

Urban Mining Cadastre – a Geospatial data challenge

Benjamin Schnitzer and Tine Köhler (Germany)



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Personal Background



- Dr.-Ing. Tine Köhler
 - Scientific staff at Research Institute for Regional and Urban Development Aachen
 - Doctorate at Geodetic Institute – Dep. Landmanagement of the Technische Universität Darmstadt
- Benjamin Schnitzer, M.Eng.
 - Scientific staff / PhD Student @ Geodetic Institute – Dep. Landmanagement of the Technische Universität Darmstadt



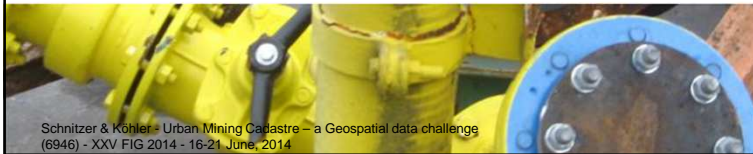
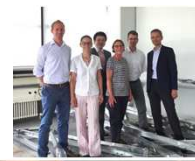
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PRRIG - 01.04.2013 until 31.03.2015



„Potential of Urban Mining in the Industrial and Commercial Building Sector: The Rhine-Main-Area Case“

- BMBF (Federal Ministry for Education and Research)
„r³ – Innovative Technologies for Resource Efficiency - Strategic Metals and Minerals“ (FKZ) 033R100A
- Fachgebiet **Stoffstrommanagement und Ressourcenwirtschaft** FG SuR (Prof. Liselotte Schebek)
- Institut für Baubetrieb IfBB (Prof. Christoph Motzko)
- Fachgebiet Landmanagement (Prof. Hans Joachim Linke)



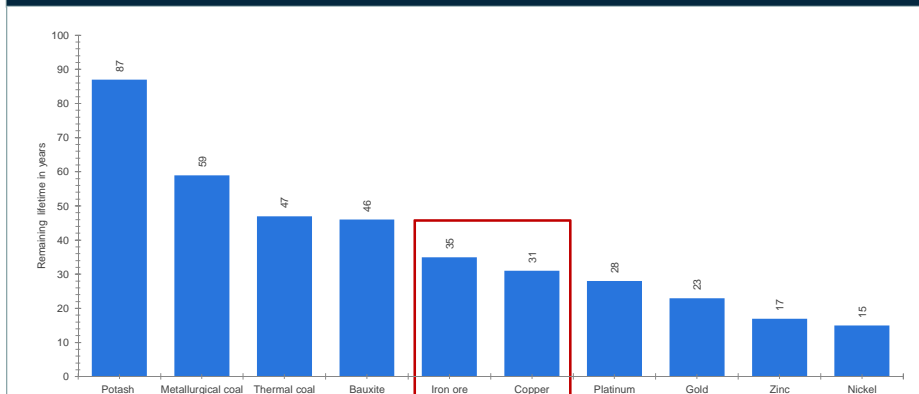
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fossil raw materials - remaining lifetime of selected raw material reserves (2012)



Remaining lifetime of the worlds reserves of selected raw materials in the year 2012 (in years)



Source: PwC, PwC - Mine 2013. A confidence crisis, Page 45 - ID 260902

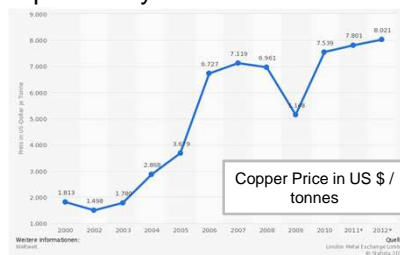
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The idea behind “urban mining“



