# WEB3D 2020

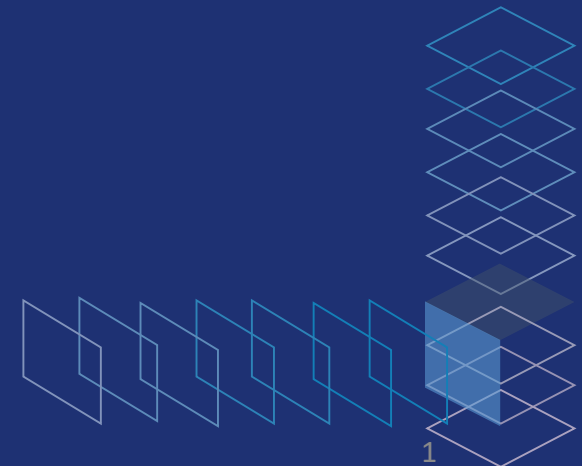# Visualizing Data and Metadata: X3D Graphics Standard for Smart City Information Portrayal

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# Summary

Standards for ISO Smart Cities are information based.

World Wide Web is how we share any information.

X3D information portrayal and exploration can help.

Let's all work together.

# Suggested workshop paths forward to consider

a. Focus on one or two cross-cutting use cases for compelling Smart City challenges/needs.

b. Identify types of data available to support study and information sharing.

c. Identify ISO and SDO standards available that support well-defined sharing of such data.

d. Present a range of information presentation and visualization techniques supporting study of such data.

e. Show a short set of hybrid examples that demonstrate the power of "mashup" information analysis using interactive visualization to gain insight.

f. Identify gaps and summarize capabilities as workshop conclusions.

g. Identify immediate opportunities for progress and necessary next-step strategies for future work.

*Immediate Outcome:* clearly articulated report enabling concerted efforts by ISO IEC Smart Cities standards committees.

*Process Outcome:* Establish Web3D Consortium and SC 24 in collaborative role with many standards as shared basis for information architectures supporting shared presentation and visualization.

# Background context

Web3D Consortium continues to think that Smart Cities domain is an excellent focus and "forcing function" to encourage combinations of different information sources in a linked complementary fashion, further amplified by 3D presentation and visualization. References of interest:

i.   "Smart cities: essential for global sustainability and urban efficiency," By Katie Bird, 5 July 2016. https://www.iso.org/news/2016/07/Ref2098.html

ii.  "Significant milestone for Smart City development - standards organizations agree to work together to move cities to greater smartness," 1 September 2016. https://www.iso.org/news/2016/09/Ref2117.html

iii. ISO Standards in action: Developing sustainably. ISO standards to promote sustainable growth,

   https://www.iso.org/developing-sustainably.html

# Big Picture, Common Motivations

- Smart City standards cover worldwide characteristics of interest.
- The more we do, the more we do: each set of connections illustrates another set of related interests, relationships and possibilities.
- Further Smart City standards will no doubt join those already in play.

- Each standard of interest has well-understood capabilities, relevance and use cases (indeed, that is why they first became standards).
- Perspective:  heart of the rationale for ISO Smart Cities standards is to unlock potential benefits when standards provide complementary, compatible *information of interest*.

# Smart City standards share common characteristics

Clear definitions for concepts, terms of reference, relationships, constraints

- Data: precise values providing contextual information of interest
- Metadata: data providing information about other data; relevance
- Use case examples illustrate how common problems can be addressed

Smart City standards might also share potential advantages:

- Web standards: scalable specifications, practices for information exchange
- Economies of scale emerge when common design patterns are reinforced
- Mashup hybrids enable insight from coherent alignment of information sets

# Big Data and Data Science

Big Data is field for analysis and extraction of large-scale information

- Characteristics include *volume, velocity variety, veracity, value* (5 V's)

- Proper structuring of data in the first place simplifies data retrieval

- Structured vocabularies, data models, XML schemas and ontologies can precisely express the clarity offered by international standards

Data science is "inter-disciplinary field that uses scientific methods, processes, algorithms and systems to extract knowledge and insights from many structural and unstructured data."

- Jim Gray, Turing awardee: perhaps "fourth paradigm" of science (empirical, theoretical, computational and now data-driven)

# Internationalization (I18N), Localization (L10N)

- (hand-waving explanation of "numeronyms")
- Wikipedia: [Internationalization and Localization](#)
- "Internationalization is the process of designing a software application so that it can be adapted to various languages and regions without engineering changes. Localization is the process of adapting internationalized software for a specific region or language."
- Web presentation can handle *all* human languages.
- Essential component for "scaling up" across all people around world.

