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Untitled (Niemandsland), *by Dirk Skreber, whose work is on view this month at Museum Franz Gertsch, in Burgdorf, Switzerland.*

Improving Open Information Capture and Delivery Services
Connecting the Real World with the Digital World at Critical Points

White Paper for the NIST National Institute of Standards and Technology TIP Technology Innovation Program Areas of Critical National Need

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What a mess this country is in during the time period this white paper was written – September 30 to October 30, 2008 - after the economic crisis, before the election. True innovation is not always necessary, but it is today for a number of reasons beyond the scope of this paper.

There is an urgent need to improve open information capture and delivery services. The first step is getting the real world and representations in the digital world to stay connected at critical points. Highlighted NIST National Institute of Standards and Technology programs and publications include: An Assessment of the United States Measurement System: Addressing Measurement Barriers to Accelerate Innovation [1]; the NSRDS National Standard Reference Data Series [2]; the SPEA Strategic Planning and Economic Analysis Group [3]; the Global Standards and Information Group [4]; the NISTIRS Computer Security Division Interagency

Reports [5]; the MSID Manufacturing Systems Integration Division, MEL Manufacturing Engineering Laboratory Publication NISTIR 7310 Evaluating Reasoning Systems [6]; the Time and Frequency Division Special Publication 432, 2002 [7] and numerous other high quality efforts already underway by Federal agencies, State and Local governments, the private sector, standards development organizations, and creative individuals across the country.

The graph below presents a contextual framework to establish alignments between needs and actions. For a global perspective, compare current standards and technology to any one of humanity's grand challenges listed in the United Nations Millennium Project Task Force Findings [8] in the middle left column. 10 examples are Hunger, Education, Economics, Disease, Medicine, Clean Drinking Water, Poverty, Population, Sustainability, and Fair Trade. Here at home, areas of critical national need include: Sustainable Energy, Health Care, Infrastructure, Education strategies for producing the next generation of innovators, Democracy, Conflict, Emergency Response, Poverty in America, Population and Affordable Housing, Trade and Global Competition. Then, there are the people who do these jobs in an approximate horizontal alignment on the right, and 3 future forecast technologies on the left. Straight lines are arbitrarily drawn to relate areas of critical need with each other and future technologies.