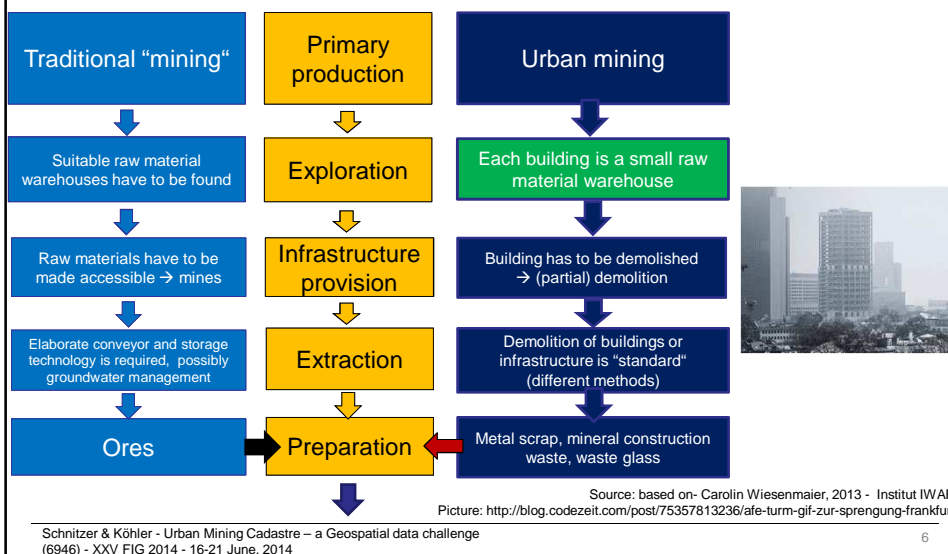
- urban mining is often discussed in the context of electronic equipment (PC, Smartphones etc.) → **rare earths**
- At the end of its life cycle, for example a building, is used as **"secondary mine"** for raw materials, especially metals & other construction materials
- And: Germany has **no significant natural metal resources** and is totally depending on imports
- Price increases in the past few years make the "urban mining" even more attractive



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Traditional “mining“ and “urban mining“



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Project goals at a glance



General:

- **Building typology** specific for an “urban mining“
- Empirical factors for **material fractions** in terms of building types/ components
- **Material flow model**
- General information of resources in the building stock
- **Target materials:** iron/steel, aluminum, copper, zinc, lead

Specific for the Rhine-Main-Area:

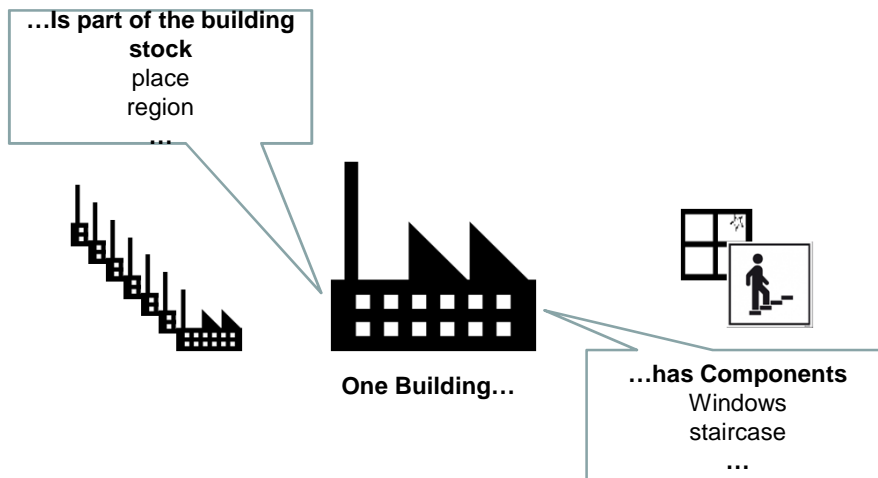
- **GIS-based building register/ regional resource Cadastre**
- Scenarios for the development of the real estate market (industrial & commercial) in the Rhine-Main Area
- **Forecast of future material flows → (2020/2030)**
- Recommendations for the regional planning



