TRANS-URBAN-EU-CHINA

Transition towards urban sustainability through socially integrative cities in the EU and in China

Deliverable

D4.1: Setting Up the Big Data Analytics Framework including Open Data and the 'Online Community of Communities'

WP 4: Integrated Transition Pathways towards Sustainable Urban Planning and Governance

Task 4.3: The Digital Transition in Urban Governance and Planning

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Executive Summary

This report - Deliverable 4.1 - describes the status of the two IT systems set up by CIUC and ISCI in Task 4.3 as of the end of August 2018, and how they are designed to contribute to the TRANS-URBAN-EU-CHINA project objectives:

1. The Big Data Analytics Framework developed by CIUC provides the functionality of a Big Data platform supporting data sharing, decision making, and data acquisition. This Big Data platform also features open data for Smart City applications addressing air pollution, transportation, and data sharing for inter-municipal cooperation. Specifically, the Big Data platform is designed to (i) support urban and rural planning data sharing, (ii) provide the required data and tools to support environmental protection activities, (iii) assist in making decisions for the transportation/traffic arena, and (iv) provide an advanced data acquisition methodology from multi data sources.
2. The Community of Communities (CoC) online platform developed by ISCI is designed to provide the Internet-based discussion functionalities to be deployed within the Urban Living Labs (ULLs) of the project. The platform is an enabling infrastructure for community building for both the consortium itself and the forthcoming ULLs. It will enable knowledge sharing and knowledge creation for the project internal communities, e.g., work packages and other self-organized communities such as the already established special interest group (SIG) on concepts and theory, and the SIG to be set up for the preparation of the book. Each such special interest group can flourish online on the Community of Communities system. In addition, the CoC system will be an online shared space to collect Big Data on the transition to smart cities and a demonstrator of how all stakeholders can be empowered to engage in the transition process, including citizens of the ULLs. The Big Data will allow for Artificial Intelligence methods to be activated for insights and predictive analysis. This platform will have a multiplying effect for all the research undertaken in the project. Ultimately, the platform will serve as a Proof of Concept of how digitalisation can support the transition to sustainable, inclusive and smart cities, since a wide engagement of all stakeholders is a key success factor in change processes. In order to effectively serve the project objectives, it will feature specific functionalities such as Social login, Categories, Conversations, Mobile compatibility, Admin dashboard, and a Multi Language Interface.

   To make the most of the CoC system contributions, a Data Analysis Platform for the CoC online platform has been set up at the CIUC in order to enable knowledge extraction from the user contributions and provide insights into the discussions and conversations taking place in the Urban Living Labs through the CoC online platform. This linkage creates a powerful new tool, which supports the transition towards socially urban sustainability socially integrative cities by collecting the feedback from citizens regarding the various dimension of the urbanization process, analysing the hot topics contributed by concerned residents, making proper decisions, and increasing the efficiency in problem diagnosis, description, prediction, and prescription.

1. Task 4.3 and Subtask 4.3.1

According to the Description of Work, subtask 4.3.1 is expected to deliver the following results in 2018:

1. Describe major trends concerning the digital urban transition in Europe and China.
2. Describe state-of-the-art policies and strategies (regional, local) to facilitate the digital transition to data-driven decision-making for urban planning and governance in respect to air pollution, transport and mobility, and data sharing for inter-municipal cooperation.
3. Identify major opportunities and challenges from the outcome of the 'Community of Communities' and validate them by practitioners from cities through joint workshops.

In accordance with the Description of Work the present Deliverable - D4.1 - reports on "Setting up the Big Data analytics framework including open data and the online 'Community of Communities'"

In order to establish the context of the deliverable, the major trends concerning the digital urban transition in Europe and China (items 1 and 2 above) are summarized hereafter, while a more detailed description will be provided as planned in a separate report in January 2019. Urban environments in Europe and China are experiencing a digitalisation through sensorification and datafication brought about by the massive application of ubiquitous computing technologies and mobile platforms. Accordingly, both the Big Data Analytics Framework - specifically addressing air pollution, transport and mobility, and data sharing for inter-municipal cooperation -, and the Community of Communities (CoC) platform (together with the data analytics system) are designed to become prominent contributors to urban digitalisation strategies. In general, efforts in Europe focus on the promotion of civil society participation and of effective feedback mechanisms, whereas in China, the prosperity of e-commerce has reshaped consumption patterns and consequently influences urban structures.

Artificial Intelligence (AI) is expected to drive technology development throughout the world for the next decades. Accordingly, many countries have already released national strategies to respond to forthcoming technological innovations involving AI. A large number of countries in Europe, Asia, North America have in fact released such national strategies over the past two years. An overview of national strategies for upcoming technologies, with particular emphasis on AI is provided below in Table 1.

