UNIVERSITY OF CALIFORNIA, SANTA BARBARA

Data Visualization: Art, Technology & Meaning

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What is Data Visualization?

Data Algorithm Visual Meaning

It is the translational process of making invisible information perceptible to the human eye.

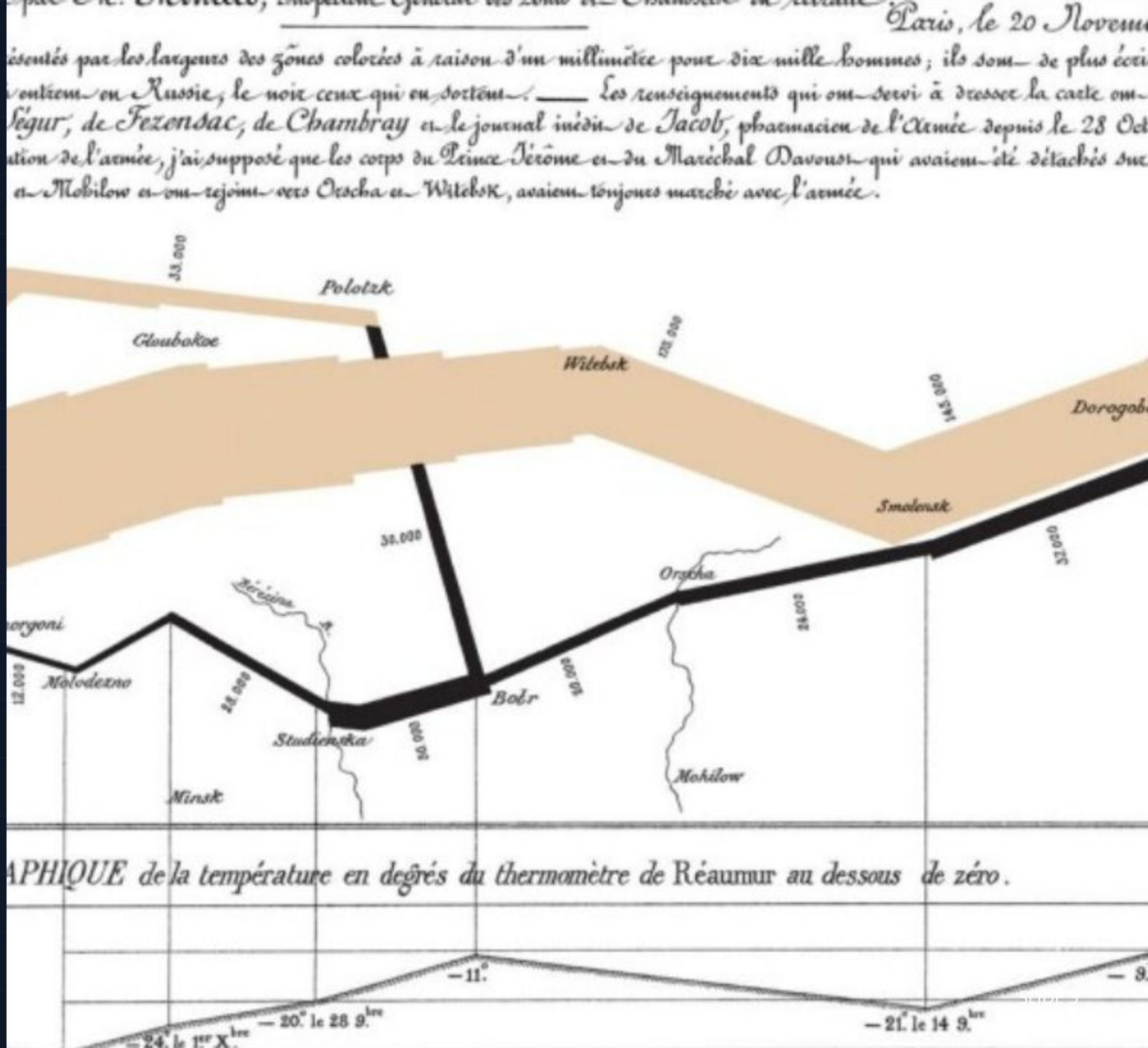
- **Reveals structure**, pattern, and behavior in complex systems.
- Connects abstract **quantitative systems** to human perception.
- Supports both rigorous **scientific insight** and artistic expression.
- **Cognitive Amplification:** Extends human working memory by offloading information to visual space.