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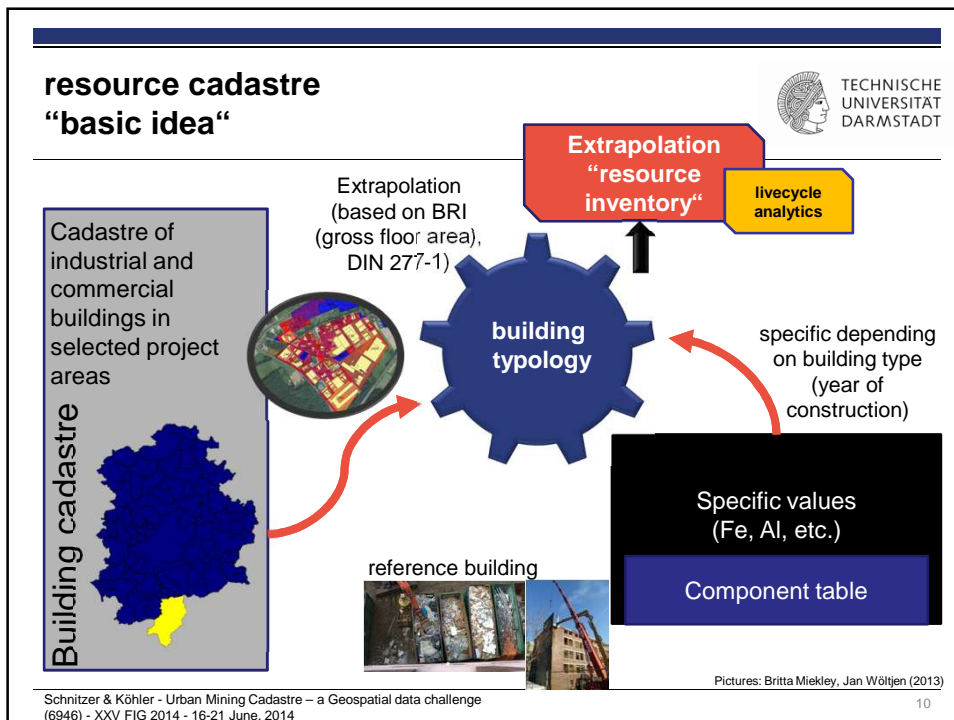
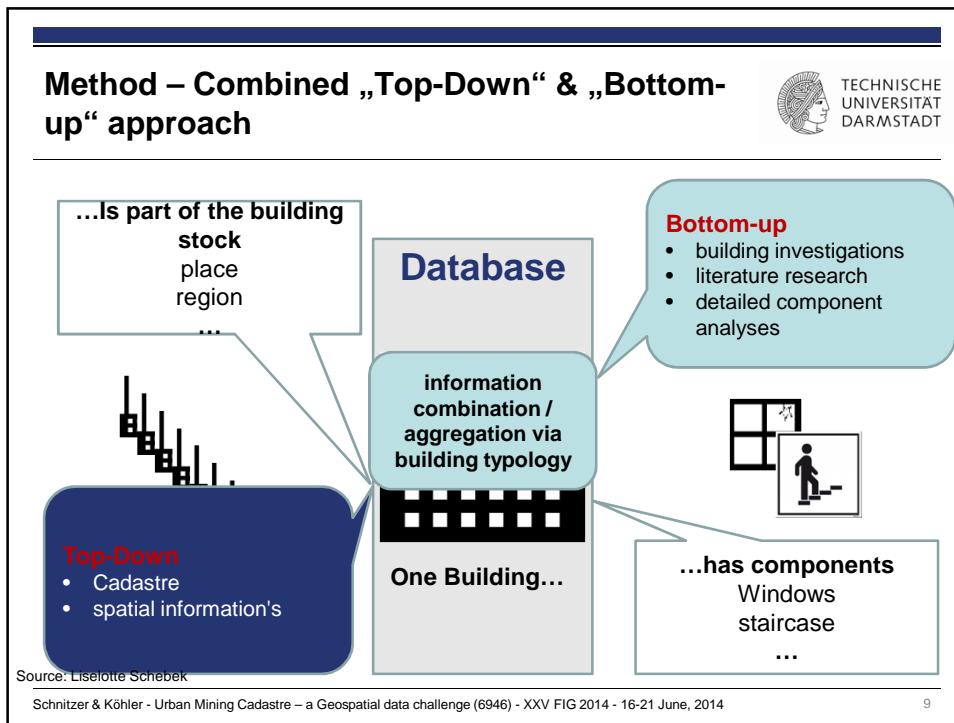
Method – Combined „Top-Down“ & „Bottom-up“ approach



Source: Liselotte Schebek

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PRRIG „urban Mining“ building typology (specific for industrial & commercial buildings in Germany)



Number	Typ (utilisation)	Subnumber	Subcategory
100	Office buildings	110	Office and government buildings
		120	Banks
		130	Office buildings in general
200	Factory and workshop buildings	210	Large-scale enterprises
		220	Craft
		230	Industry
		240	Production halls
		250	Barracks
300	Commercial buildings	260	EVU
		310	Food
		320	Non-food
400	Warehouses	330	Shoppingcenter
		410	Warehouses in general
		420	Garadge buildings
500	Hospitality buildings	510	Hotel business
		520	Gastronomy
		530	Roadhouses
600	Education buildings	610	Nurcery
		620	Schools
		630	Universities
700	Traffic buildings	710	Airports
		720	Train stations
		800	Health care buildings



table: project PRRIG
Pictures: Britta Miekley, Jan Wöltjen (2013)

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Source: Jan Wöltjen, Baubetrieb, TU Darmstadt

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A geo-spatial challenge? (top down approach)

Geo-spatial challenge

- spatial data overview (using ALKIS)
- Selection and analyses of industrial and commercial reference buildings in the research area
- Mapping of the reference buildings to the developed building typology
- Determination of the buildings' specific resource values
- Classification of all industrial and commercial buildings according to the building typology and the specific resource values of the reference
- extrapolation of the spatial and temporal availability of resources