Table 1: National Strategies for Upcoming AI Technologies

Country/Region	National Strategy	Release	Year
EU Commission	Communication on Artificial Intelligence		2018
Nordic-Baltic Region (Denmark, Estonia, Finland, the Faroe Islands, Iceland, Latvia, Lithuania, Norway, Sweden, and the	Declaration on AI in the Nordic-Baltic Region		2018

Åland Islands)		
Denmark	Strategy for Denmark's Digital Growth	2018
Sweden	National Approach for Artificial Intelligence	2018
Finland	Finland's Age of Artificial Intelligence	2017
	Work in the Age of Artificial Intelligence	2018
France	For a Meaningful Artificial Intelligence: Towards a French and European Strategy	2018
Germany	Eckpunkte der Bundesregierung für eine Strategie Künstliche Intelligenz	2018
Italy	Artificial Intelligence: At The Service of Citizens	2018
United Kingdom	The UK's Industrial Strategy	2018
China	A Next Generation Artificial Intelligence Development Plan	2017
Japan	Artificial Intelligence Technology Strategy	2017
South Korea	Mid- to Long-Term Master Plan in Preparation for the Intelligent Information Society Managing the Fourth Industrial Revolution	2017
Singapore	AI Singapore	2017
India	National Strategy for Artificial Intelligence #AI for All	2018
UAE	UAE Strategy for Artificial Intelligence (AI)	2017
United States	National Artificial Intelligence Research and Development Strategic Plan	2016
Canada	Pan-Canadian Artificial Intelligence Strategy	2017
Mexico	Towards an AI Strategy in Mexico: Harnessing the AI Revolution	2018

Australia	Australia 2030: Prosperity Through Innovation	2017

As proposed by Margarita Angelidou [2], smart city policies can be characterized according to four criteria, each corresponding to a strategic alternative: national Vs local strategies, strategies for new Vs existing cities, hard Vs soft infrastructure-oriented strategies, and sector-based Vs geographically-based strategies. Meaningful examples are shown below in Table 2.

Table 2: Four strategic choices for smart city policy making and corresponding cases [2]

Smart City policy category	Sub-type	Case
National vs. local strategies	National strategy	Malta
	Local strategy	New York City
Urban development stage: new vs. existing cities	New city	Songdo IBD
	Existing city	Amsterdam
Hard vs. soft infrastructure oriented strategies	Hard infrastructure oriented strategy	Rio de Janeiro
	Soft infrastructure oriented strategy	Barcelona
Economic sector-based vs. Geographically based strategies	Economic sector-based strategy	Singapore ('Intelligent Nation 2015 (iN2015)')
	Geographically based strategy	Thessaloniki

Focusing on strategies at the local level, several meaningful examples of actions undertaken by local governments or research institutions to help facilitate digital transitions concerning data sharing, environment, and transportation can be found. Such actions currently materialize primarily in the form of projects and platforms, which indicates the exploratory nature of the corresponding technological application scenarios. The following paragraphs briefly illustrate the nature and scope of these applications, and present examples in the three selected investigation areas: data sharing, environment (for both the regional and cross-regional scale), and transport.

Data Sharing

Overall, data sharing is undergoing three main transformations that will play a major role in the transition towards sustainable digital cities:

1/ Transformation of data sources: from specific providers to heterogeneous bodies

2/ Transformation of data formats: from fully digested to raw data

3/ Transformation of data accessibility by the public: from passive reception to re-creation,

Data sharing is a process involving data sources (the origin) and users (the final destination). Data available for sharing usually belong to two main categories: non-governmental open data and governmental open data. Open Knowledge International (https://okfn.org) is an example of non-governmental open data. As aa global non-profit organization, it focuses on helping civil society groups access and use data to take action on social issues. As concerns governmental open data, the Shanghai Open Data Apps (SODA) project (https://soda.datashanghai.gov.cn/) features a municipal level competition organized in Shanghai to select the best applications developed for the use of open government data.

- **Environment**

Decision processes in the field of environment and land management are crucial for the success of urban transition strategies. They require an accurate understanding of environmental phenomena, including risks and impacts. Novel information and communication technologies (ICT) are able to provide useful tools to achieve this goal [5].

1/ Regional Scale

The evolution of the IoT (Internet of Things) allows to overcome the classical limitations of the Internet in connecting the web with the real world. It offers a variety of innovative technological features, ranging from embedded systems and linked sensors development (Cyber Physical Systems) to the application of intelligent systems to communications protocols [5].

The project SESAMO (Figure 1) is supported by the Italian enterprise OPENET Technologies S.p.A. proposing to establish an integrated information system for the acquisition, management and sharing of environmental data for decision support. An environmental information platform has been developed that is capable to integrate data from various environmental monitoring systems and to provide monitoring services for decision support. An early warning system for rainfall-induced landslides (Figure 2) is also under design. In the prototype, static and dynamic modelling are integrated that are expected to realize a higher value and a better sensitivity of the system.

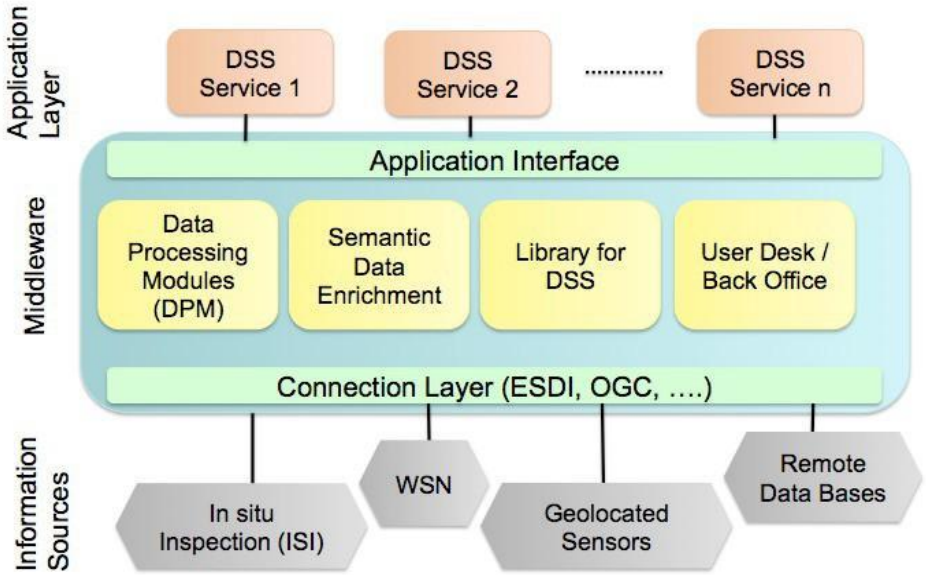

Figure 1: Logic architecture of the SESAMO platform (La Loggia et al., 2012)