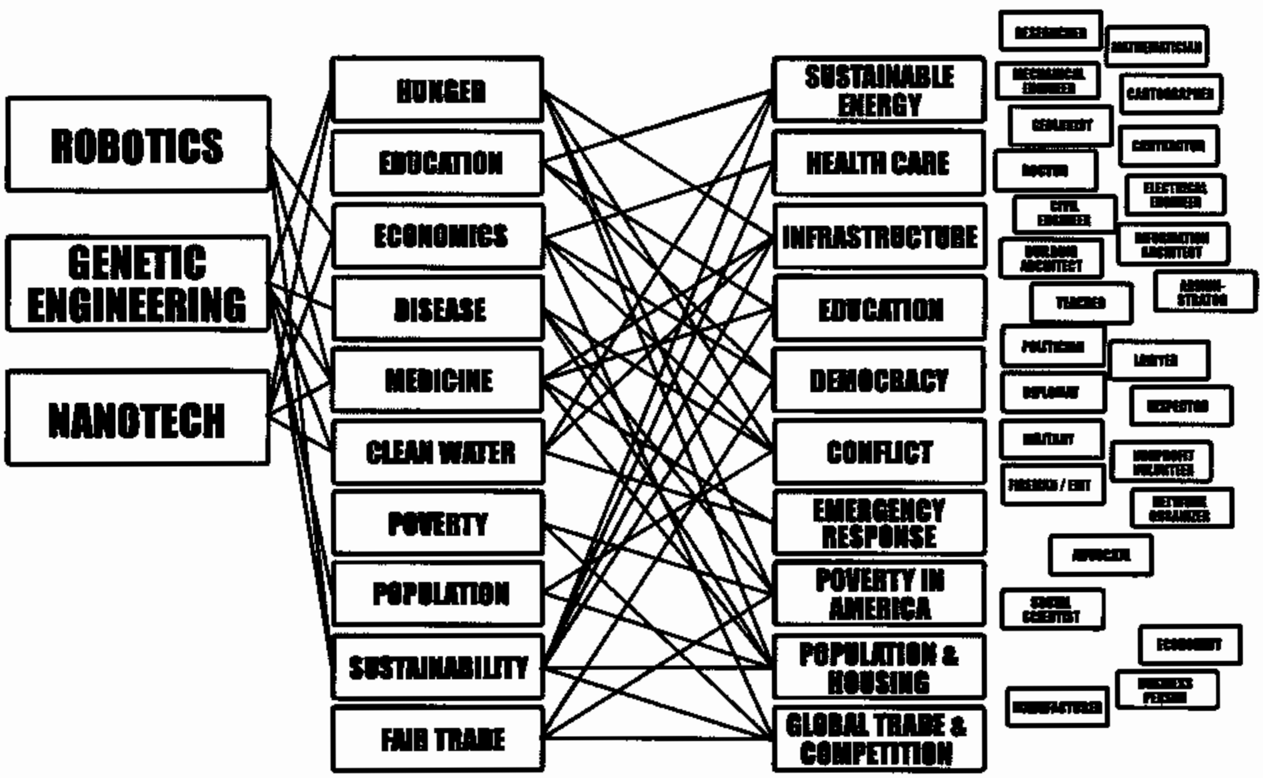

Figure 1: Needs Graph

The relationships, top needs, jobs listed, and future technologies require complex studies to be accurate, suggestions to improve accuracy are included where possible. BLIS the Bureau of Labor Statistics should be consulted to properly identify the names of these occupations and gather statistics on the actual number of people working in these jobs.

It can be difficult to imagine how innovative technologies can actually benefit ancient, potentially un-winnable battles like hunger and poverty. One way to boil modern circumstances down to one new problem was recently stated by John Sowa on ontolog-forum [9] where he argues "we need formal definitions to support long chains of reasoning in computer systems". Innovative technologies, areas of critical need, and the jobs to do this work on the ground do require long chains of exchange and reasoning to achieve innovation and see what is working.

The right way to make this framework real would be to bring together representatives from each of the impacted industries and critical needs experts to hammer out a consensus on the top 10 global and national needs, top 3 future technologies, and top 25 to 30 relevant jobs to create a framework everyone can live with for 5 years. Then have a word freeze so this structure can serve as a basis for complex analysis and creativity to collide and generate ideas. This limited set of words should be translated into all languages used in the real and digital world. The framework should be continuously examined and discussed to be officially revised and reissued in 5 or 10 year cycles. Ideally, some areas of critical need will be downgraded over time, partially solved but inevitably replaced with new priorities. If a TPIP innovation objective could be the ability to reason with unprecedented, enormous quantities of ideas and information at the largest scales imaginable ~ where should the people working in these jobs deliver and publish open information to support long chains of reasoning beyond their area of expertise?

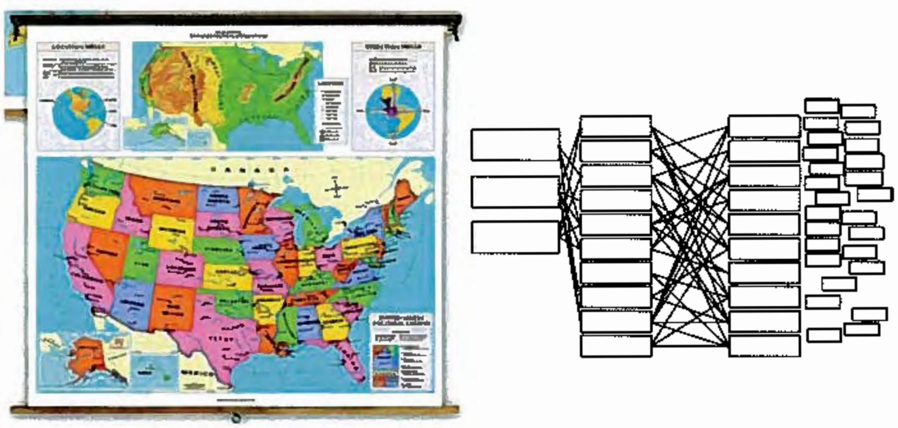

Figure 2: USA Discovery Map Manufactured by Cram / Blank Framework

Knowing Where We Are

To generate actionable ideas, it is time to look hard at the science, engineering and technology that has fueled US prosperity since World War II to decide where innovation is actually needed versus areas where most of the functional parts are already working. Then, a concerted effort to facilitate near term achievable results such as sustainable affordable housing and all the jobs that creates to build these places, and the data capture opportunities this presents to understand more about energy and buildings ~ or any other kind of critical need problem to be solved through innovations in standards and technology. The health care scenario includes buildings like hospitals and clinics with large scale, high-risk, high-reward research and development.

