Access and Reuse of Open Government Statistical Data - Challenges

Yuh-Jong Hu   Shih-Chi Liang
hu@cs.nccu.edu.tw, 98971016@nccu.edu.tw

Emerging Network Technology(ENT) Lab.
Department of Computer Science
National Chengchi University, Taipei, Taiwan

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Motivations

1. Building a transparent and accountable government through available open statistical data sources on the Web.
2. However, current statistical data sources are used only for humans but not for machines (or software agents), which have limitation on finding insight of data correlations across subject-domains.
3. The truth is that multiple statistical data sources are hard to consume simultaneously by humans.
4. We need an environment which without too much human intervention for (statistical) data publishing, accessing, dissemination, filtering, capturing, integration, reusing, and visualization.
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Major Challenges and Solutions

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1. Syntactically, open government statistical data are offered in heterogeneous formats.
2. Semantically, these statistical data lack clear semantics to describe what they really mean
3. So statistical data are limited for integration, analysis, reuse, and visualization.

Solutions

1. RDF(S)-based ontology is used to express the statistical data format and also describe its semantics.
2. Link Open Data (LOD) principles allow data integration from multiple sources by machines.
3. W3C's RDF data cube with its extension allows effective statistical data integration and reuse.

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1. Investigating current research status about semantic statistics.
2. Exploiting seamlessly statistical data exchange and integration techniques.
3. Verifying the feasibility to realize semantic statistics concept.
4. Implementing a statistical data integration and query platform.

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Related Work

Related studies are:

- OnLine Analytical Processing (OLAP) [5] [9].
- Statistical Data and Metadata EXchange (SDMX) [3] [8].
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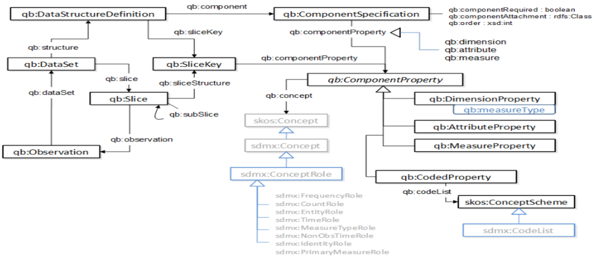
W3C RDF Data Cube

- Information Model for RDF Data Cube [14]



- Builds upon the following existing RDF vocabularies
  - SKOS for concept schemes
  - SCOVO for core statistical structures
  - VoiD for data access
  - FOAF for organisations
  - Dublin Core Terms for metadata

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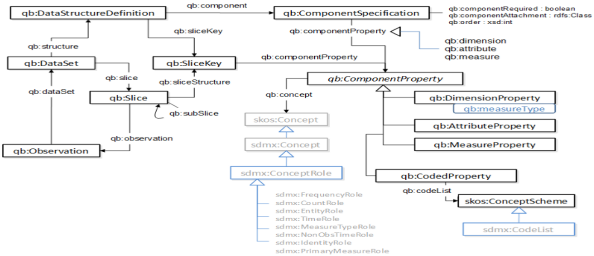

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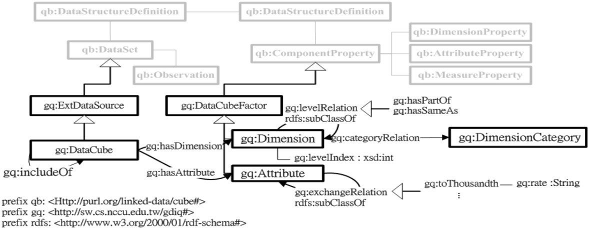
RDF Data Cube with its Extension

- Data Cube Extension for Integration and Reuse



Integration Library

- Some facts
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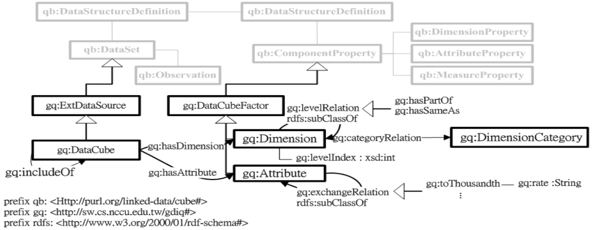