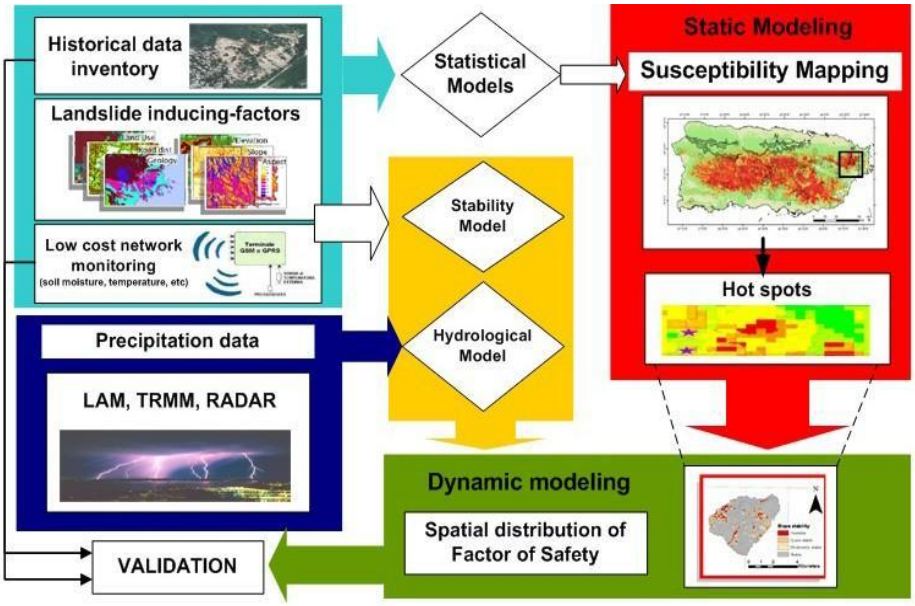

Figure 2: The prototype of the Early Warning System for rainfall induced landslides [5]

2/ Cross-regional Scale

Environmental science frequently focuses on issues related to public health. Promoting the reliability of air pollution monitoring helps providing citizens with credible, valid data. A case in point concerns Persistent Organic Pollutants (POPs), a common and vital indicator of environmental quality that are transported through the air over long ranges. They are global pollutants that can migrate over long distances and bio-accumulate through food webs, posing health risks to wildlife and humans. Remote sensing techniques enable the macroscopic observation, yet cannot so far replace field monitoring to meet the requirements for data accuracy. Major uncertainties in POP air measurements originate from different sample preparation and analytical techniques used by different laboratories for the same chemicals [3].

The Stockholm Convention on Persistent Organic Pollutants is proposed by the United Nations Environment Programme (UNEP). It is a global treaty to protect human health and the environment from chemicals that remain intact in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissue of humans and wildlife, and have harmful impacts on human health or on the environment. The Global Monitoring Plan for POPs (GMP) is an internationally integrated program for POPs observation that enables the effective evaluation of the Convention. This strategic monitoring plan could provide consistent and comparable monitoring data for POPs, supported and supplemented by global and regional transport models.

- **Transportation**

1/ Urban traffic simulation

Efficient methods and tools for road network planning and traffic management are critically important in the ever more urbanized world. The Dutch National Data Warehouse (NDW) for traffic information provides traffic data generated by thousands of sensors installed along the arterial roads throughout the Netherlands. Real-time measurements include parameters such as vehicles speed, traffic intensity and travel time. On this data foundation, accurate simulations of road traffic are expected to be realized with a data-driven multiscale modelling approach. Melnikov and others [6] comprehensively reviewed multiscale traffic flow modelling and road network modelling. They consider the NDW traffic data as highly valuable for defining the macroscale model parameters, and beneficial for reverse-engineering and calibrating the micromodel parameters in that their integral simulation results can be validated with the sensor data [6]. Massive sensor data and inherent valuable information are thus feeding into strategic traffic management and – possibly - into future road network design.

2/ Cycling infrastructure planning

The urban traffic simulation with the above mentioned NDW provides inspiring cases of structural sensor data use in the Netherlands: the bottom-up project Stgo 2020 utilizes ‘idiotic data’ to make data-driven decisions on cycling infrastructure planning in Santiago de Chile. Researchers observed frequent interruptions, so called ‘idiotic data’, in the ordinary experience of cycling, which include breakdowns, everyday contingencies, forgetfulness, and re-interpretations of the assemblage of devices, data, humans, and bicycles. Whereas the adoption of sensors and digital applications are a basis for operationalizing a Smart City, the inevitable interruptions in the daily operation of those devices are by no means insignificant. The case shows how smartness and idiocy emerge together and become enmeshed in the process of quantifying the urban mobility of cyclists, in a sort of dialogue or mutual ‘correspondence’ [4].