To lay out the strategic terrain for connecting the real and digital world (before critical points can be identified) it is easier to begin in the real world where the territory is more familiar. Such a task requires an acknowledgement that, in cartography at least, the real world is mathematically indescribable due to continual change. By contrast, the digital world is what we make it.

The primary objective of this proposal is accurately mapping our nation and the world in complimentary, tied together physical and digital forms to make it more obvious which maps and data structures to use based what each user or research group is looking for. Accomplishing this will let the focus shift to places, more detailed maps, buildings and computer systems where critical information is generated, interpreted, and measured. The remainder of this paper details and links together secondary objectives that can be accomplished using Building Information Modeling [10], Ontological Engineering [11], and Spatial Location [12]. The tolerances and performance requirements for precision versus generalization vary greatly.

For example, note the discrepancies in longitude and latitude where this paper was mailed: 100 Bureau Drive Gaithersburg, MD 20899-4701. The differences are insignificant for the post office and this message hopefully has been received at the intended place, but what about location issues that need to be more precise?

from google	latitude	longitude
decimal	39.144601	-77.216255
deg-min-sec	39° 8' 40.5636"	-77° 12' 58.518"

from geocoder	latitude	longitude
decimal	39.144336	-77.216461
deg-min-sec	39° 8' 39.6096"	-77° 12' 59.2596"

from yahoo	latitude	longitude
decimal	39.144336	-77.216461
deg-min-sec	39° 8' 39.6096"	-77° 12' 59.2596"

from terraserver	latitude	longitude
decimal	39.14431000	-77.21651000
deg-min-sec	39° 8' 39.516"	-77° 12' 59.436"

from ibegin	latitude	longitude
decimal	39.144336	-77.216461
deg-min-sec	39° 8' 39.6096"	-77° 12' 59.2596"

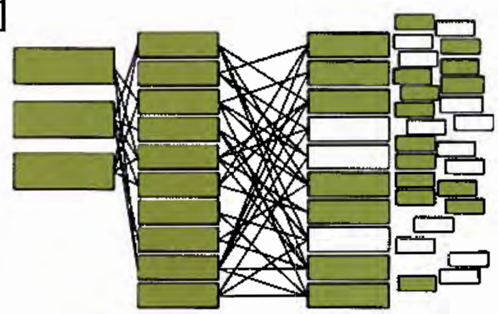

Figure 3: Converting Addresses to/from Latitude/Longitude in One Step, Stephen P. Morse [13]

Significant common addressing issues are holding up progress. Address types are not limited to: GIS based vs census tracks vs city codes vs mailing codes vs community codes. Emergency responders can suffer from unnecessary delays and confusion when the community code does not match the response city. An imperative innovation is the ability of shared databases and repositories to accommodate all forms of address in use at a given place or point in time.

Next, after a place is registered, there are issues of location representation, common reference points, quality assurance procedures and exchange protocols. A tremendous challenge is consistent specification of open information exchange about buildings and regions over extended lifecycles. Refer to the AECOO Architect Engineering Contracting Owner Operator Testbed at OGC Open Geospatial Consortium [14] for an excellent work in progress. To quickly recognize building types, OmniClass Table 11 [15] could be used to standardize GIS Global Information Systems Symbology [16]. Refer to the Building Service Performance Project [17] for more information. The emergency response community, and those they serve, would realize the earliest benefits from this innovation.

To establish a reliable reference point on buildings, architects could deliver technology neutral keyplans, a simple outline of the building footprint, with a north arrow on every drawing, model or sketch. Add to that, the emergency response community may be starting to prefer using the North East corner to quickly assess the relative location and basic structure of any building. If so, the simplest way to proceed is to assign a common reference point for all buildings at the North Pole, then periodically radiate down East longitudes until an intersection hits the designated corner of any building in any location. Accomplishing this goal is comprised of the following steps: Convene a team of experts in direction and architecture to properly define this problem; bring together an ad-hoc industry consortia to get initial rules into software; start using; propose as OGC and NBIMS National Building Information Modeling [18] Standards; facilitate adoption by the 44,000 AHJ Authorities Having Jurisdiction across the country. Geographers and the map users they serve could benefit the most from this innovation.