Historical Foundation

Minard's "Napoleon's March" (1869)

Often cited as the best statistical graphic ever drawn.

- Multivariate narrative in a single graphic.
- Maps Geography, Temperature, Troop Size, and Time.
- **Visual Storytelling:** Effectively visualizes the tragic loss of life through line thickness reduction.



Why Visualization Matters ?

Understand Complexity

Distills massive, incomprehensible datasets into digestible visual formats.

Expose Hidden Systems

Reveals correlations and behaviors that are invisible in raw spreadsheets.

Insight via Abstraction

Uses abstraction to move from raw metrics to meaningful conclusions.

Decision Making

Facilitates faster, more accurate decision-making in environments of high uncertainty.

Component 1: The Data Source

The *data source* defines the scope, structure, and potential patterns of the visualization.

> **Garbage In, Garbage Out:** The quality of the output is directly dependent on the integrity of the data source.

Key Data Types

- **Spatial:** Geographic coordinates, physical placement.
- **Temporal:** Time-series, sequences, durations.
- **Behavioral:** User actions, communication logs.
- **Metadata context:** The 'data about data' that provides necessary semantic framing.

Case Study: Flight Patterns

Aaron Koblin (2005)

GPS coordinates converted into plotted paths using time-based interpolation.

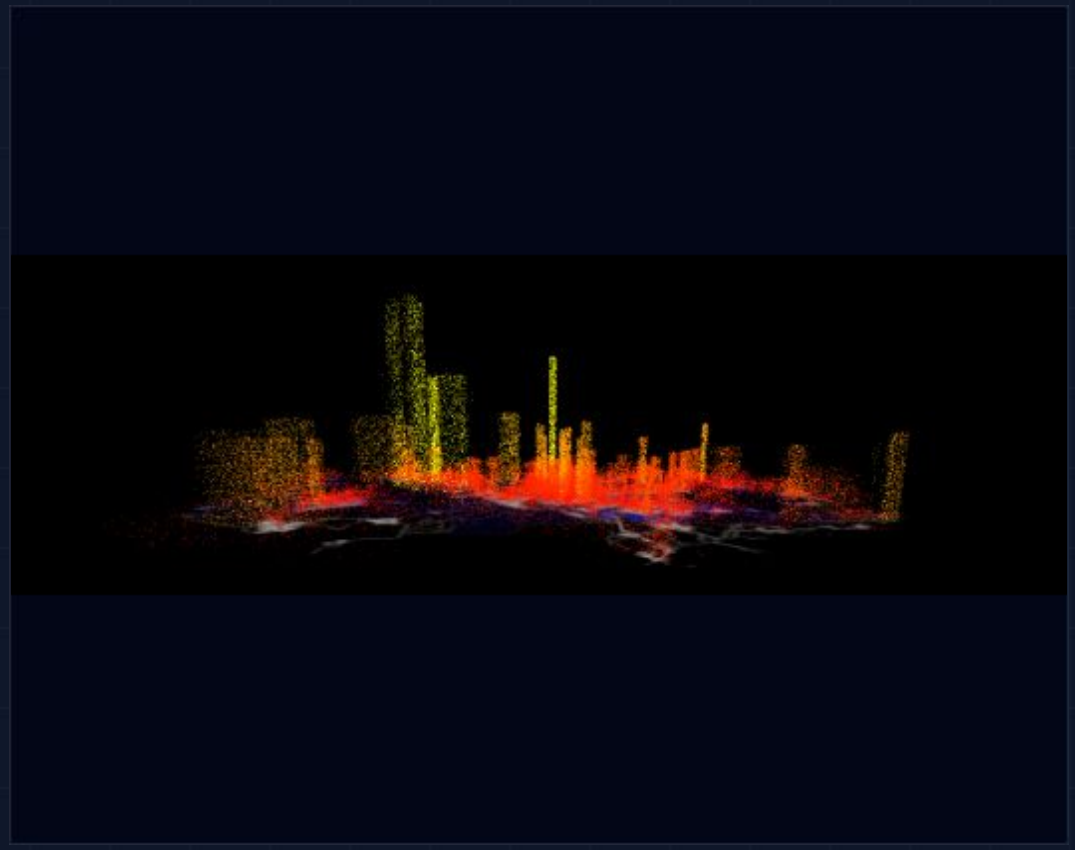
- **Technique:** Additive blending creates glowing trails.
- **Concept:** Visualizes the "heartbeat" of air traffic.
- **Impact:** Turns logistical data into an aesthetic experience of global connectivity.