2. The Big Data Analytics Framework Setup including Open Data

Data-driven decision and policy making is a currently observable in both Chinese and European cities [8], as data sharing is expected to encourage citizens to engage actively in decision making and political activities [9] [10]. In order to effectively foster citizens' participation in decision and plan making, the reference system featuring information integration and effective planning operation for planners must first be established, as a prerequisite for further opening up to the public. To this end, the CIUC developed a Big Data platform including a variety of open data for smart city applications that notably address air pollution, transportation, and data sharing for inter-municipal cooperation:

This Big Data Analytics platform pursues the following objectives:

- Supporting integrated spatial planning by providing and superimposing plans and data from various sectors including urban planning, management, and operation;
- Resource planning provisioning[1] and support as well as timely management of progress and problems during constructions where the data can be acquired to conduct the near real-time analyses on the issues occurring in the planning and proper decisions accordingly made as the result;
- Real-time information transmission, multi-channel monitoring, real-time decision-making, and timely feedback of policy implementation;
- Information data classification and screening management, trend prediction, data intelligence analysis and visualization display, which effectively supports decision-making;
- Service design for emergency management.

In their paper [7], Pan et al. define urban Big Data and its applications to China's city intelligence. The Big Data Analytics platform built by the CIUC provides intelligent urbanization data support with reliable mathematical assistance for scientific research and policy-making in the three fields

- intelligent diagnosis,
- intelligent planning, and
- intelligent governance of urbanization development (Figure 3).

The CIUC established an urbanized Big Data cloud platform named City Big Data Bank (CBDB) with the goal to assist in achieving following objectives:

- grading docking of spatial planning with plans from various sectors including urban planning, management, operation and other aspects;
- resource planning provisioning and support as well as timely management of progress and problems during constructions;
- real-time information transmission, multi-channel monitoring, real-time decision-making, and timely feedback of policy implementation;
- information data classification and screening management, trend prediction judgment, data intelligence analysis and visualization display, which effectively supports decision-making; and emergency management service design.

[1] Resource planning provisioning basically means resource allocation, including land, capital, geographic information, and human resource management, etc. For example, in China, urban planning and land planning frequently have interactions in plan making and subsequent execution. Resources should be well allocated in order to coordinate different plans.

The fully-built intelligent urbanization data support platform will provide reliable mathematical assistance for scientific research and policy-making in the three fields of intelligent diagnosis, intelligent planning and intelligent governance of urbanization development. The following work has been completed:

Architecture of intelligent urbanization overall database

In October 2013, the system architecture research and development of the entire intelligent urbanization database was completed, covering the geographical, economic, social, and environmental aspects of all administrative levels, i.e., nation, province, city, county and town. It satisfies the data needs of the intelligent urbanization platform, ensuring comprehensive Big Data across modules input, display and analysis in the future intelligent urbanization diagnosis, planning and governance decision-making. Data integration, database, data warehousing and data mining technologies are applied to solve the data demand problems in reality via intelligent city decision support platform.