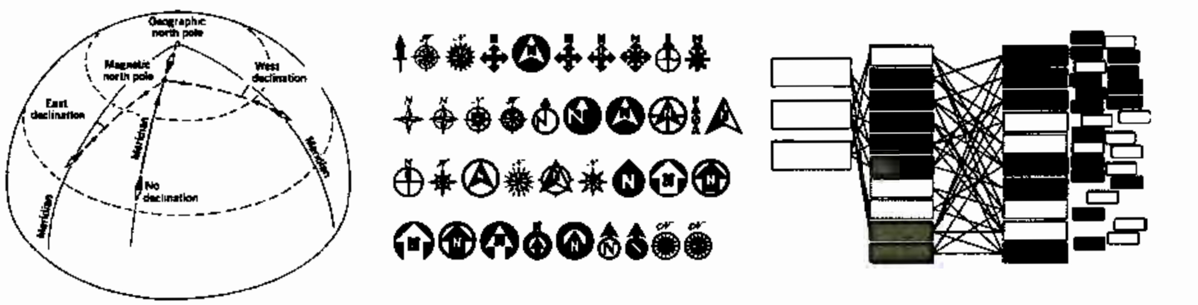

Figure 4: Magnetic Declination, A.N. Strahler [19] North Arrow Assortment, Gerald Gallo [20]

Once the subject is a particular building, some day there will be building information models and geographic information about most buildings and regions. OSCRE the Open Standards Consortium for Real Estate [21] is getting very clear and precise about space definition rules. The digital world needs complementary semantic space definition rules and compliance procedures. Until then, there is need for rapid prototyping and simulation of space where there are no drawings or maps, or it is likely the records that exist are incomplete, incorrect, or out of date. A useful innovation would be to use sensors, mathematics and spatial imagery to measure and establish overall dimensions. For example on buildings, typical window distances or curtainwall mullion placement also indicate typical floor to floor distances.

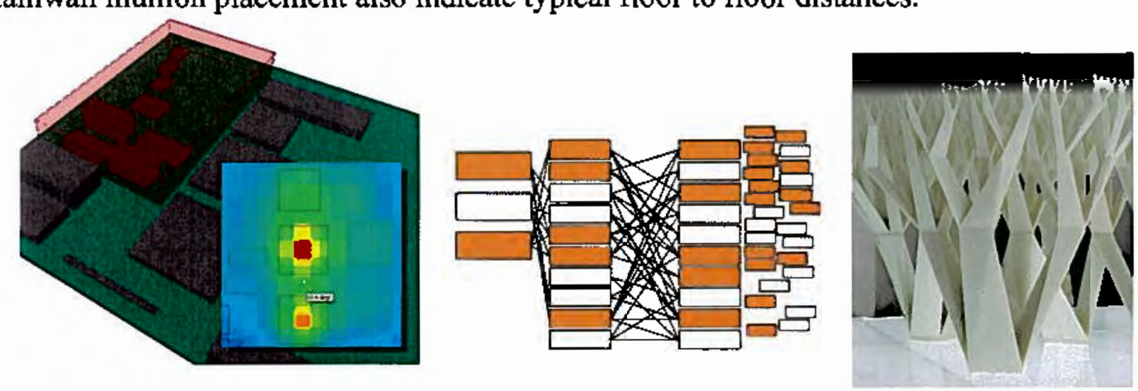

Figure 5: FLO/PCB v4.1 by Flometrics [22] Fractal Table Wertel Oberfell, Matthias Bär [23]

When the US provides a building as part of a reconstruction or humanitarian effort, we should firmly insist these projects meet a minimal set of performance requirements in the physical and digital world. Use local materials and teach the people who live there how to build repeatable designs for example "school", "fire station", "museum". Start by talking with public and private organizations dedicating resources to the rapid deployment of BIM Building Information Modeling and GIS Geographic Information Systems. For example, Onuma Planning System, refer to the BIMstorm series of exercises [24] for top notch examples. Design, build and actually deliver these places in the real world, make a BIM of each of them, use GIS to show where they are located, then monitor these points around the globe to study the impact of global warming.