Literature

definition of building Typology

Database model

```

public prrig_building
(
  prb_id serial(4) PK,OR
  prc numeric(9)
  city varchar(50)
  street varchar(100)
  h_rif varchar(10)
  h_rf_additional varchar(10)
  building_name varchar(100)
  building_use varchar(100)
  building_height double precision
  floors double precision
  bti smallint
  construction_type varchar(100)
  year_construction varchar(50)
  year_construction_virtual varchar(50)
  prrig_main_type varchar(100)
  prrig_sub_type varchar(100)
  geom geometry(MULTIPOLYGON, 25832)
  index prrig_building index
)
                    
```


Building information:







- Type (PRRIG-typology)
- Year of construction
- Surface
- Height (absolute / floors)
- „Structural changes“

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Building information – a lot of sources

▪ variety of possible data sources

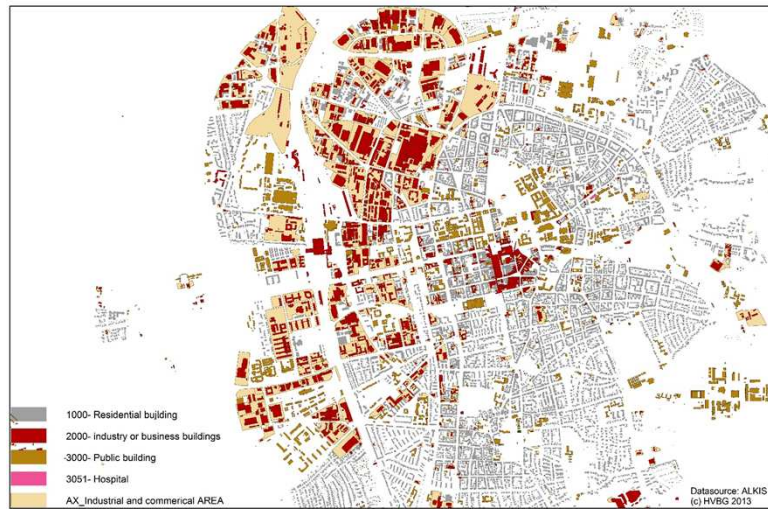


Picture sources: EU, AdV, BKG, cityGML.org

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Building cadastre – Official German Cadastre A brief overview



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Building cadastre – data modelling official German Cadastre



Objektartengruppe: Angaben zum Gebäude		Stand: 31.01.2005
Objektart: AX: Gebäude Kennung: 31001		
Modellart:	DLKM	
Definition:	'Grundfläche' ist die Gebäudegrundfläche in [qm].	
Attributart:		
Bezeichnung:	unbauterRaum	
Kennung:	URA	
Datentyp:	Volumen	
Kardinalität:	0..1	
Modellart:	DLKM	
Definition:	'Unbauter Raum' ist der unbauter Raum [Kubikmeter] des Gebäudes.	
Attributart:		
Bezeichnung:	baupjahr	
Kennung:	BFA	
Datentyp:	Integere	
Kardinalität:	0..*	
Modellart:	DLKM	
Definition:	'Baupjahr' ist das Jahr der Fertigstellung oder der höchsten Vollendung des Gebäudes.	



Source: Adv 2013

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Spatial data: HVBG 2013

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INSPIRE European SDI

Yes, but...

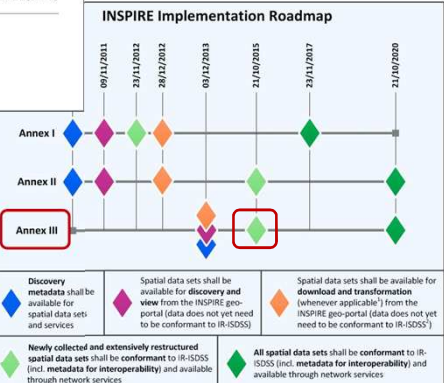
Code list values

Label	Parent
residential	
agriculture	
industrial	
commerce and services	
ancillary	
individual residence	residential
collective residence	residential
two dwellings	collective residence
more than two dwellings	collective residence
residence for communities	residential
office	commerce and services
trade	commerce and services
public services	commerce and services

Source: <http://inspire.ec.europa.eu/codelist/CurrentUseValue/> (Registry)
 Picture: <http://inspire.jrc.ec.europa.eu/index.cfm/pageid/44>



INSPIRE Implementation Roadmap



INSPIRE Registry: Enhancing access to European spatial data

Discovery metadata shall be available for spatial data sets and services.

Spatial data sets shall be available for discovery and view from the INSPIRE geo-portal (data does not yet need to be conformant to IR-ISDSS).