Amsterdam SMS

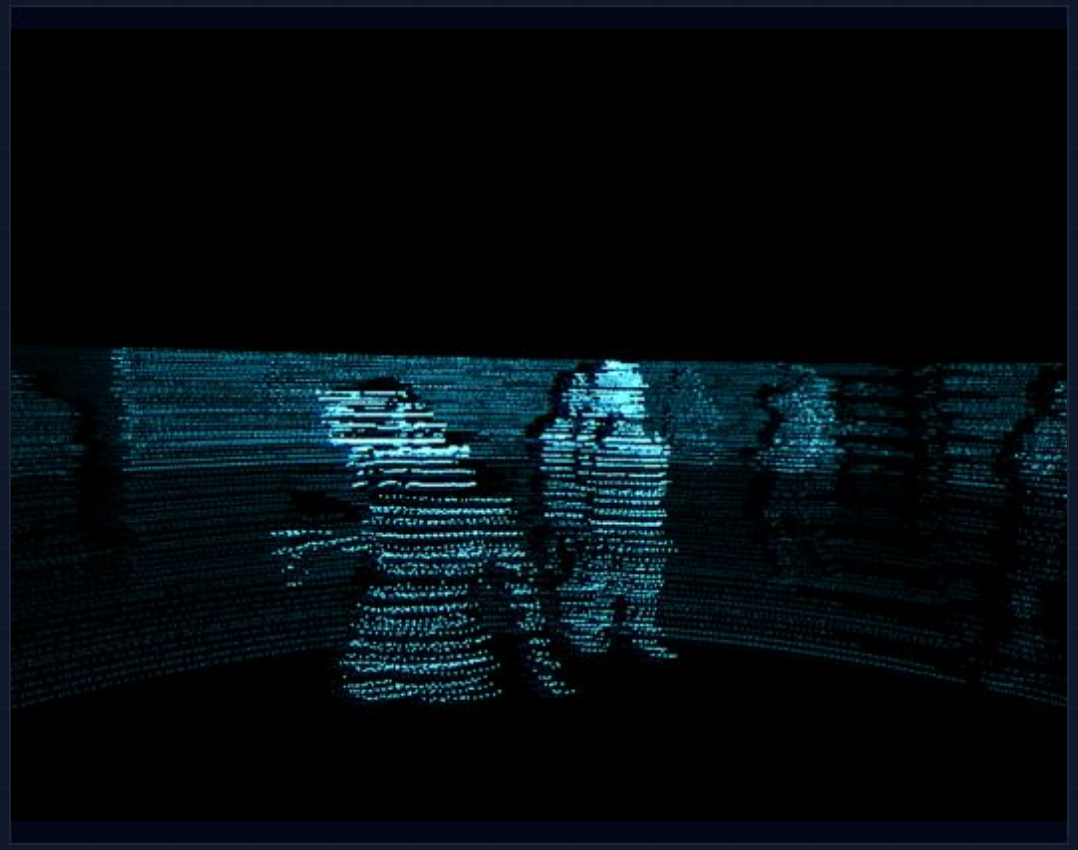
Aaron Koblin

This project visualizes citywide SMS activity logs to reveal urban dynamics.

- Combines **geospatial** location with **temporal** data.
- Treats communication as a behavioral signal.
- **Emergent Patterns:** The city's structure is defined not by roads, but by human interaction density.



House of Cards



Crowdsourced Creativity

A music video created for Radiohead using 3D plotting technologies.

- **Input:** Thousands of drawings collected from global users.
- **Process:** Collective image formation (Participation → Visualization).
- **Technique:** Lidar-like point cloud aesthetics generated without cameras.