# Visualization for handling complexity

Visualization can reduce complexity by selectively examining voluminous details in a distilled fashion. Numerous concepts and techniques pertain.

"Visualization (graphics) includes techniques for creating images, diagrams or animations to communicate a message." Variations of interest include

- Scientific visualization for transformation, selection, or representation of data.
- Educational visualization uses simulation images for teaching.
- Information visualization software tools explore large amount of abstract data.
- Knowledge visualization supports data analysis and knowledge transfer process.
- Product visualization viewing and manipulation of 3D models, technical drawings.
- Visual communication illustrates ideas through visual display, includes usability.
- Visual analytics as science of analytical reasoning via interactive visual interfaces.

# [ISO/IEC JTC 1/SC 24](#) Computer Graphics

- Computer graphics, image processing and environmental data representation
  - standardization of interfaces for information technology based applications relating to computer graphics and virtual reality,
  - image processing,
  - environmental data representation,
  - support for Mixed and Augmented Reality (MAR), and
  - interaction with, and visual presentation of, information
- SC 24 might offer collaborative role as standards basis for information architectures supporting presentation and visualization
  - [Web3D Consortium](#) is Class A [Standards Development Organization (SDO)](#)

# Web3D Consortium Working Groups

"Open Standards for Real-Time 3D Communication"

Proven path for successful, productive collaborative efforts

- Extensible 3D (X3D) Graphics for technical basis and cross-connects
- Cultural and Natural Heritage for archival publication
- Design Printing and Scanning for CAD, BIM, engineering capabilities
- Geospatial for geographic positioning and OGC alignment
- Humanoid Animation (HAnim) for animated figures, human motion
- Medical for anatomical rigor, potentially medical records
- Web3D User Experience, Web3DUX for measurable effectives
- X3D Semantic Web for ontology-based queries across domains

# [X3D version 4](#) offered for public review

- Multiple papers, tutorials, workshops, demos in Web3D Conference

- Thousands of example scenes show direct evolution from X3D version 3

- Advanced glTF rendering and advanced W3C Audio API auralization

- Ability to convert, portray and connect both arbitrary data and metadata

- Can run standalone on client, on server/cloud, or inside HTML page

- Coexists with other Web standards

- Language independence: XML, ClassicVRML, JSON, Java, Python, more…

- Semantic Web queries now available

- Rigorous validation, quality assurance avoids Garbage In Garbage Out

# 3D Data is ubiquitous

- Many datasets and many models are explicitly 3D in nature.
- Even more datasets are implicitly 3D in nature, when placed in context at a given location or relative position with other things.
- Data does not have to be visualized in 3D to be analyzed, but often information in 3D is simply not considered feasible (when it could).
- Deeper exploration and interaction within 3D data yields new insights.

- Perhaps organizing question is not "What data is 3D data?" but rather we should work from a basis of "What data isn't 3D data?"

# Comparison exemplar: what's the difference?

Comparison of point cloud visualization nodes in X3D

- "Common data set of 2488 points, each point with associated normal direction coordinates and RGB color triple. This cloud is a random sample of the point cloud used to construct mesh model."

- http://www.kshell.com/pages/archimedes/visualization_comparison
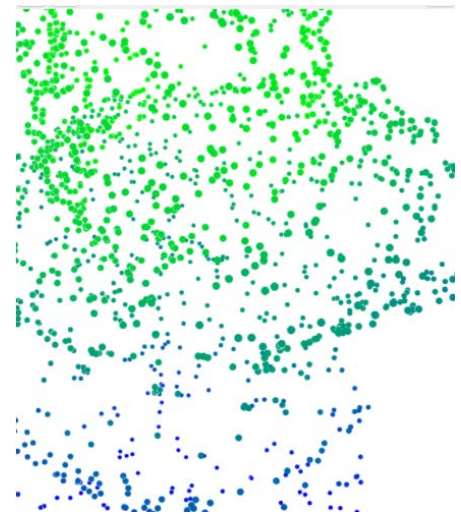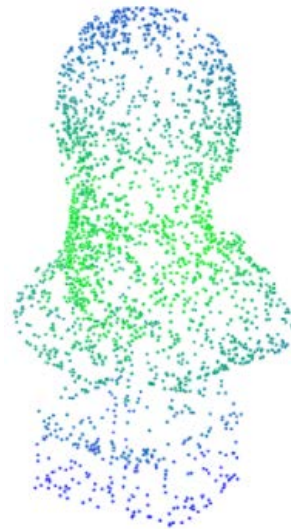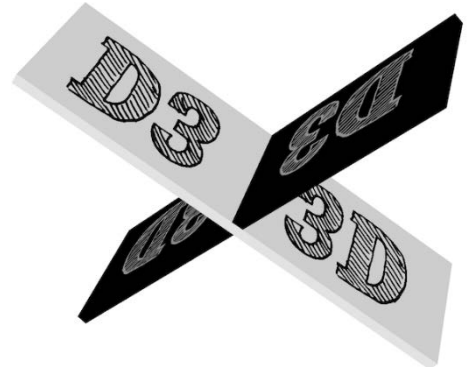
# d3-x3d library by James Lee Saunders