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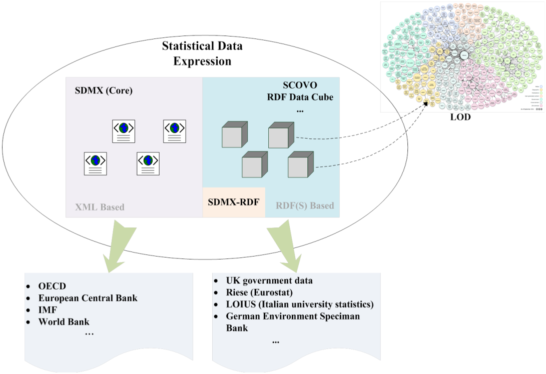
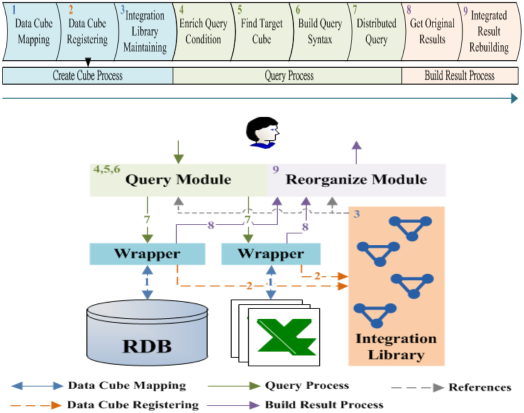
SDMX vs. SCOVO/RDF Data Cube



Statistical Data Integration Processes and Framework



A Simple Example for Data Correlations Discovery

Average salary

	Mining and Quarrying		Manufacturing		Financial and Insurance	
	Average salary	Annual growth(%)	Average salary	Annual growth(%)	Average salary	Annual growth(%)
2008	39,940	-1.81	34,123	0.17	52,150	-6.57
2009	40,636	1.74	32,518	-4.7	52,420	0.52
2010	40,975	0.83	33,383	2.66	54,507	3.98
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The index of industrial production

	Mining and Quarrying		Manufacturing		Electricity and Gas Supply	
	The index of industrial production	Annual production growth rate(%)	The index of industrial production	Annual production growth rate(%)	The index of industrial production	Annual production growth rate(%)
2008	79.07	-4.69	106.65	-1.56	101.11	-1.81
2009	72.43	-8.4	98.15	-7.97	97.83	-3.24
2010	83.25	14.94	126.22	28.6	102.81	5.09
2011	80.09	-3.8	132.68	5.12	105.07	2.2

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Number of Enterprises and sales

		Count of companies	Total amount of sales (Thousand of NTD)
2009-01	B.Mining and Quarrying	1,314	45,028
	C.Manufacturing	129,096	166,457,893
	D.Electricity and Gas Supply	369	30,214
2009-02	B.Mining and Quarrying	1,306	6,187,706
	C.Manufacturing	128,700	1,115,169,731
	D.Electricity and Gas Supply	368	86,732,785
2009-03	B.Mining and Quarrying	1,309	59,600
	C.Manufacturing	128,349	210,905,779
	D.Electricity and Gas Supply	369	52,463

A Simple Example for Data Correlations Discovery (conti.)