Case Study:Making Visible The Invisible

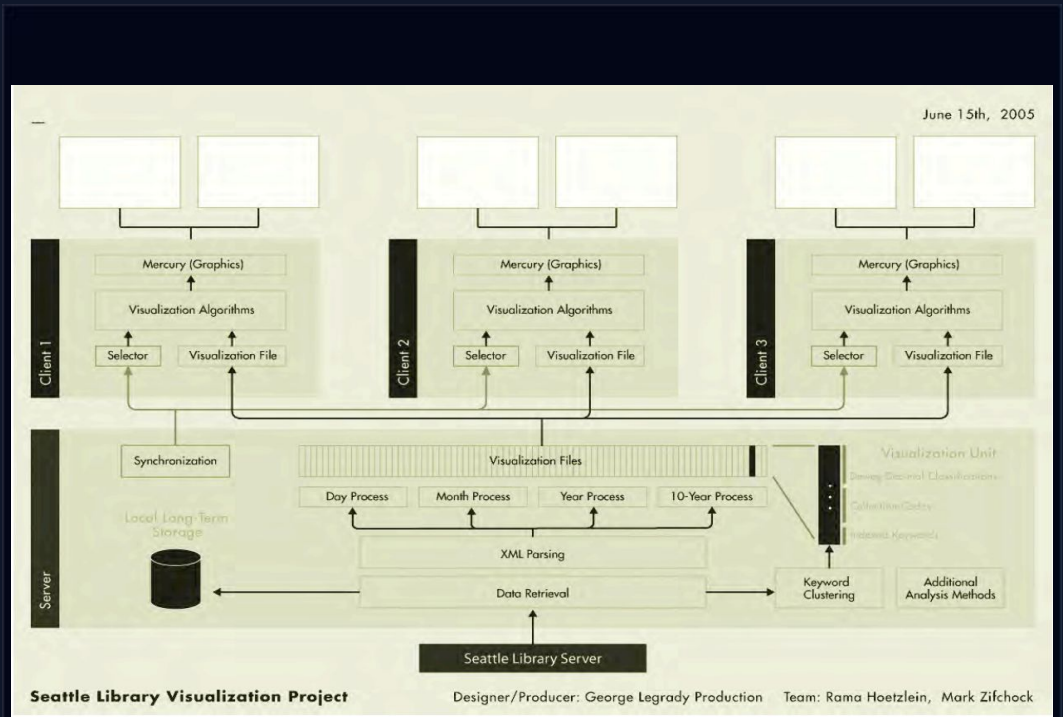


Fig. 4: Data Flow Map, Rama Hoetzlein, Mark Zifchock

SEATTLE LIBRARY DATA FLOW VISUALIZATION

"Making Visible the Invisible" is a commission for the Seattle Public Library. The installation consists of animated visualizations on 6 plasma screens located on a glass wall horizontally behind the librarians' main information desk in the Mixing Chamber, a large open public space dedicated to online computer research. The 6 screens feature visualization generated by custom designed statistical and algorithmic software that map the flow of data received from the library's Information Technology center. The project focuses on data flow and the library as a data exchange center where the circulation of books can be made visible and expressed statistically.

Experimental Forms

Beyond the Chart

Moving data off the screen and into physical space and other sensory channels.

- **Sound, Sculpture, Light, Motion.**
- Makes complexity perceptible through materiality.
- Reveals emergent behaviors and systemic resonance.
- **Immersive Analytics:** Utilizing VR/AR to step inside the dataset itself.

1.26 Denver - Janet Echelman

Data is transformed into a large-scale tensile sculpture suspended across the city.

- **Data Source:** 2010 Chile earthquake and tsunami.
- **Title:** The event shortened the day by 1.26 microseconds.
- **Form:** Data becomes architectural; abstract numbers become physical space.
- **Scale:** Transforms a planetary event into a local, human-scale experience.

Unnumbered Sparks

Echelman & Koblin (2014)

A massive interactive sculpture where the public draws light patterns using their phones.

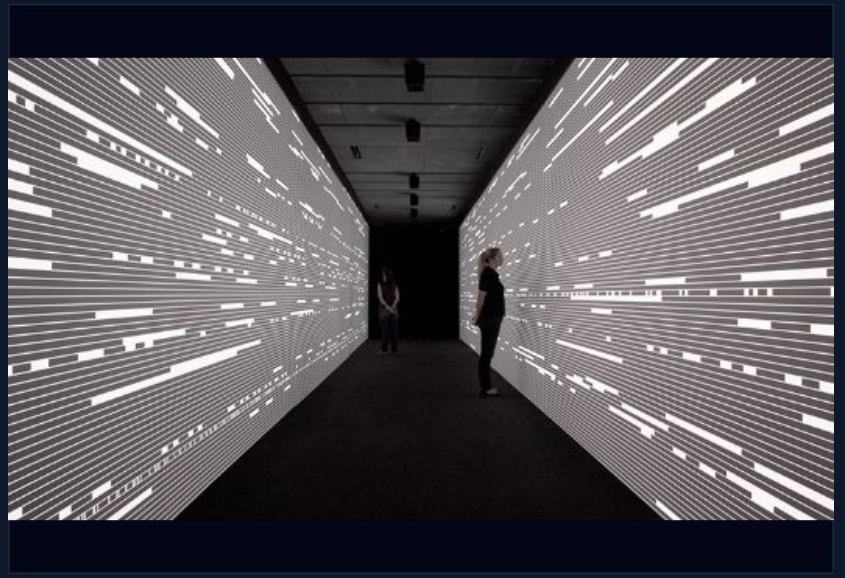
- **WebGL Engine:** Renders real-time particles.
- **Interaction:** Architecture becomes a medium for social interaction.
- Projected onto a physical net sculpture.
- **Civic Engagement:** Turns a passive spectator into an active creator of the skyline.