Spatial data sets shall be conformant to IR-ISDSS (whenever applicable) from the INSPIRE geo-portal (data does not yet need to be conformant to IR-ISDSS).

Newly collected and extensively restructured spatial data sets shall be conformant to IR-ISDSS (incl. metadata for interoperability) and available through network services.

All spatial data sets shall be conformant to IR-ISDSS (incl. metadata for interoperability) and available through network services.

IR-ISDSS = Implementing Rules on interoperability of spatial data sets and services (Commission Regulation (EU) No. 1089/2010)

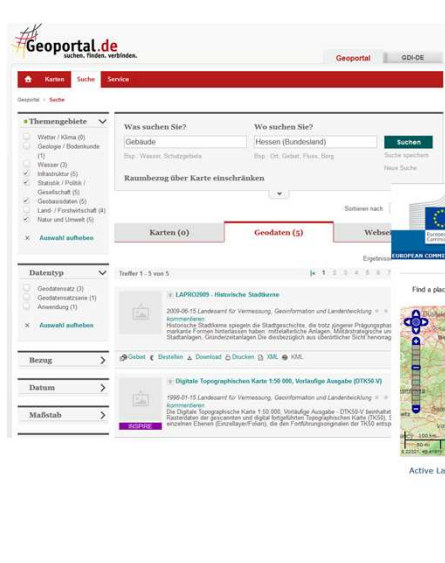
1 Transformation Services only need to be provided if data sets are not made conformant with the IR-ISDSS by some other means (see Art. 7(3) of the INSPIRE Directive)

2 With the exception of newly collected and extensively restructured Annex I data sets, which already have to be compliant with the IR-ISDSS by 23/11/2012

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Spatial data catalogs (GDI)



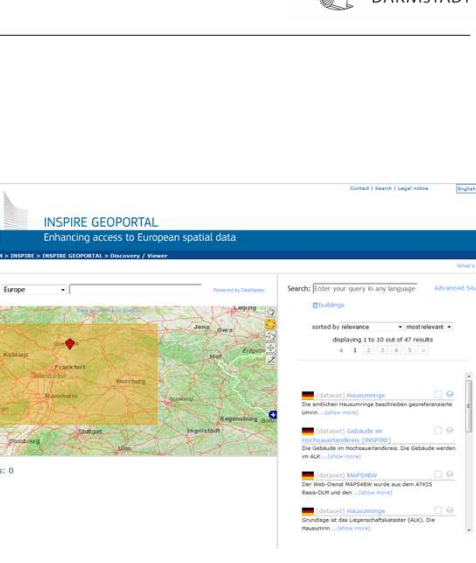
Geoportal.de: suchen, finden, verbinden.

Suche: Was suchen Sie? Wo suchen Sie?

Suchergebnisse: 5 Datensätze

1. Historische Stadtkarte (LAPRO309)

2. Digitale Topographische Karte 1:50 000, Vorläufige Ausgabe (DTK100)



INSPIRE GEOPORTAL: Enhancing access to European spatial data

Find a place in Europe

Suche: [Enter your query in any language]

Sortiert nach Relevanz


1. Historische Stadtkarte (LAPRO309)

2. Digitale Topographische Karte 1:50 000, Vorläufige Ausgabe (DTK100)

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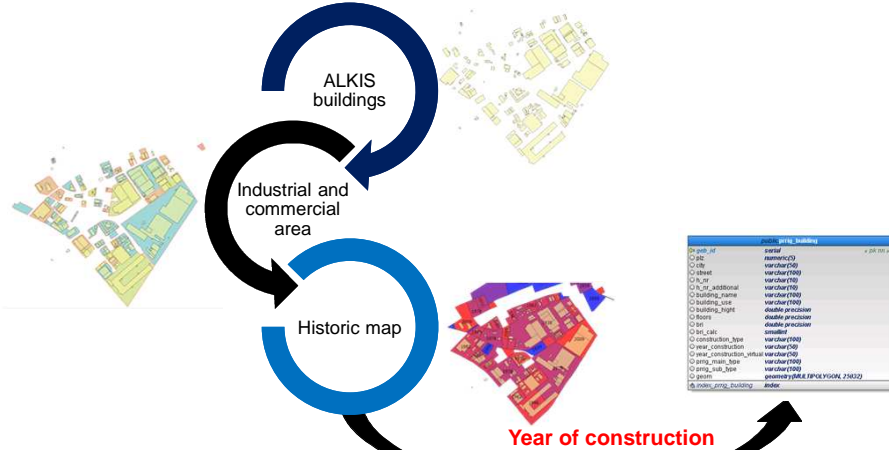
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Historic Settlement Development



