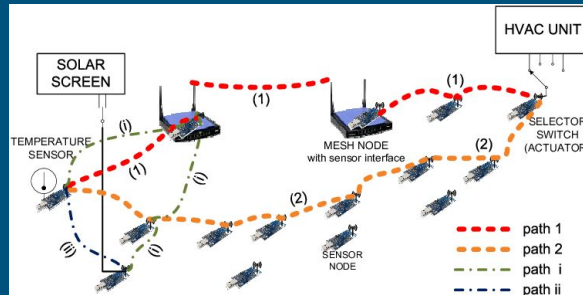
- Robotic 3D construction
  - More complex, efficient forms
  - Many connectors 3D fabricated
    - Outside and inside concrete
- Continuous update & control via BIM
  - Visualization
  - Training
  - Safety
- Most transport robotic
- Most parts include sensors

Commissioning Phase

Commission will be by a fleet of measurement robots that will "flex" the building through hundreds of variations to ensure proper operation. The data will be fed to the BIM model so there is always available a display of actual vs. the benchmarked commissioning performance.

- Testing of all systems
  - BIM coordinated and recorded
  - Robotic testing tools
  - Embedded and additional sensors
- Rapid fixes
  - Robotics
  - 3D Printing
- Visualization
  - Of expected vs actual

Operations Phase

During operation most routine maintenance tasks will be robotic, including inspection and BIM model updating.

Each guest will have their preferences stored on their personal device. They will be shared with the hotel as part of registration.

- Room view
- Temperature & Rh schedules
- Kitchenette Stocking

Hotel cameras will recognize guests and service will respond according to preferences

- BIM controls & records operations
  - External connections for life safety
  - Monitoring of equipment failure
  - Efficiency & sustainability operations
- Robotics for most operations
  - Maintenance & cleaning & transport
  - Guest services
    - Human services a preference option
    - Entertainment
  - Security monitoring
  - Repairs & alterations

Demolition Phase

When the building has exceeded its life then the BIM model will be central to its safe deconstruction and component recycling. The AI will propose alternatives for the deconstruction sequence and methods for component salvaging and transport to maximize the money saved. Most work will be performed by robots for safety and efficiency reasons, with drones and networks monitoring progress and determining alterations from the plan, as well as labeling components for salvage and demolition.

- BIM & AI oversite
- Robotics
  - Dismantling
  - Transport

Source