- 3D Data Driven Charting Library with D3 and X3D

- Combining power of D3.js data-driven documents visualisation library and X3D graphics standard, d3-x3d makes it simple to produce beautiful 3D data visualisations with minimal code.

- Inspired by Mike Bostock's reusable charts, d3-x3d has foundation of building-block components to create variety of data visualisations
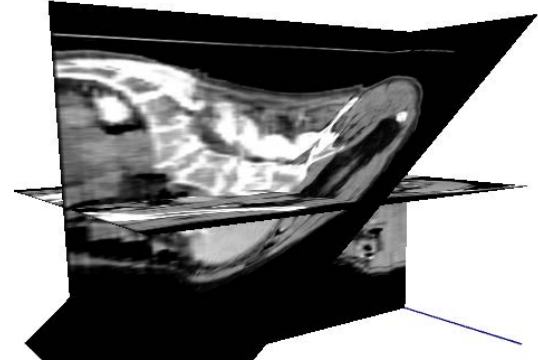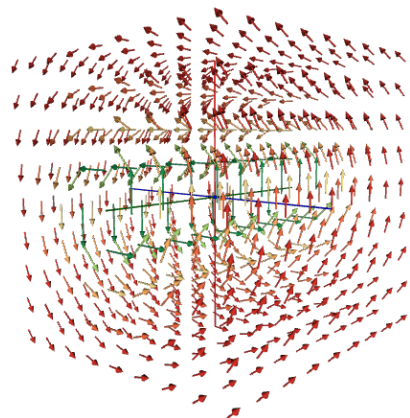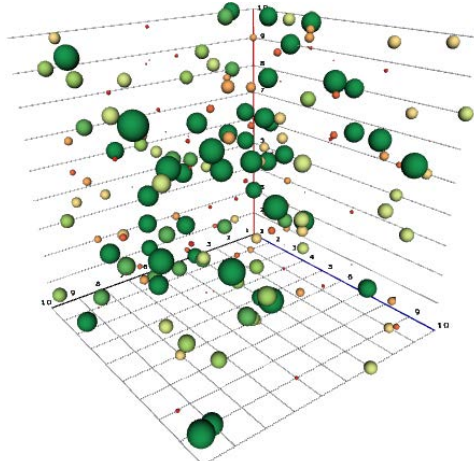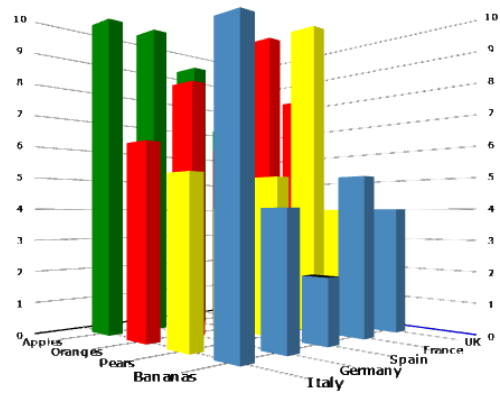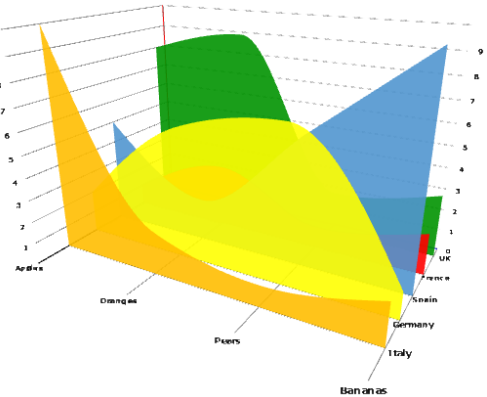
# Engineering and Geospatial use cases, arc.vt.edu