Each building would start out like proverbial matching salt shakers on cafeteria tables, but their location and use of local materials would make each one unique as soon as constructed. There is no need to monitor the activities of the occupants, only the performance of the HVAC system, materials, indoor air quality, and water purity – as these relate to areas of critical need.

For open information capture and delivery services coming from buildings all over the world, there is an underlying need to come to terms with strong brands and proprietary names versus generic interoperable descriptions. Ideal interoperability should be geared towards security, support of economic activity, law enforcement, search and rescue, environmental protection, and the support of and conduct of science – a position set forth by the Polar Research Board and collaborators in Polar Icebreaker Roles and U.S. Future Needs: A Preliminary Assessment [25].

There are so many smart and creative people in the United States. To envision these innovations the fastest track could be to get people from the movie and gaming industries to simulate the simulations before they actually need to work.

Maps to Administration Guidance

A multi-level walkthough is below:

At the city level, more quantitative research is needed to keep tabs on growing needs before they reach critical mass. Refer to ERIC Education Resource Information Center in Critical Needs, Critical Choices: A Survey on Children and Families in America's Cities. A Research Report of the National League of Cities [26]. The report cites child care as the top concern, with family stability, before- and after-school programs, and housing affordability listed as pressing needs. Areas of community safety, recreation, neighborhood revitalization, delinquency/youth crime, housing affordability, gangs, and drug and alcohol abuse are classified as main concerns. Housing affordability IS listed twice, it is a persistent need across all levels.

At the state level, empower the states to depict and monitor their regulations. State regulations such as building codes vary significantly from California, setting the standards for performance and sustainability, to Texas that prefers to be "code free" to the point the city of Houston does not have a zoning department. Whatever manner an AHJ functions, there is still a need to be coordinated with the states and addressing systems in use.

At the national education level, the National Science Foundation has produced a National Action Plan for Addressing the Critical Needs of the U.S. Science, Technology, Engineering, and Mathematics Education System [27]. The objective is to create a road map to improve STEM

Science, Technology, Engineering, and Mathematics Education pre-kindergarten to college and beyond. Components include providing horizontal coordination of education among states and promoting vertical alignment of education across grade levels. What does this look like? Can other education initiatives adopt it? What features are required for this knowledge transfer space to function optimally to produce a numerate, scientifically literate society?

At the level of scientific publications, refer to the maps of science in the exhibit Places & Spaces [28] curated by Katy Borner at Indiana University. Click around on mapofscience.com by Kevin Boyack at Sandia National Laboratory and Richard Klavans at SciTech Strategies [29]. Another favorite is the Taxonomy Validation Tool by Katy Borner, W. Bradford Paley, et al. In large scale data exchange, weak taxonomies are weak links in the chain, impacting everyone.

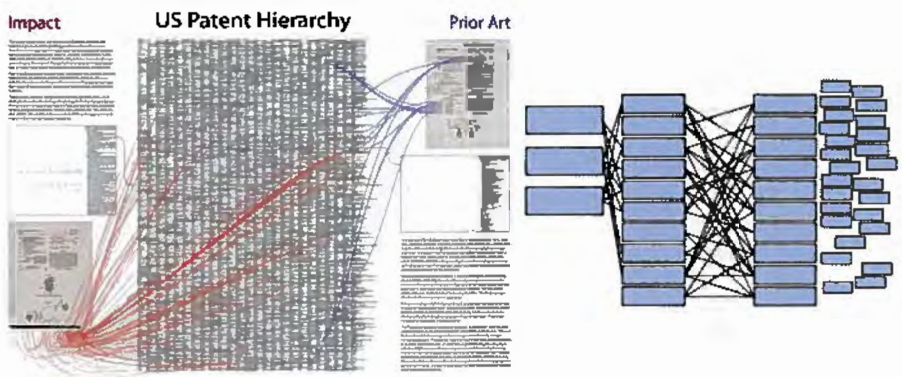

Figure 6: Taxonomy Visualization of Patent Data by Katy Börner, Elisha Hardy, Bruce Herr, Todd Holloway, Bradford Paley, 2006 [30].