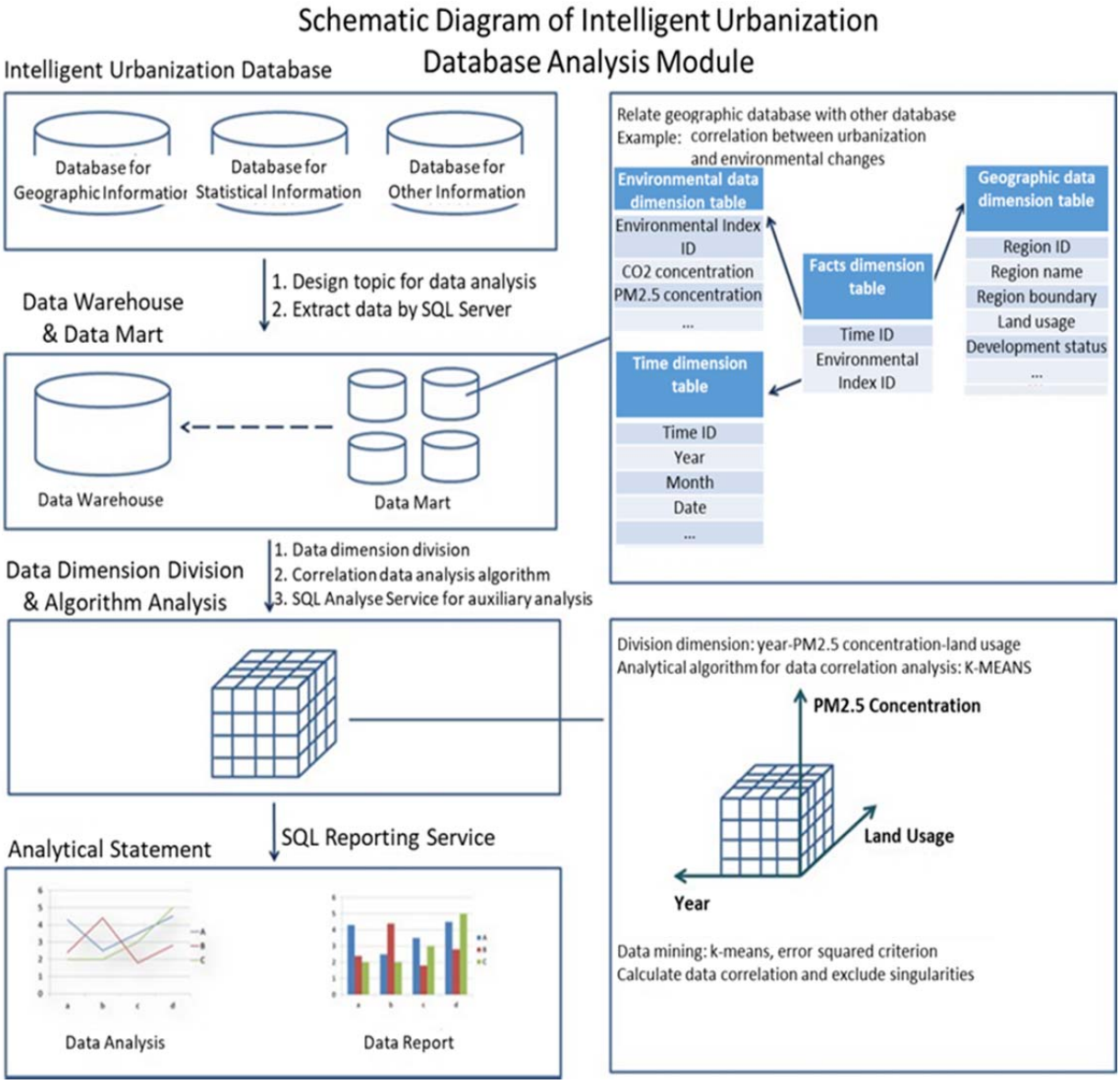

Figure 3: Intelligent Urbanization Database Analysis Modules

From the perspective of urban comprehensive management, the data support platform connects various original and newly-built business system data based on unified standards and logical database models, and it logically implements a physical distribution storage plan of core business data of the data centre. This ensures that data sources enter the system one at a time, are automatically summarized and updated, shared and used in multiple places. Meanwhile a data warehouse construction strategy is developed to ensure comprehensive information services, data mining and decision-making.

This database analysis module (Figure 3) is composed of four parts, each corresponding to primary data collection (first part - Intelligent Urbanization Database), data filtration and reprocessing (second part – Data Warehouse & Data Mart), data processing and analysis (third part – Data Dimension Division & Algorithm Analysis), and analysis report (forth part – Analytical Statement). The design of the system supports both data flow and the corresponding analysis; therefore its flexibility is able to meet various demands generated during planning work.

The overall architecture of the platform can be summarized as follows:

- ✓ **The data platform implements "urban and rural planning data sharing":**

The platform provides assistance for urban and rural planning through integration and sharing of local urbanization development data obtained during the process of local service establishment.
The data sharing system (Figure 4) starts from analysing the different needs for urban and rural planning and collects various pieces of information in real-time. This comprehensive information involves economy, population, industrial, tourism, historical protection, environment, transportation, municipal disaster prevention, and urban construction. The real-time data of the eight dimensions are collected and organized, establishing a database. The system provides the corresponding functions such as data query, browsing and downloading for planners to meet their needs. In addition, a cooperative database related to the application platform facilitates background management and database maintenance.

Figure 4: Map user interface of the Big Data analytics platform

In March 2014, “Urban and Rural Planning Data Sharing” (Figure 5) has been completed and applied in the Tongji Urban Planning and Design Institute in Shanghai. It is an upgraded version of the previous Intelligent Urbanization Database Analysis Module. The construction of a unified platform promotes information exchange and resource sharing of various design institutes and research centres in the research institute. The use of the same data sources by different projects effectively saves project cost. Moreover, the data collection times are clearly shortened and the work efficiency has been improved. Meanwhile, the demand-oriented modular model library allows for an easy accessibility for non-GIS professionals to the GIS technology, benefiting planning work in the application and promotion of new technologies.