**Nuclear Safety & Simulation**

VRS-Rapid collaborative Web application for intuitive input, real-time simulation, analysis, 3D visualization of nuclear systems using RAPID Code System.
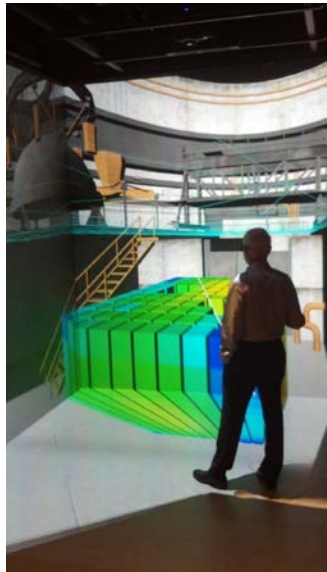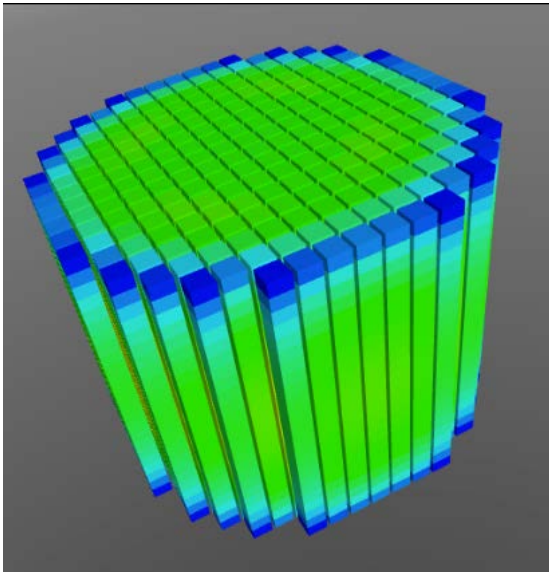
**3D Blacksburg**

City planning and exploration for students, citizens, elected officials. Relate project in natural history, environmental preservation, robot integration, search and fun!

# Metadata: data about data (no really!)

- Structured vocabularies with precise terms of reference
  - Plus general terms: provenance, revision dates, URI names, etc.
  - "Metadata includes data associated with either an information system or an information object for purposes of description, administration, legal requirements, technical functionality, use and usage, and preservation."
- X3D for Web Authors: Metadata Examples
  - X3D provides general validatable technical characteristics
- Born to Be 3D: Digital Stewardship of Intrinsic 3D Data
  - #B2B3D, 2 November 2018
- X3D Ontology for Semantic Web: ability to query within of geometry of 3D models and across multiple domains of interest
- The more we do, the more we will do...
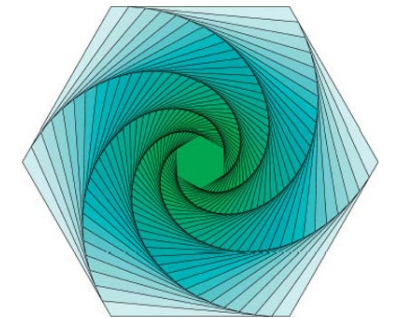
# Collaborative 3D Visualization for Ashore, Afloat and Expeditionary Readiness Workshop



Hosted by Virginia Tech, Web3D Consortium, U.S. Naval Facilities Command (NAVFAC), Naval Postgraduate School (NPS) December 2019

- Harbor facilities are common to most cities, always cross-disciplinary
- 3D scanning, 3D printing, 3D visualization are all complementary

# Potential shared use case: contact tracing?

- Compelling exemplar that involves multiple disciplines, constraints
- Contact tracing cannot be solved by any single nation individually.
- Airports and transit hubs include smaller zones and extrapolate into larger urban commons.
- Not all transmission vectors are yet fully understood, greater insight regarding cause-and-effect is always valuable.
- Round trip: following a traveler from heart of a city, through transit system, to airport security and screening, then aboard aircraft… returning to heart of another city touches every part of Smart City.

# Repeating: suggested workshop paths forward

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# Contact

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# WEB3D 2020

## 3D for a Hyperconnected World

The 25th International ACM Conference on 3D Web Technology
November 9-13, 2020, Virtual Conference, Seoul, Korea

ACMSIGGRAPH    web|3D CONSORTIUM    Korea Computer Graphics Society