At the level of comparing ourselves with Europe, refer to MACE Metadata Architectural Contents of Europe [31] particularly the Visual Project Browser and Architectural Knowledge Browser. It would be beneficial to understand the exchange requirements of impromptu collaborations between active professional member organizations like AIA American Institutes of Architects and private enterprises like Google Earth [32] to feed these collaborations clean high quality data for interpretation. Combine that with the Smithsonian's congressional mandate to interconnect the databases of separate museums including 143.7 million historic, artistic, and scientific treasures. These treasures along with innovations in open architecture can be used to tell the American story in rich, searchable interactive form to eventually join forces with interesting work in sustainable practices and interoperability well ahead of us in Europe.

At the open standards level, a super innovation challenge is how to maximize open source technology and linked open data. Numerous participants around the world are already using XML [33] as serialization format to talk to each other, work together and exchange structured data. XML is also fundamental to the structured exchange of interoperable building and geospatial data. OASIS the Organization for the Advancement of Structured Information Standards [34] is an excellent example of a consensus based, technical standards development body working to speed the pace of innovation the right way. OWL the Web Ontology Language [35] the next logical step for open building data. Maybe UMBEL Upper Mapping and Binding Exchange Layer [36] can be used to help potential collaborators orient and connect work coming from all over the map.

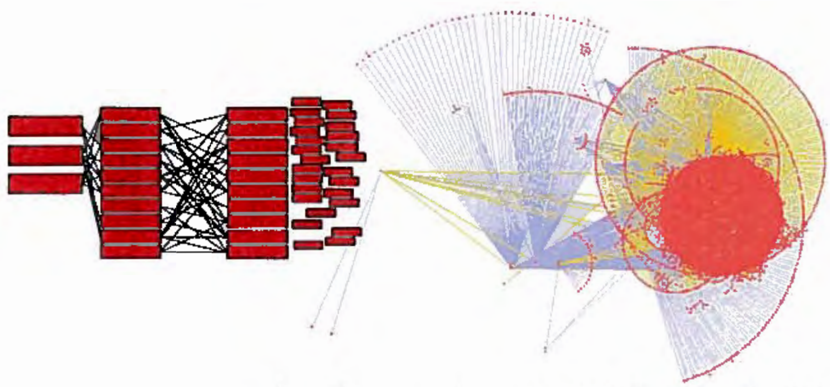

Figure 7: Large scale UMBEL graph with approximately 20,000 nodes, by Mike Bergman [37]

Justifies Government Attention

It is a Federal role to foster better management and communication between the states and 44,000 AHJ. Conditions are different whether this means snow loads in Maine vs hurricane preparedness in Florida; or local laws governing the requirements to pay attention to local rules.

Essentials for TIP Funding

Hire full time research assistant(s) for Susan Turnbull at GSA Office of Intergovernmental Solutions for the Expedition Workshop series [38].

Establish an Open Information Capture and Delivery Services Innovation Program with $1,000, $10,000, and $100,000 grants to provide capacity support, equipment, and software to non-profit organizations to implement designs, provide on the ground feedback, and tie into large networks.

Fund the mapping of science led by Katy Borner at Indiana University, Kevin Boyack at Sandia National Lab, and Richard Klavans at SciTech Strategies Inc to measure and depict the structure of science. Extend to all university cyberinfrastructure sites, national laboratories, and qualified small organizations. Connect these efforts with the STEM program to constrain the horizontal and vertical dimensions to be able to run along them in a consistent manner. Work with the GPO Government Printing Office and ET.gov [39] to get these maps into classrooms.

Contract Rex Brooks at Starbourne Communications [40] to spearhead the open design and implementation of the emergency response space in collaboration with the IRSC Integrated Response Services Consortium [41], open ontology community [42], and OASIS.

Team with Canada and Norway to boost funding for the US and Canadian CSI Construction Specification Institutes to develop the IFD International Framework for Dictionaries [43]. Increase funding for NIBS the National Institute of Building Sciences [44] focusing on standardization of the building industry and related industries including industrial and process plants, geospatial mapping and data processing, real estate commerce, and building automation. Actively support bSa the buildingSMART alliance projects, innovations that have already been accomplished, and most especially the bridges they are building between the government and private sector around the country, and standards organizations around the world [45]. Support organizations developing long chains of reasoning, for example OpenCyc [46].

