Urban Planning, Health, Internet of Things, Security

Panel Discussion at DOE BTO Peer Review on April 14, 2015
Panelists: Dave Rouse (APA), Jonathan Herz (HHS), Jon Francis (Bosch), Jason Christopher (DOE)

Summary by Nora Wang (PNNL)

1. Urban Planning and the Future Built Environment (Dave Rouse, American Planning Association)

1.1. Presentation highlights

- Trends and drivers of change:
  - Climate change
  - Resource depletion due to projected consumption and population growth
  - Technology development, which is unpredictable, unimaginable, and even disruptive
  - Health (chronic diseases as new epidemics) and equity (disparities in health between poor and affluent populations)
- Urban planning implications
  - More involvement of stakeholders in the planning process, featuring real-time feedback to different planning scenarios.
  - Look at outcomes that can be measured at different scales, such as sustainability at the district level.
  - Integration with the natural environment is critical. Green infrastructure principles include multi-functionality, connectivity, habitability, resiliency, identity, and return to investment.
- Implications for buildings
  - Design a building with a deep understanding of its regional impact.
  - Design a connected flow of energy, material, and people movement.
  - Design a building adapting to disturbance and change.
  - Design for habitability (healthy environment). The definition of our mission of public health is to share the society interests and provide conditions that people can be healthy. Nothing is more important than health.

1.2. Implications for Future Buildings

- A Future urban environments are —
  - Eco-districts valuated by multi-dimensional performance metrics. An individual building's contribution and impact (local, regional, global) should be considered (during design and planning) and measured (during operation);
  - Multi-functional and connected (physically and virtually) environments, featuring a sense of place;
  - Adaptive developments that anticipate extremes and employ low-tech and distributed solutions relying on local resources.

2. Building Health (Jonathan Herz, Department of Health and Human Services)

2.1. Presentation highlights

- Buildings construction, renovation, and operations not only consume resources (energy, raw materials, water), but also directly and indirectly produce greenhouse gas, landfill waste, and pollutions (SO_2, airborne particulates).
- Current building materials (e.g. chemicals and toxins) and methods have negative impact on workers and communities. Health threats include cumulative impacts on young, old, chronically ill, and poor, societal system failures, and emergence of diseases.

- Unjust distribution of resources (3% go to the 36% poor; while 80% go to the 15.6% richest).
- The challenge for the future is how to translate the data and concept to design and practice. The biggest challenge is the economic decision making. The Triple Bottom Line was introduced in 1997 to pursuit economic prosperity, environmental quality, and social equity. Comprehensive estimates of the expected benefits and costs to society (social net benefits) have been included in the budgeting process since 1992.
- Environment should not be a subset of the economy. Economy should exist within the environment as a construct of society.

2.2. Implications for Future Buildings

- Achieving positive human health outcomes must be the basis for our designs. We need to —
    - Apply what we know about human health impacts of our built environment into positive health outcomes;
    - Establish an evidence-based, human health baseline for design;
    - Make positive health outcomes central to design standards and systems, and to our economic decision-making process.
- Measurable health impact of a building is the first essential step to reduce the negative impact on health. The future buildings should be able to enhance and support human health.

3. Internet of Things (Jon Francis, Bosch Research Technology Centre)

3.1. Presentation highlights

- Internet of Things is a network embedded sensors and actuators. IoT is intended to enable devices to achieve higher functionality through connectivity and coordination. It also incudes a wealth of software services. Different applications are based on use cases in various fields (e.g. manufacturing, healthcare, energy/power, transportation).
- The challenges include the large-scale infrastructure (product provisioning) to support IoT, connectivity of big data from different devices (sometimes with conflicting interests), data processing and visualization, and data protection (privacy and security).
- System boundaries are being re-evaluated as applications need to process data from more and more other devices. Data will be translated to knowledge, then to control strategies, which will enable intelligent systems.

3.2. Implications for Future Buildings

- Buildings will contain more hybrid (integrated) and distributed systems with eliminated boundaries (such as combined lighting, security, HVAC control system with modular components).
- Devices from manufactures will have base functions and be personalized later based on user tastes/preferences (enabled by machining learning).
- Building-wide or city-wide intelligent applications will collaborate and exchange data to provide optimized outcomes.
- A “living building” can —
    - Monitor its own performance, detect problem, and predict maintenance needs;
    - Automatically personalize building areas through various applications;
    - Optimize energy use to achieve net-zero and contribute to the grid.

4. Cyber Security for Building Systems (Jason Christopher, Department of Energy)

4.1. Presentation highlights

- In the 1990s, only 1% of the world population had Internet access, now over 40%. This 40% of world population is widely connected via various apps and social networks. The computer speed is exponentially getting faster. These trends will continue. Cyber security, in the coming decades, will have more people (and

more threats) computing (and attaching) faster than today. In buildings, any control system or application that has a human interface can be attacked.

- Cyber security is more than just technology. Everyone thinks that cyber security is taken care of by others, it therefore lacks proper implementation.
- Risk-based protections lead to resilience. It will help us develop better solution and maximize the benefits of connected devices.

4.2. Implications for Future Buildings

- In the future, Internet may not be the prevailing technology, but the "connectivity" remains the fundamental truth regardless of the technologies. Cyber security should not be the roadblock to the increased connectivity but part of the maintenance practice. A new workforce may evolve to meet the needs for better system protection and security implementation.

5. Questions and Discussions

- **Will powering the IoT devices use more energy?**
    - Sensors will be in sleep mode when not activated. They only transfer the needed data rather than the whole data string. A little bit of energy can go a long way. Comparing to today's practice that a lot of energy is wasted due to lack of sensors and improper controls, IoT devices will save energy.
    - In the future, if we can generate energy more locally, the IoT devices will not add burdens to the centralized energy supply.
- **How data and connectivity will impact future building design and development?**
    - Complying to standard protocols does not mean security. However, we need to have a common dialogue on interoperability first to establish a common framework. Then we can better establish the metrics for security. These two need to be developed together.
    - Open data can enable informed design and planning decisions.
    - Ideally, connected data can help create harmonious society. Transparency of building products should be part of the conversation.
    - We also need to think about who is going to maintaining these data and make sure they work properly.
- **How the health aspect can be better integrated into buildings?**
    - People need to think about what going into the buildings, the impact of people in the buildings, the community around them, and the whole supply, construction, recycle, and disposal chain. This kind of knowledge will help us build better buildings and community.
    - Think about the connection of the buildings, their surroundings, and the environment. The walkability and landscape are also important aspects of a healthy urban environment.
    - We can use data collected from the buildings to improve building operation and enhance the indoor environment quality.
    - Health data is always the target of hacking. Security the data!
- **How can manufacturing contribute to future buildings?**
    - Get manufactures and supply chains to integrate security as part of their practice.
    - Use locally based production and resources.
    - Transparency movement of materials will make manufacturing and suppliers reduce use of certain chemicals in their products.
    - Power comes from the integration of systems—manufacturing is a main player to enable better integration.