New Value Chains and Technical Issues for Future Data Eco-Society

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Value Chains of Data Eco-Society
Geographical Data
Data of Intelligent Transport System

(ref) https://smartercitieschallenge.wordpress.com/category/lagos-nigeria/
Overview of Smart Grid
Data of Smart Grid
Data Business for Smart Grid
## Data Types for Smart Grid

### Energy
- Charging
- Energy Management Systems
- Energy Monitoring
- Energy Generation
- Energy Efficiency
- Energy Business Model
- Grid Solutions
- Energy Storage & Batteries

### Transportation
- Navigation
- Travel
- Tourism
- Traffic
- Parking
- Intra-City & Intercity Trip Planning

### Logistics
- Shipping & Tracking
- End-to-End Tracking
- Urban Fulfilment Hubs
- Logistics & Delivery
- Fleet Management

### Sharing
- Public Data
- Taxi & Limousine
- Sharing Economy
- Ridesharing & Carpooling

### Information
- Telematics
- Customer Interaction
- Portals, Marketplaces & Social Networks
- Smart Maintenance
- Artificial Intelligence
- Big Data & IoT
- Security & Driver Assistance

### Vehicles
- Smart Vehicles & E-Mobility
- Smart Construction Vehicles
- Drones
- Internet of Vehicles
- Autonomous Vehicles
- Future Transport Systems
- Aerospace Vehicles
Telematics Data
Data Types of Healthcare
Medical Data Visualization
What is the Language of Cyber World?

<table>
<thead>
<tr>
<th>Cyber Language</th>
<th>Physical Language</th>
<th>Natural Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>Language for Semantic Knowledge</td>
<td>Human Language</td>
<td>Human Language</td>
</tr>
<tr>
<td>Language for Platform</td>
<td>Language for Building,</td>
<td>Language for Monkey</td>
</tr>
<tr>
<td></td>
<td>Road, Station, Airport, Hospital</td>
<td></td>
</tr>
<tr>
<td>Language for System and Application</td>
<td>Language for TV, Car, and Airplane</td>
<td>Language for Dolphin, Dog, Pig,</td>
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<td></td>
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<td>Elephant</td>
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<tr>
<td>Operating System (OS)</td>
<td>Language for Hardware and software</td>
<td>Language for Mouse, Chicken,</td>
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<tr>
<td>Machine Language (e.g., device driver)</td>
<td></td>
<td>Bird</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Language for Bee, Ant, Insect</td>
</tr>
</tbody>
</table>
Value of Data - 1

Raising the value of data
Value of Data - 2

http://www.slideshare.net/ishahrour/
conference-of-isam-shahrour-smart-city-for-energy-transition-precop22

New Services
- Education
- Health
- Culture
- Tourism
- Mobility
Value of Data - 3

Translating Data Into Insights

Data

Compare

Information

Context

Meaning

Connotation

Insight

Decision = Data + Rules

“Big Data”

Data Science

17
Big Data and Analytics Process

http://jtonedm.com/2013/06/05/big-data-and-analytics-fueling-competitive-advantage/
Who is the Winner at Data Eco-society?

• Maximize data eco-environments or eco-domains
  – Maximize coverage and applications
  – Minimize conversion or interpretation overheads

• Win-Win approaches among stakeholders
  – Get synergy effects of all the stakeholders

• Get the values from collective intelligences
  – Find new values by knowledge accumulation of heterogeneous domains
Technical Issues for Data Technologies
Key Research Challenges for ICT

**Internet of Things**
(The ongoing convergence of evolution of devices)

**Computing Clouds**
(Deployment of large shared infrastructure)

**Big Data**
(Accumulation of data from sensors and social networks)
Data as a Service

http://www.thetechbulletin.com/promptcloud-big-data-crawlers-18384/
Data Analytics Eco-system


http://planetsystems.in/blog/preductive-analysis/
Data Intelligence

Business Level
- e.g. Smart City, Intelligent Manufacturing, M2M, CPS, Smart Appliances.

Application Level (+ domain specific)
- e.g. Dublin Core, FOAF, SSN and OpenIoT.

Semantic Level
- Existing vocabularies (e.g., NCI, SSN-XG)
- Relationships: closeMatch, exactMatch, broadMatch, narrowMatch, relatedMatch

Sensor Middleware Level
- owl:sameAs, rdf:seeAlso

Virtual Sensor Level
- e.g. X-GSN

Other knowledge base and ontologies
- e.g. DBPedia, Geonames

Physical Level (Device Standards)
- e.g. IPv6, 6Lowpan, IETF CoAP
Geospatial Data of OGC
Linked open Data (LoD) of Web

Application Layer

Data Access, Integration and Storage Layer

Web of Data

Publication Layer

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Approaches toward New Data Society

• Key Issues to realize New Data Society
  – How to utilize interactive power of computer and communications technology?

