SystemViz codex

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DESIGN + VISUAL THINKING

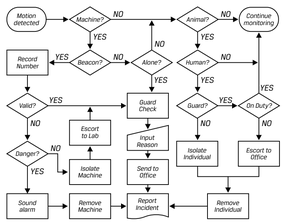
SYSTEM VIZ

V. 0.5-B BY PETER STOYKO

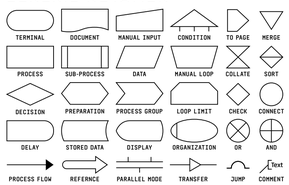
VISUALIZATION**TYPES**

01 FLOW

LINKS BETWEEN OBJECTS SHOWING CAUSAL DIRECTION, MOVEMENT, OR SEQUENCE

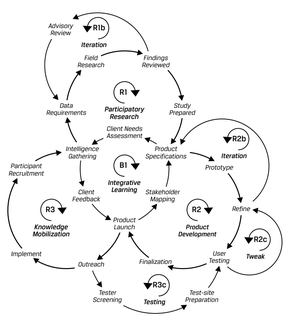


GENERIC NOTATION

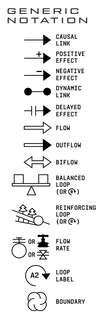


02 LOOP

STOCKS, FLOWS, AND SYSTEM DYNAMICS ARE MAPPED AS LOOPS

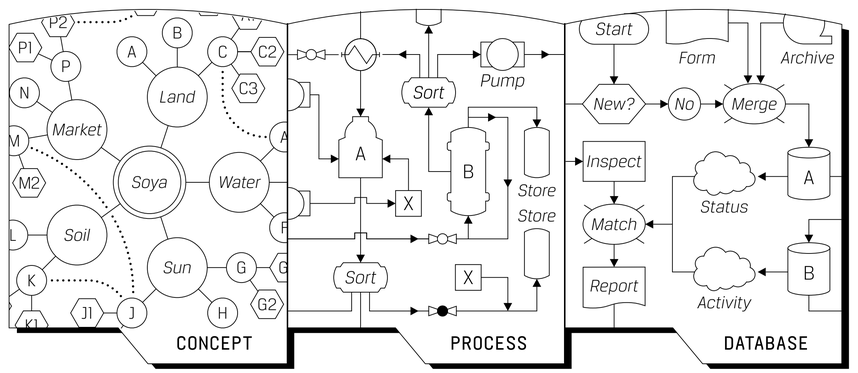


GENERIC NOTATION



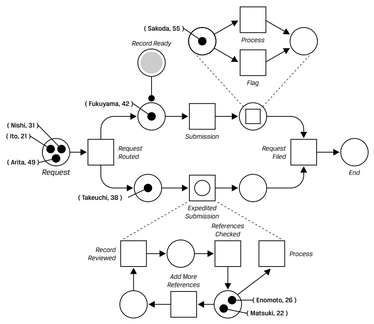
03 ARRANGE

NODES AND LINKS ARE ARRANGED AND CATEGORIZED WITH VARIOUS SPATIAL ARRANGEMENTS

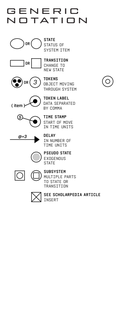


05 TRANSITION

PETRI NETS AND OTHER MATHEMATICAL GRAPHIC NOTATIONS SHOW SYSTEM PHASES WITH PRECISION

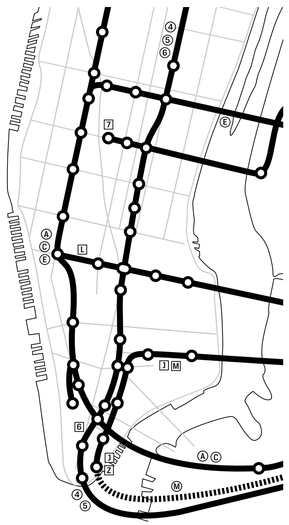


GENERIC NOTATION

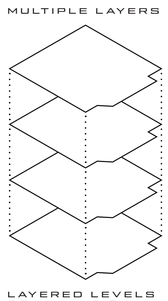


06 SITUATE

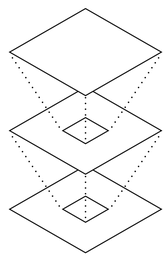
SYSTEM DIAGRAMS ARE LAYERED OVER MAPS OF PHYSICAL SPACE AND OTHER DIAGRAMS



MULTIPLE LAYERS

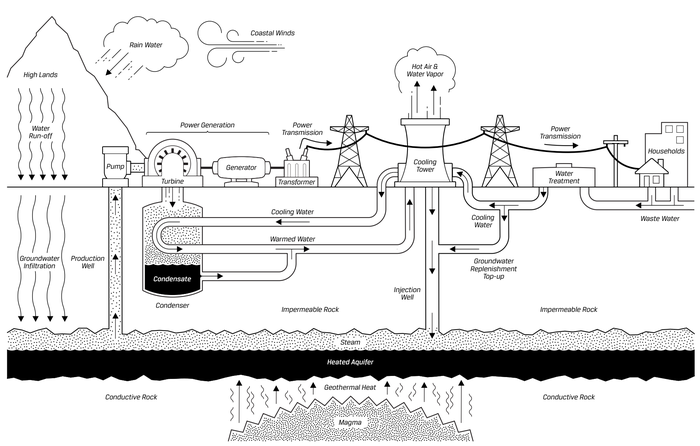


LAYERED LEVELS OF ANALYSIS



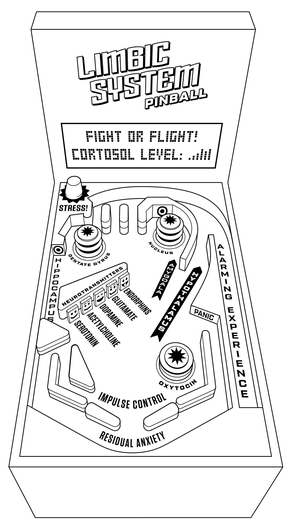
07 EXPLAIN

ILLUSTRATED DIAGRAMS SHOWS HOW A SYSTEM WORKS BY MIMICKING REAL-WORLD APPEARANCE



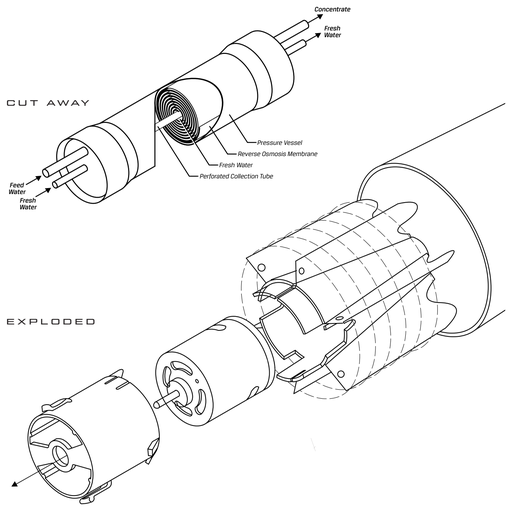
08 LIKEN

VISUAL ANALOGIES COMPARE SYSTEMS TO OTHER SYSTEMS THROUGH BLENDING



09 EXPOSE

PART AND WHOLE RELATIONSHIPS OF SYSTEM ARE SHOWN REALISTICALLY THROUGH CUT-AWAY AND EXPLODED VIEWS



VISUALIZATION**HURDLES**

NO-NAME CONNECTIONS // FIX //
Unspecified links between items make relations and dynamics ambiguous, often suggesting analytical evasion.
Link labels, badges, symbolic ends, or encodings (e.g. color coding) indicate nature of link.

SPAGHETTI TANGLE // PARTIAL FIX //