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- „Prototype“- Data of the Regionalverband Frankfurt Rhine/Main



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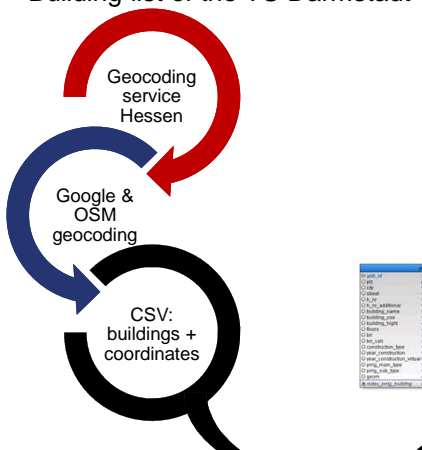
21

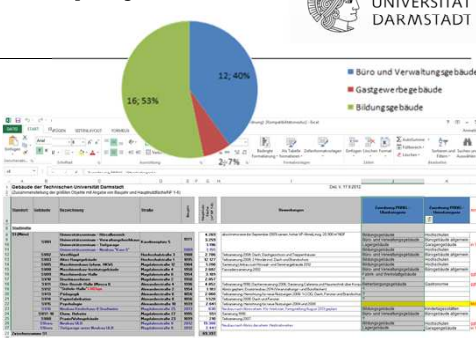
Example 2: Information from the project partners - geocoding



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- Basic data
Building list of the TU Darmstadt






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Gebäudeauswertung TU Darmstadt (Britta Miekley, 2014)
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OpenData - Statistics



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OPEN DATA

GOVDATA

Diese Suche liefert Ergebnisse aus dem gesamten Katalog, also Daten, Dokumente und Apps setzen, oder oben eine auf "Daten", "Dokumente" oder "Apps" spezialisierte Suchseite aufrufen

Bauanträge

Filtern nach: 1 Treffer

Sortieren nach: Relevanz Name

Typ

Datensatz (1)

Offenheit der Lizenz

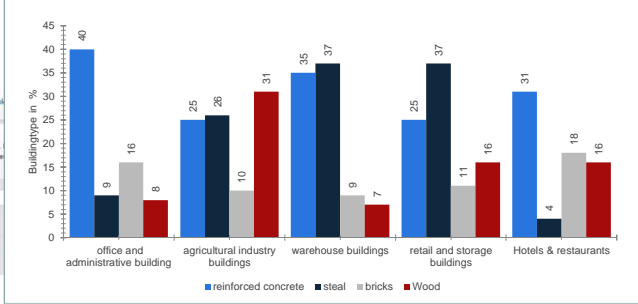
Alle

Freie Nutzung (1)

Kategorien

Öffentliche Verwaltung, Haushalt und Steuern (1)

Distribution of building permissions (Building Type and used materials) 2012




Building Type	reinforced concrete	steel	bricks	Wood
office and administrative building	40	9	16	8
agricultural industry buildings	25	26	10	31
warehouse buildings	35	37	9	7
retail and storage buildings	25	37	11	16
Hotels & restaurants	31	4	18	16

Source: Statistisches Bundesamt, Statistisches Bundesamt - Bauktätigkeit und Wohnungen - Bauktätigkeit 2012, Seite 37 f. ID 252743

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Conclusions



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- Complex material usage in the buildings
No reliable data yet about the material composition of the buildings (distinction in terms of the building type)
- Further detailing of the building data
- Reviewing and combining different spatial data harmonization processes (e.g. building typologies)