	Average salary	Annual production growth rate	Total amount of sales
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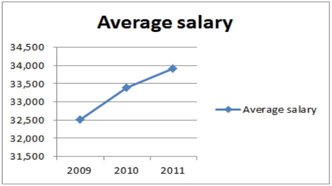
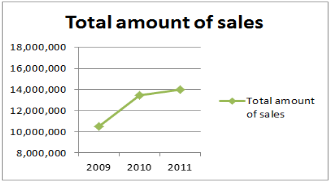
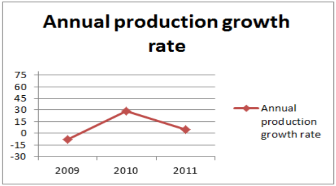
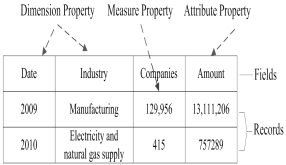
2010	33,383	28.6	13,474,671
2011	33,920	5.12	13,954,562







Mapping from RDB/Excel to RDF



Date	Industry	Companies	Amount
2009	Manufacturing	129,956	13,111,206
2010	Electricity and natural gas supply	415	757289

```
eg:rec1  a qb:Observation;
   qb:dataSet eg:dataset1;
   gdiq-dimension:Date "2009";
   gdiq-dimension:Industry "Manufacturing";
   gdiq-attribute:unit "Companies" ;
   gdiq-measure:value 129956
   .
```

```
eg:rec2  a qb:Observation;
   qb:dataSet eg:dataset1;
   gdiq-dimension:Date "2010";
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Dimension Property Measure Property Attribute Property

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Fields

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Dimension Property Attribute Property

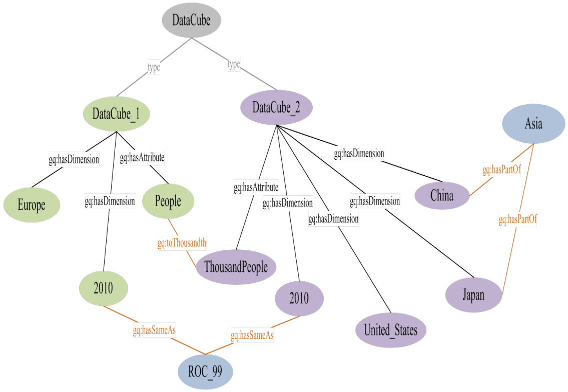
Date	Purpose			Residence	
	Business	Tourism	Visit	Japan	USA
	Thousand People	Thousand People	Thousand People	Thousand People	Thousand People
2009	796	2,298	414	1,001	369
2010	938	3,246	497	1,080	396

Measure Property

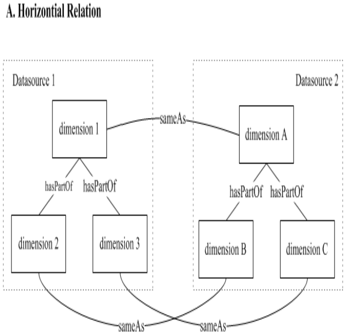
```
eg:ev1  a qb:Observation;
   qb:dataSet eg:dataset2;
   gdiq-dimension:Date "2009";
   gdiq-dimension:Purpose "Business";
   gdiq-attribute:unit "Thousand People" ;
   gdiq-measure:value 796;
   .
```