Unmanageable links between objects makes it difficult to distinguish relationships.
Prioritize and differentiate lines. Use layering techniques. Add visual affordances to guide the eye.

STATE EXPLOSION // TRADE-OFF //
Unmanageable numbers of diagram nodes, especially for number of potential states in Petri nets.
Increase level of abstraction at the cost of precision. Use different levels of analysis for crucial details.

EVERYTHING CONNECTED // FIX //
The temptation to connect everything to everything else because, at some level, a relation can be imagined.
Rank and differentiate relationships according to well articulated analytical priorities.

FALSE EQUIVALENCE // FIX //
Failure to sufficiently differentiate linkages creates mistaken impression of equal importance.
Differentiate lines in ways that convey magnitude and qualitative differences. Add text labels and numerical weights.

NOTATION OVERLOAD // PARTIAL FIX //
Number of symbols and distinctions exceeds viewer's ability to differentiate and juggle in working memory.
Reduce number of encodings, especially for minor distinctions. Do not rely on legends.

PERCEPTUAL SIMILARITY // FIX //
Basic shapes used in diagram are not sufficiently differentiated so that important distinctions are overlooked.
Use shapes (and other encodings, such as color and text style) with higher levels of contrast.

ETHNOCENTRIC SYMBOLISM // PARTIAL FIX //
Symbolic visual objects (such as icons) carry cultural meanings that are not universally understood.
Research cultural background of symbols. Use symbols recognizable across cultures.

SUBJECT MISMATCH // FIX //
Diagram method is poor fit to the nature of the subject matter because of mismatched theory of use.
Use more suitable method. Abandon highly standardized notation for more bespoke graphics.