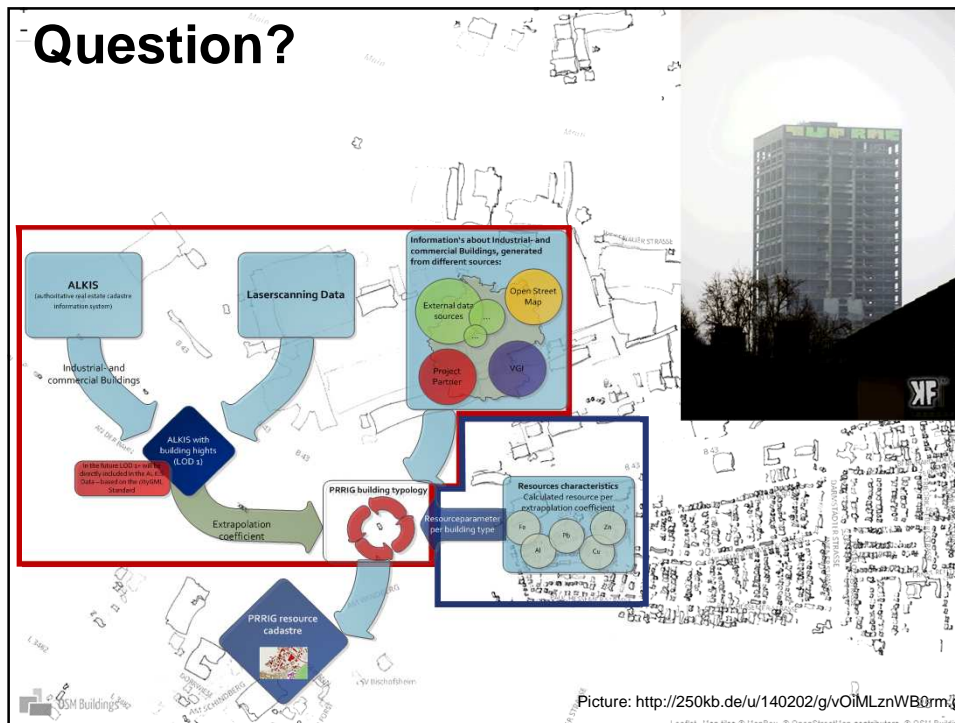
Perspectives

- Integration of additional data within the research area
- Data fusion – step-by-step detailing
- cityGML, BIM etc.
- WebGIS for visualization of selected areas

→ Adoption of methods to different areas
(Germany → Europe → Worldwide?)

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Contact:

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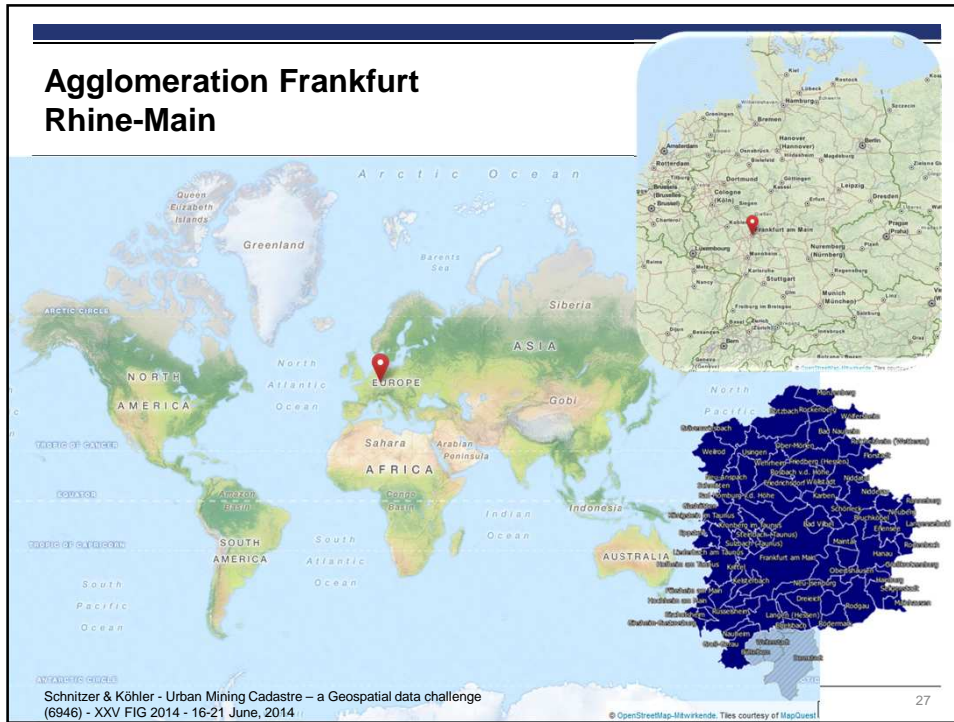
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www.prrig.tu-darmstadt.de


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
Benjamin Schnitzer



General project structure: Procedure




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Conceptual work

- Literature review
- Definition of building typology
- Forecasts for real estate development in the Rhine-Main-Area
- Analysis of construction materials
- Material flow models
- ...



Practical studies

- Case studies of building types
- On-site investigations
- Evaluation of building documentations
- Identification of specific values
- ...