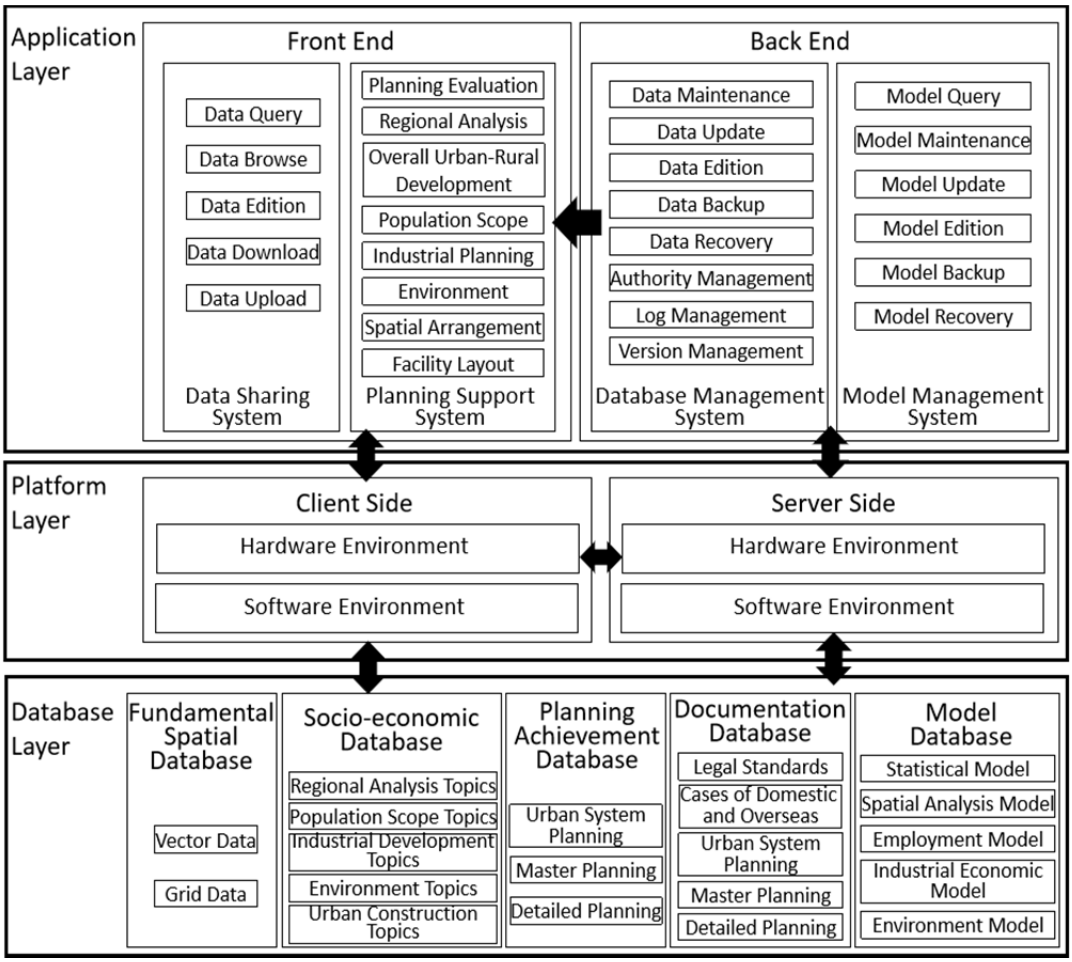

Figure 5: Schematic diagram of data sharing and planning support platform architecture for urban and rural planning

The overall concept is divided into three layers: the data layer, the middle layer, and the application layer. The function of each layer is clearly defined, and the coupling degree of each layer is reduced lowering the overall development difficulty, thus ensuring the quality of the project. The data layer realizes extraction, integration and storage of massive statistical data, geographic data and others related to smart urbanization. The middle layer implements data analysis and reuse of the underlying information, and it provides a report analysis tool and a Rest API interface for public users. The application layer realizes the database visualization access platform, supporting operations of uploading, querying, adding and modifying intelligent urbanization data, with functions that allow for possible subsequent analysing reports and GIS-based analytical

representations. The following is the framework of the intelligent urbanization data support platform.
The data acquisition is driven by multiple data acquisition methods. The main methods of obtaining the most important data are:

- information on life services provided by China telecom co. LTD;
- map content, navigation and location service information provided by Gaode Map;
- Geographic information and application analysis software related information provided by ESRI China;
- basic data for urban and rural planning and construction of various consulting service cities in China provided by Shanghai Tongji Urban Planning and Design Institute; and
- case study dataset of urbanization construction provided by CIUC.

In the future, it is planned to cooperate with the information centres of local governments to share some relevant data on urbanization.

Based on these available systems and data sources, the CIUC adapted and expanded the available platforms and the databases in order to satisfy the additional needs of the TRANS-URBAN-EU-CHINA project:

- The database was expanded to store the datasets needed by the project, e.g., by the datasets purchased from Oxford Economics including economic and social data from cities all over the world, and providing also historical as well as prognosis information. They are necessary to conduct city analyses (also over time) and to create the corresponding reports. The datasets are centrally stored and managed through the ArcGIS portal. They can be shared between partners upon request with the proper privileges.
- More functions were developed to accommodate the needs of the project including data analysis (e.g., traffic, air pollution). The taxi flow can be analysed by using the embedded Big Data analysis tools to reveal the traffic patterns within a city. The outcome can be used to diagnose issues in urban development.
- Additional user interfaces were implemented for extended functionalities required by different data types, e.g., the user interfaces for data analytics and visualization were created to facilitate the corresponding work (some samples have been listed in the document).
- The underlying architecture was revised to enable the communication between the CIUC and the CoC platform, in order to provide the necessary data transfer and analysis result information exchange. Currently the developers are implementing the communication between the CoC system and the CIUC Big Data platform in order to realize the information exchange between the two platforms. The data collected by the CoC platform will be transferred to the CIUC Big Data platform, where it will be analysed and visualized. In addition, a prototype for sentiment analysis was designed and developed, which will be eventually deployed for the analysis of the data collected by the CoC system.
- A more complicated and comprehensive user management functionality was designed and implemented. The ArcGIS portal provides an excellent framework for managing users and their privileges. It supports data sharing and exchanging, and posting analytical results in map formats. This technology facilitates greatly the collaboration between the project partners.

✓ **The platform provides the data and tools to support environmental protection:**

One of the major functions of the Big Data platform is to acquire air quality data automatically and to provide the tools to view, analyse, and report on air pollution, water quality, and other environment-related subjects. The analytical outcome provides the municipal administration with the information needed to make decisions for reducing air pollution, and increasing the quality of life for the residents. An example of real time air pollution (PM 2.5) is depicted in Figure 6.