NEGLECTED**CONCEPTS?**

THE FOLLOWING ARE SOME EXAMPLES OF SYSTEM CONCEPTS THAT ARE BEING COLLECTED AS PART OF THE PROJECT TO SEE IF EXISTING VISUALIZATION METHODS CAN ADEQUATELY REPRESENT THEM. CURRENTLY, THE DATABASE HAS APPROXIMATELY A HUNDRED ITEMS GATHERED FROM ACROSS NATURAL AND SOCIAL SCIENTIFIC DISCIPLINES.

Forces

KLUDGE
A make-shift work-around to cope with an immediate problem, adding variation (often complexity) to system; source of "jagaad" innovation.

ENABLER
A factor that gives another factor a boost, either as a necessary ingredient or as a contributing one.

FRICTION
A factor that impedes another factor directly to blunt, delay, or skew.

PROXIMATE DRIVER
A variable that directly causes another variable to change; that is, an immediate cause.

ATTRACTOR
An element that draws others towards it or distorts its trajectory through an attractive force.

REPELLER
An element that pushes others away or distorts its trajectory through repelling force.

SIDE EFFECTS
Externalities or unanticipated consequences caused by a force or dynamic between two objects.

DISTAL DRIVER
A background cause observable at a high level of analysis ("bigger picture"); a diffuse factor acting on more obvious factors in a causal chain.

Boundaries

CONTAINER
A boundary that groups items discretely by separating them from others

SEPARATOR
A boundary that separates or differentiates two groups or areas

SEMI-PERMEABLE
A boundary that blocks certain factors but not others depending on their qualities

BOTTLENECK
A boundary that limits the throughput of forces through an area or process

An obstacle that prevents a variable from running its course by affecting other variables in a causal chain

PROTECTOR
A blocker that preserves the state of a variable from some or all outside influences

Relations

PARASITE
An outside agent that derives benefit from an host or system while imposing costs

COMPATIBILITIES
Aspects of a system that are able to interact functionally or to mutual benefit because of compatible design features

Domains

Factor that has to be present for one thing to cause another to change, perhaps part of the environment

DIVERSITY WITHIN
The amount and quality of variation found within a single category of object

DIVERSITY BETWEEN
The variation between different categories of object

Signals

PERSPECTIVE
How the system changes depending on the vantage point or qualities of the viewer.

SENSING
Parts of the system that receive signals from the external environment or elsewhere in the system.

INPUT/OUTPUT
Parts of the system that take in or expel factors from the outside.

01

TAKING STOCK OF VISUAL METHODS. The first challenge is that there are many ways to display systems visually. Diagram formats and notations have proliferated. Some correspond to particular disciplines or tasks. Each has innumerable minor variations. It is worth taking stock of these "visual vocabularies" because the choice of visualization method skews the way systems are understood. Different methods emphasize different things and removes certain details from the picture: all are, by definition, a form of reductionism; all contain implicit assumptions about what a system is and how it behaves. For example, one method may depict systems as stocks and flows, another may depict them as logical sequences; another as causes, effects, and two-way dynamics; another as signals and boundaries. These differences depend on the underlying theory in use, but also the unthinking tendency to adopt a visualization method out of convenience or habit. The result is a paradox: without visuals to help model systems, understanding is limited; visual conventions frame the way systems are understood, which can undermine understanding. Thus, the first task of this project is to provide an inventory of the various visualization methods by grouping them according to their main points of differentiation. This is a first approximation. The aim is to solicit feedback about this way of organizing visuals and determining if there are major errors of omission. The aim is also to have a discussion of the biases and blind spots of the respective methods.

02

IDENTIFYING MISSING CONCEPTS. There are many systems concepts that are applicable across practical and academic disciplines. The overall literature is wide and deep. Some concepts are wide recognized; others less so, partly because of a lack of trans-disciplinary engagement. That presents an opportunity for visuals to act as an interdisciplinary *lingua franca*. That also raises some important questions: What systems concepts are not easily depicted using conventional methods of visualization? Identifying these concepts is the second aim of the project. The hope is to start a conversation about visualization methods that might fill these glaring omissions.

03

EXPLORING VISUALIZATION CHALLENGES. Creating an inventory is an opportunity to reflect on recurring problems and trade-offs. That is the third task of the project. The goal is to provoke a discussion about ways of overcoming these difficulties. A few lessons from the discipline of information design provide partial guidance. The ultimate goal is to turn these stock-taking exercises and "guide posts" and turn them into a design and teaching tool (a "codex") in an appealing and accessible form. This post is an early step in that direction. Inspiration is drawn from David Garcia's *Manual of Architectural Possibilities* series of road-map-like foldable posters. Interactive, screen-based versions may also emerge. If the project yields some interesting techniques, the goal is to make those openly available to members of the larger community interested in systems thinking.

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