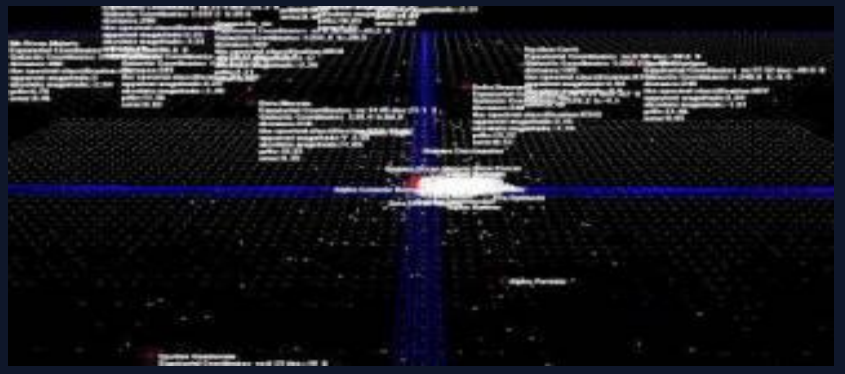
Ryoji Ikeda — datamatics

Computational Minimalism

Uses pure numeric datasets (like DNA or mathematical constants) to create high-density audio-visual experiences.

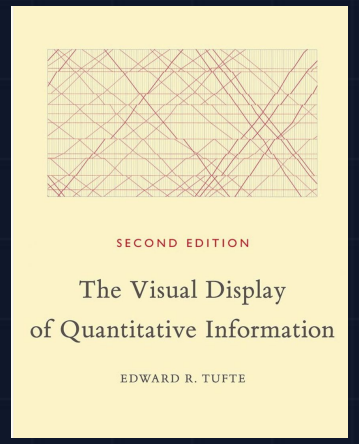
- **Precision:** Extreme flicker and strobe.
- **Scale:** Overwhelming sensory experience.
- Pushes human perception to its limits.
- **The Sublime:** Evokes the mathematical sublime through sheer data magnitude.





Theory & References (Books)

- **Edward Tufte** — *The Visual Display of Quantitative Information*
- **Stephen Wilson** — *Information Arts*
- **Lev Manovich** — *The Language of New Media*
- **Edward Shanken** — *Art & Electronic Media*
- **Bloomsbury** — *Digital Handbook of Media Art*



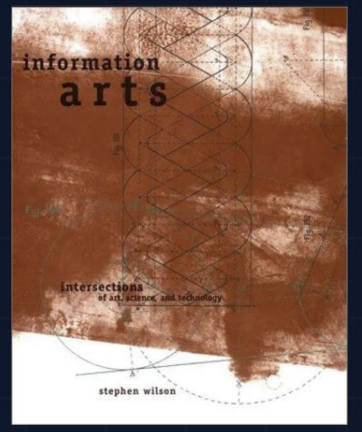


Image & Artwork References

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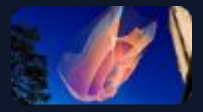

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Source: www.echelman.com

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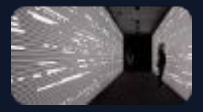
Source: www.aaronkoblin.com



https://www.ryojiikeda.com/data/work/datapath2.jpg

Source: www.ryojiikeda.com

Key Insights

Hidden Order

Visualization acts as a lens, revealing hidden order in apparent chaos. Otherwise, we could have never observed.

Resonance

Rare events can be materialized to create large-scale systemic resonance.

Perception

Data fundamentally influences and alters our perception of time and space. Even though artists make the decision to design the visualization, the data influences how the work ends most of the times.

Expression

Artists are crucial in expanding what data can be. It is analytical and expressive.