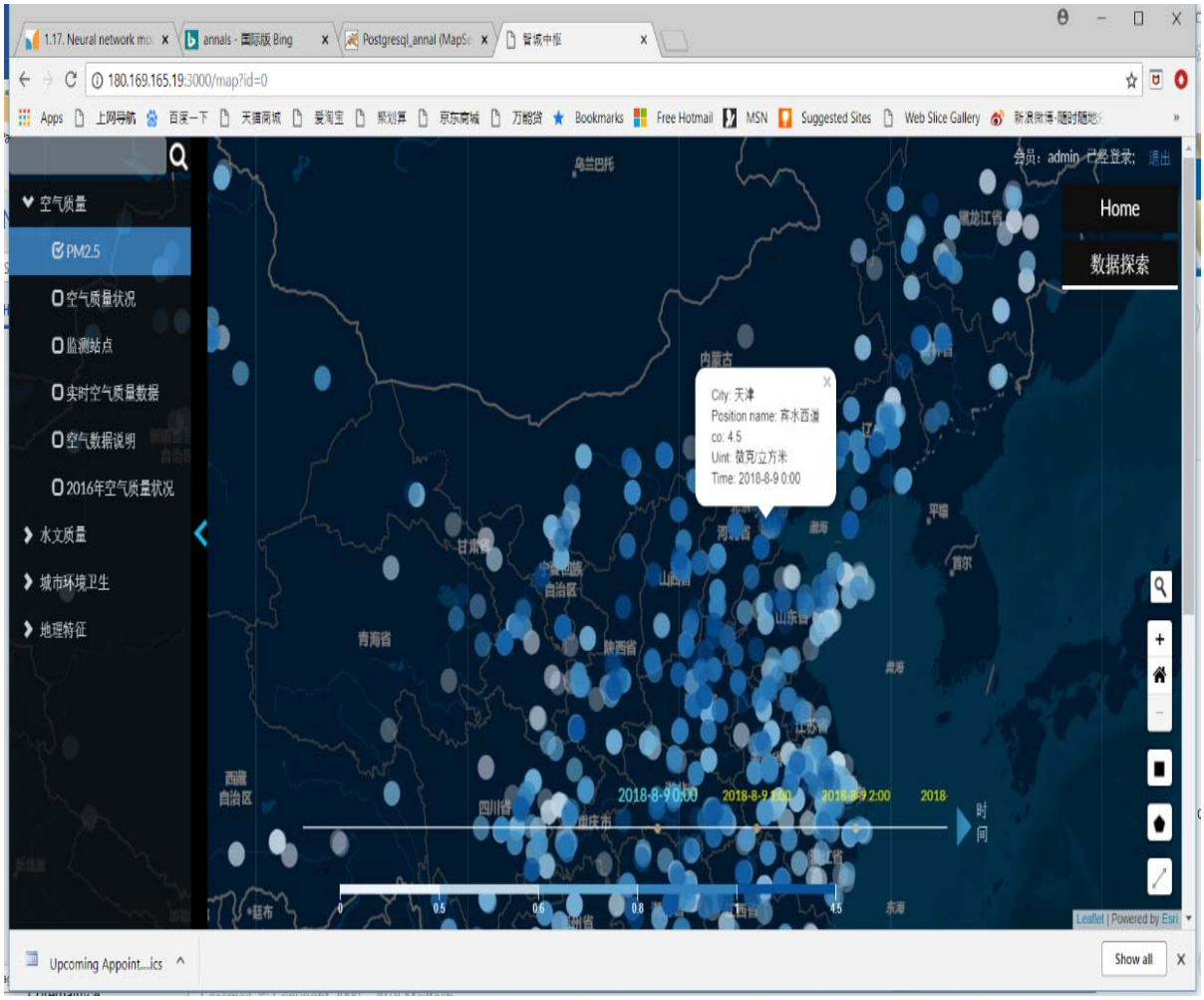

Figure 6: Overlay of environmental data on the Big Data analytics platform

✓ **The platform data supports decision-making in the transportation/traffic arena**

The Big Data platform allows also for analysing traffic situations for a certain area, for pinpointing traffic problems, e.g., to identify infrastructure bottlenecks, unreasonable traffic light settings, or hot spots during the rush hours (Figure 7). The data related to transportation can be viewed, analysed, and reported. The data can also be shared with team members to enable collaborative decision making. Since taxi data reflects the general traffic well, the platform provides also various datasets in this regard. One of the data usages is to predict traffic status (light, normal, congested) of a street block and can be visualized on the map. During peak hours and regular hours, the traffic patterns can be different. The Origin-Destination analysis (Figure 8) can be used by transport planners as an input

for transport models. The following diagrams illustrate traffic analyses based on taxi data stored in the application (hot spots and Origin-Destination analysis).