• General Approaches toward New Data Society
  – Behavior Cycle for future human life and business culture
  – Open Environments for Network, Software, and Device
  – New data format to create, deliver, and consume
  – Eco-systems between physical society and cyber society
  – Intelligent emerging devices including smart phone, smart TV, smart car, smart building, and smart things, etc.
Creating New Data World

• Need new data types for knowledge society
  – (Mapping) Data types connecting physical world to cyber world
    • Identification/classification, Location, Status, Role/Function, etc.
    • (Example) GPS, address, serial no. etc.
  – (Interpretation) Data types for human understanding, meaning, interpretation, and translation, perception, recognition based on accumulated knowledge, reasoning, learning, action, behaviors, and experience
    • (Example) Pythagorean Theorem, know-how of medical treatments, etc.
  – (Visualization) Data types for communication, sharing, visualization, rendering, expression of word, image, gesture, etc.
    • (Example) icon, logo, graphic image, character sets,
Data Types depending on Applications

• **Telecommunication and Broadcast Industry**
  – Telephony, SMS, AV/Multimedia stream, and AR/VR, etc.

• **Internet and Web Industry**
  – File, image, documents, and social media, etc.
  – Virtual/Object Data, and web of data

• **Location related Industry**
  – GPS, CPS, and physical 2D/3D geographic location
  – Transport and Logistics (Geolocation Map)

• **Identification related Industry**
  – Sensor/RFID code, product code, bar code, and blockchain, etc.
  – Trade, copyright, and ownership (Shipping code, product code, watermark, etc.)

• **Data Intensive or Contexts related Industry**
  – Big data analytics, Healthcare and medical applications
Requirements for Future Data Format

• (Basic) Recognize by human organ and their supporting utilities
  – Simple audio/sound, and visual image
  – Language including translation tools

• (Extended) Accumulation, Filtering, and Processing
  – Linked chains among related data or sensing data from IoT equipment
  – Accumulation by collective intelligence and crowdsourcing
  – Filtering based on experience, preference, and accumulated know-hows
  – Creation of new information and knowledge (like big data processing)

• (Applications) IoT Media, Energy Avatar, Traffic Guider
  – Context-aware information based on IoT sensors and AV devices
  – Navigation assistant (or Guider) for road and traffic conditions
  – Energy Avatar for analysis and prediction of energy consumption
Technical Issues for Data Platform

• Usage Behavior Analysis
  – Behaviors for Human Relationship (chat, discuss, share, etc.)
  – Behaviors for Entertainments (Game, TV, Drama, Film)
  – Behaviors for Works (collect, search, analyze, decide, etc.)
  – Behaviors for Life (Shopping, Education, Dining, etc.)

• Interaction Process between Human and ICT Environments

See, Hear → Decide

ICT Network & Computing

How to provide Interactive Power?
How to help?
Open Data Platform - 1

• (Metadata) Data could not stand alone without metadata or descriptors
  – Re-define Data and Metadata → Metadata is not only descriptive information of data
    • used for handling, sharing, and processing data

  – New data format including metadata is needed
    • Active Hyperlink or JavaScript at web → like computer virus
    • New Metadata is different from existing metadata standards
    • Recursive data format according to levels of perception and intelligence

(ref) http://aspiresquared.co.uk/
Open Data Platform - 2

• (Platform) new model for data processing including database
  – “Data + Processing + Storage” in harmony ➔ web-based common platform?
  – New version of web platform ➔ HTML5-based IoT/WoT world?
    • How to contain location, status, behaviors information that is not descriptive from existing web standards (such as text script/binary-based web)
    • Recursive data format to support complex and iterative algorithm or logics
    • New Markup language to adopt new UI/UX tools (e.g., 2D/3D drawing, gesture, expression, etc.)
  – Data platform for IoT/WoT application !
    • Web platform to reflect physical world (e.g., new organic sensors, etc.)
    • Semantics for experience/knowledge accumulation from IoT devices
  – How to build Cyber Physical System for future flexibility?
    • 3D virtual space, location, and depth/granularity/tier/level/attribute, etc.
Open Data Platform - 3

• (Next Generation Web) good for future open data world?
  – Common platform for data creation, delivery, share, and consumption
  – Keep Simple User Interface and allow billions of software/applications
    • Utilize existing wireline/wireless network, computing/software, and database
    • No download and no installation → Just access and use it!
  – Support flexible data platform for energy, transport, medical/health, education, and safety, etc.
    • Don’t steal data from owners and customers → good data governance!

• (Cloud) sharing data by using cloud platform
  – Performance, security, availability, and manageability of cloud platform are suitable for future data eco-society
  – Open ecosystem for data sharing and good data governance
Technical Issues of New Data Format

• HTML5-based UI/UX to help human perception
  – Device API, RESTful interface, Javascript, etc.
• Data and Metadata Together
  – Media object and media resource model
  – Media Ontology, Media Annotation
  – File Format, Microformat, ATOM/RSS
  – Device Data Format for Mashup
• Data format for Web-based open Platform
  – Open, Auto-configurable, and future flexible
  – But, Securable and manageable is in question?
Web-based IoT Data Format

• XML/RDF Schema
  – Well-known data format?
    • JSON, Microformat (e.g., vCard, hCalendar), ATOM/RSS
  – DTD syntax, schema, and semantics, etc.
    • Tag, Index, Summary, Thumbnail, Preview, etc.