Where the digital world meets the real world, if all the previous graphs could be transparent and combined, an overlay of their colors would result in some kind of brown. Areas that need more attention would be lighter because their box is not always filled in. This graph is wrong on purpose. It illustrates the perils of making decisions too early, this graph was put together on the first round, and not updated. Mistakes and changes are an inevitable part of the design process with a tendency to hang around too long.

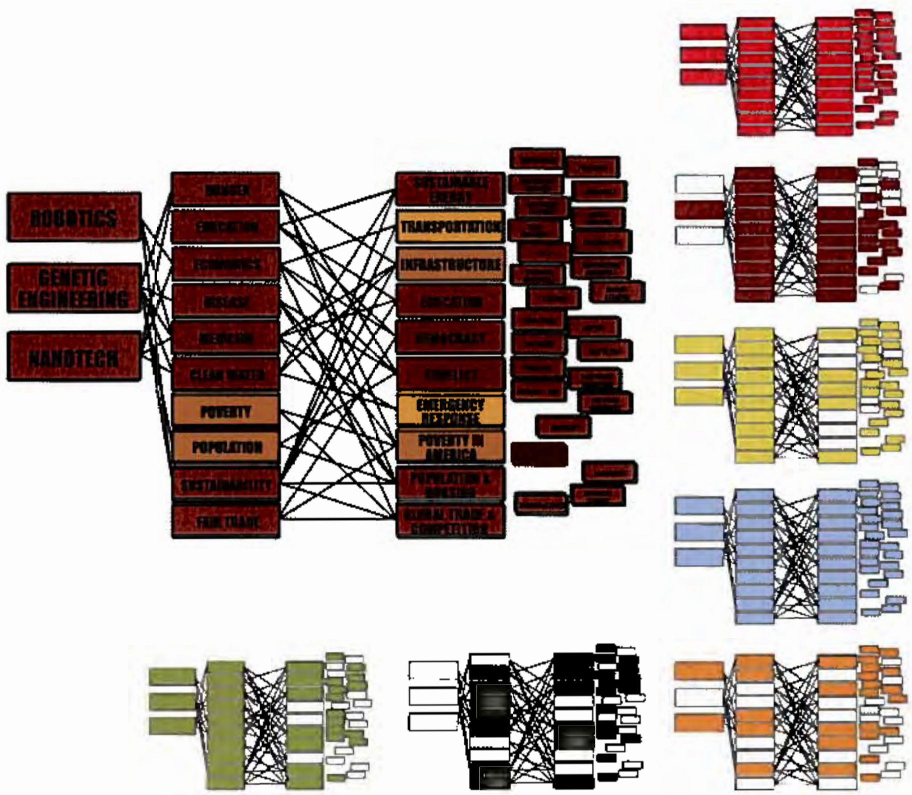

Figure 9: Combined Graphs

The Research (Technology or Technologies) to be Developed

Net-zero energy technologies, new construction techniques, scientific and technical means to reduce water use, building materials to minimize waste, technologies and practices to promote health, comfort, and productivity, high-performance design tools and guides for planners, architects, contractors, and others [47]; BACnet Building Automation and Control Networks; BIM Building Information Modeling; GIS Geographic Information Systems; IAI International Alliance for Interoperability; IFC Industry Foundation Classes; IFD International Framework for Dictionaries; NBIMS National Building Information Modeling Standard; OASIS CAP Common Alerting Protocol 1.1 Standard, EDXL Emergency Data Exchange Language, OBIX Open Building Information Exchange; OGC Open Geospatial Consortium; OWL Web Ontology Language; Modeling, Simulation and Analysis; Scanners and Sensors; Signal Processing; Sustainable Design Monitoring and Data Capture; WYSIWYG What You See Is What You Get.

Path to Achieving Goals

Keep working. Treat these the same: Concept = Room, Occupancy = Demand, Building = Subject, Zoning = Compliance, City = Subject Matter Experts, County = Discipline, State = Area of Expertise, National = Domain, International = WWW, Universe = Uncharted. The aim is to execute a 5 year project which is an integral part of a proprietary invention to start drawing the geometry of knowledge changing over time.

Keywords
Sustainable, Energy, Compliance, Open Architecture, Exchange Rules, Semantic Web, Ontology

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