Building cadastre

- Characterisation of the building stock
- Acquisition of buildings in the "surface"
- Analysis of statistics
- Construction of an „urban mining“ cadastre

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REFERENCES

Picture references

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[1] Blog Codezeit: <http://blog.codezeit.com/post/75357813236/afe-turm-gif-zur-sprengung-frankfurt> (10.03.2014)

[2] Foto: <http://250kb.de/u/140202/g/vOiMLznWB0rm.gif>

[3] Screenshot: <https://www.govdata.de/>

[4] INSPIRE Roadmap: Bild:
<http://inspire.jrc.ec.europa.eu/index.cfm/pageid/44>

[5] Image: http://commons.wikimedia.org/wiki/File:Factory_icon.svg



References

Full list see corresponding paper



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Urban Mining – a Geospatial data challenge
FIG Congress 2014 - Engaging the Challenges, Enhancing the Relevance,
Kuala Lumpur, Malaysia, 16 – 21 June 2014
- Tanikawa, Hiroki; Hashimoto, Seiji (2009): Urban stock over time: spatial
material stock analysis using 4d-GIS. In *Building Research & Information* 37
(5-6), pp. 483–502. DOI: 10.1080/09613210903169394.
- Zhu, Xuan (2014): GIS and Urban Mining. In *Resources* 3 (1), pp. 235–247.
DOI: 10.3390/resources3010235.
- D2.8.III.2 INSPIRE Data Specification on Buildings – Technical Guidelines.
INSPIRE Data Specification for the spatial data theme Buildings, checked on
2/25/2014.
- Umweltbundesamt (UBA) (2010): Ermittlung von
Ressourcenschonungspotenzialen bei der Verwertung von Bauabfällen und
Erarbeitung von Empfehlungen zu deren Nutzung. Leibniz-Institut für
ökologische Raumentwicklung, Dresden. With assistance of Georg Schiller,
Clemens Deilmann (56/2010), checked on 11/8/2013

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Spatial Data



© OpenStreetMap contributors - <http://www.openstreetmap.org/>

Geobasisdaten Hessen – ALKIS – 2013:
Hessische Landesamt für Bodenmanagement und Geoinformation (HLBG)
<http://www.hvbg.hessen.de>

Orthophotos: WMS HLBG 2014
<http://www.hvbg.hessen.de>

Daten zur Historischen Siedlungsentwicklung: 2013 Regionalverband
FrankfurtRheinMain
<http://www.region-frankfurt.de/>

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Rohstoffe - Importabhängigkeit und Selbstversorgungsgrad Deutschlands 2008
Deutschland



Merkmal	Eigenschaft
Erhebungszeitraum	2008
Erheber	BGR
Besondere Eigenschaften	
Region	Deutschland
Altersgruppe	
Veröffentlichung durch	IG BCE
Herkunftsverweis	IG BCE - Informationen zur Rohstoffpolitik, Seite 8
Veröffentlichungsdatum	August 2012
Hinweis	* Anteil der Primärproduktion an Raffinadeproduktion
URL auf der Webseite	http://de.statista.com/statistik/daten/studie/246390/umfrage/importaehaengigkeit-und-selbstversorgungsgrad-deutschlands-bei-rohstoffen



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Kupfer - Kupferpreis 2000-2012
Weltweit



Merkmal	Eigenschaft
Erhebungszeitraum	2000 bis 2012
Erheber	LME
Besondere Eigenschaften	
Region	Weltweit
Altersgruppe	
Veröffentlichung durch	Deutsches Kupferinstitut
Herkunftsverweis	kupfer-institut.de
Veröffentlichungsdatum	Dezember 2012
Hinweis	Die Preise für Kupfer gelten laut der London Metal Exchange (LME). *LME-Handelspreis jeweils zum 01. Dezember
URL auf der Webseite	http://de.statista.com/statistik/daten/studie/37791/umfrage/kupferpreis-seit-2000



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Wirtschaftsbau - Baugenehmigungen nach Gebäudeart und verwendetem Baustoff 2015
Deutschland



Merkmal	Eigenschaft
Erhebungszeitraum	2012
Erheber	Statistisches Bundesamt
Besondere Eigenschaften	
Region	Deutschland
Altersgruppe	
Veröffentlichung durch	Statistisches Bundesamt
Herkunftsverweis	Statistisches Bundesamt - Bautätigkeit und Wohnungen - Bautätigkeit 2012, Seite 37 f.
Veröffentlichungsdatum	August 2013
Hinweis	Die Prozentangaben wurden eigenständig errechnet und gerundet. Basis der Berechnung war jeweils die Gesamtzahl der genehmigten Gebäude aus einer Kategorie. Die Summe der Prozentwerte für einen Gebäudetyp ergibt nicht 100 Prozent, da weitere Baustoffe wie z.B. Kalksandstein, Porenbeton oder Leichtbeton/Bims aufgrund der geringen Relevanz nicht dargestellt sind.
URL auf der Webseite	http://de.statista.com/statistik/daten/studie/252743/umfrage/struktur-der-genehmigten-wirtschaftsbauten-in-deutschland



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