```
eg:ev2  a qb:Observation;
   qb:dataSet eg:dataset2;
   gdiq-dimension:Date "2009";
   gdiq-dimension:Residence "Japan";
   gdiq-attribute:Unit "Thousand People" ;
   gdiq-measure:value 1001;
   .
```

Core Ontology for Semantic Statistics



Data Cube Dimensional Relationships



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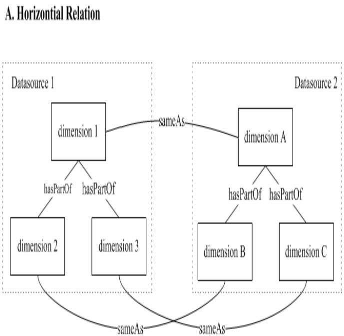
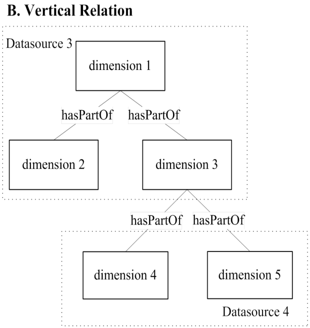
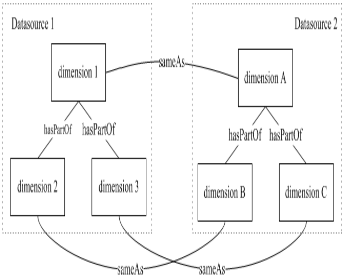


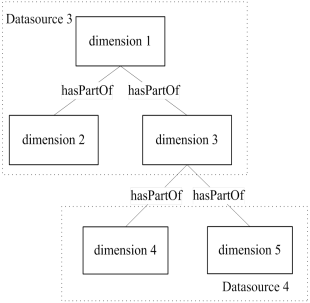


Data Cube Dimensional Relationships

A. Horizontial Relation

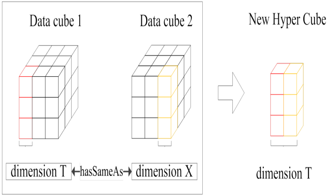


B. Vertical Relation



C. Exchange Relation

Measurement Transformation



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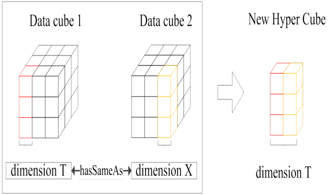
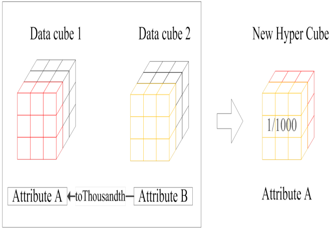
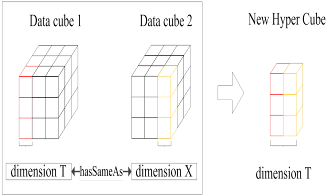
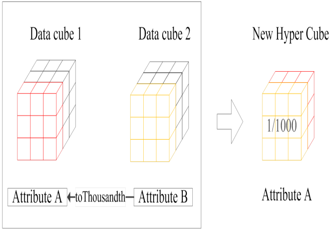
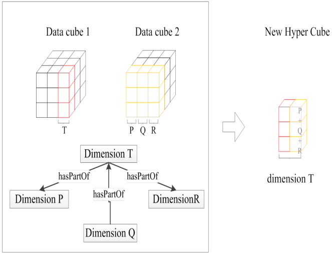




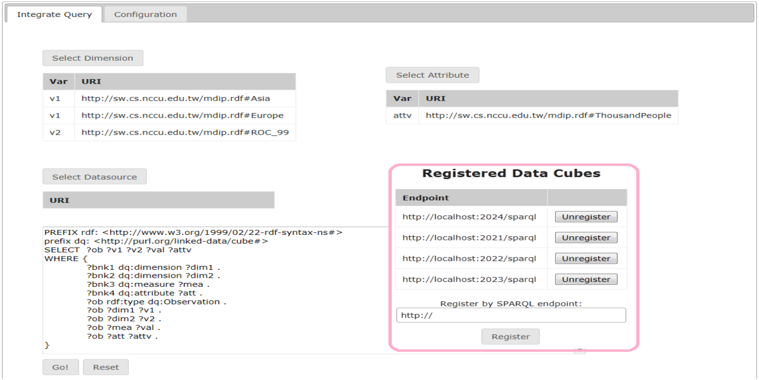
Measurement Transformation







Query Interface



Conclusion

1. We have designed and implemented a process for statistical data access and reuse from multiple public data sources.
2. We have built an infrastructure for (statistical) data accessing, capturing, integration, reusing, and simple visualization without too much human intervention.
3. A preliminary semantic middleware platform has been established to realize the semantic statistics concept for effective virtual integration and discover insight of data correlations across subject-domains.

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Future Work

1. Experiment on more empirical open government's statistical datasets to verify the feasibility of semantic statistics integration concepts.
2. Offer an annotation and query environment for various domain experts to interpret and annotate their insight of statistical data correlations discovery across subject-domains.
3. Establish a process to access and reuse direct big data instead of indirect statistical datasets to realize the semantic statistics integration concept without violating the data protection principles.

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