• IoT Data Format for future life and business
  – Continue to URI/URL/URN-based?
  – Microservice, microdata for semantics
  – Mashup format for heterogeneous data applications
IoT Data Standards for Smart City
IoT Data Standardizations for Smart City

- IoT data cloud system for Smart City
- Real-time data analytics for Smart City
- IoT metadata for Smart City
  - Syntax, semantics, context-aware for unstructured IoT data
- Data security and trust for Smart City
- Data applications for Smart City (including visualization)
- Interoperability and Deployment scenarios for IoT-based Smart City
Thank you!
Appendices
Meanings of Data, Information, and Knowledge - 1

• (Value) “Data is King” or “Data is new Oil”
  – **New Value when data is processed and accumulated**
    • Added new value when combined with other data and different environments
    • Different meaning and understanding when the environments is changed
  – **Various form of data when it is created, shared, processed, and utilized**
    • Depending on applications (energy, transport, health, education, safety, etc.)
    • Supported by metadata and descriptor
    • Depending on activated conditions and environments
      – Vitalized with the related information and filtering conditions
    • May have self-proliferation phenomenon of biological cell at future
  – **But, Data is very “Dangerous” like Nuclear Power**
    • Imagine radioactive contaminated water
Meanings of Data, Information, and Knowledge - 2

• (DIKW) Value chains among Data, Information, and Knowledge
  – **Linked Structure** among data, information, and knowledge
  – How to make a **process** of data to get useful information
    • No meaning like “01100101100110…”
  – Tier-x data extracted from **intelligent filtering** process
    • Based on previous or background information, and statistics, etc.
  – **Decision making** by aggregating the related data
    • Depending on know-how, experience, and context-awareness

• (Environments) What environment for data is valuable
  – At **right** time, **right** place, and **right** condition
  – Location-, time-, and context-**awareness**: 5W1H rule!
(Human Perception) How to make a process from data acquisition to get knowledge?

- What percentage of data is perceived by human?
  - Could not monitor all the CCTV cameras during 24 hours/day
- What amounts of information are extracted from same image and sound?
  - Depending on his/her experience and intelligence level!
    (e.g., X-ray image, intonation of sound, smell, etc.)
- If new tools create, share, and utilize open data from IoT devices
  - Identify location and time
  - Recognize screen image and situation!

(ref) http://darmano.typepad.com/
Data Sciences for Knowledge Society - 2

- (Type/Format) Cyber physical space for Energy, Transport, Health, Environment, and Surveillance, etc.
  - Various **Standards** for 3D physical space!
    - 3D scalable geo-graphic, MPEG, OGC, Web3D, OpenGL, etc.
  - **Resolution and Accuracy** of cyber physical 3D information
    - Depending on applications, data volume, and processing time, etc.
  - **Data Type and Format** for IoT/WoT applications
    - Data format for energy, transportation, health, surveillance/monitoring, etc.
    - 3D game, 3D image for navigation, 3D simulation for war and building construction, etc. → data format may be different!
Data Sciences for Knowledge Society - 3

• (Accumulation) Learning/Experience for Cognition Process of Knowledge
  – How to accumulate human knowledge collectively!
    • Collectively intelligence by mechanisms of perception – see, hear, touch, smell, taste, and attention
    • New platform for knowledge sharing and accumulation!
  – Sharing tacit knowledge and real/virtual experience!
    • Experiences of driving, cooking, and gaming by simulation at virtual space
Linked Chain of Data

• New values of Linked Open Data (LoD)
  – New Values when Data are linked
    • \( \text{H} + \text{H} + \text{O} \rightarrow \text{Water } [\text{H}_2\text{O}] \)
    • Dynamic Hyperlink among similar and/or heterogeneous data
  – Environments/Conditions such that Data is meaningful
    • vegetable + salt + pepper + pot [Environment] \(\rightarrow\) Kimchi
    • “On the Origin of Species” \(\rightarrow\) survival plan of live data
    • CCTV camera + location + status \(\rightarrow\) meaningful data/information
Data Model of Resource Description Framework (RDF)

- **Entity–Attribute–Value model**
  - Making statements about resources
    - (Examples) XML DTD (Document Type Definition), JSON, tag, name, address, etc.

- **Data Serialization Model**
  - File, memory buffer, packets of communication protocol, time-varying data (A/V), etc.
  - Text-based/binary-based, structured/unstructured, hierarchical/non-hierarchical, scalar/vector/graph, class/object, etc.
    - (Examples) Binary/Integer/Real/Exponent/Character/String/Boolean/Time, Vector/Matrix/Array, 2D/3D Graphics, Recursive, Audio/Video Stream, etc.

- **Markup/Metadata/Schema/Semantic Model**
  - Specify the processing to be performed or the related actions (i.e., activate, trigger, invoke, etc.)
  - Create the values of the data
    - (Examples) metadata, semantic ontology for IoT/CPS, OWL, etc.