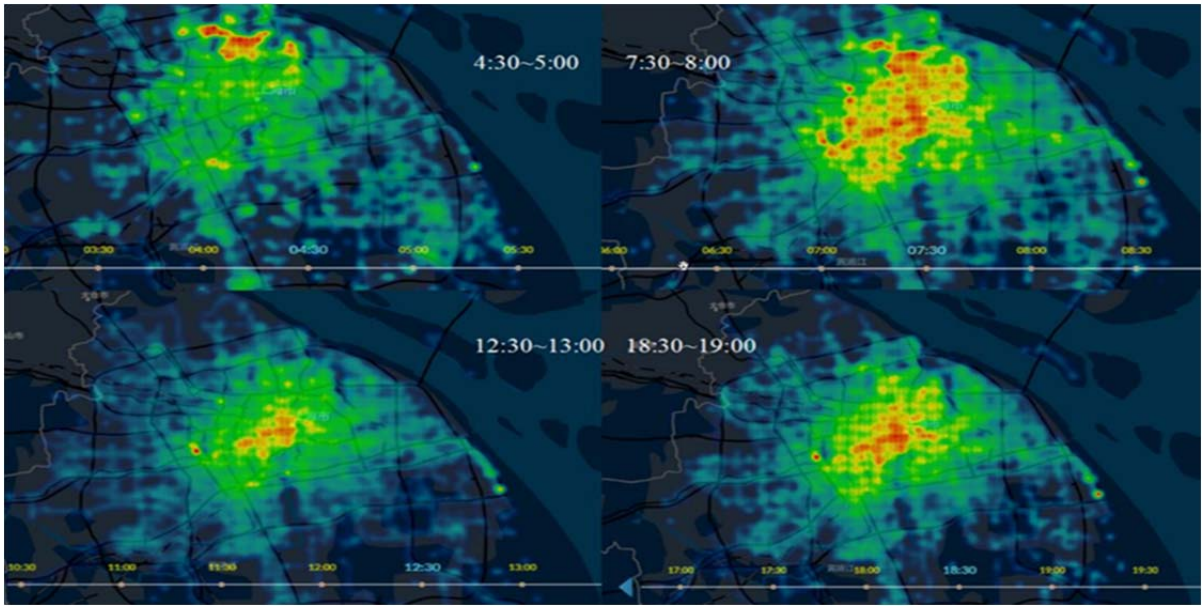

Figure 7: Overlay of traffic hot spot on the Big Data analytics platform

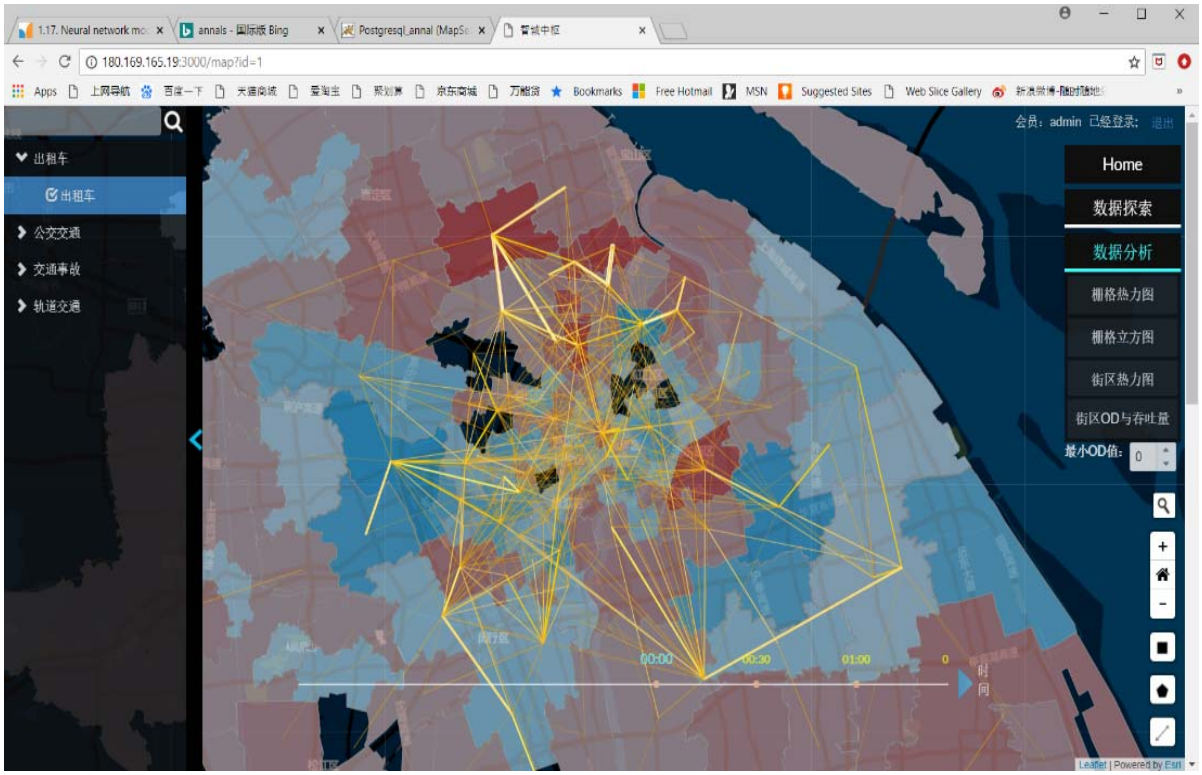

Figure 8: Overlay of Origin-Destination data on the Big Data analytics platform

Multi Data Sources and Advanced Data Acquisition Methodology:

Main data sources - besides government data on urbanization - are as follows:

- information on life services: provided by China Telecom Ltd;
- map content, navigation and location service information: provided by the Gaode Map;
- Geographic information and application analysis software related information: provided by ESRI China;
- basic data for urban and rural planning and the construction of various consulting services for cities in China: provided by Shanghai Tongji Urban Planning and Design Institute;
- case study datasets of urbanization construction: provided by CIUC

Together with the CoC platform (see Chapter 3 hereafter), the platforms will function as the information repository for the TRANS-URBAN-EU-CHINA project. The CoC system will retrieve the relevant information, and the collected data will be cleaned and transferred to the Big Data platform. Because of the analytical functionality built into the Big Data platform, the data collected through the CoC platform can be analysed through sentiment mining to find out the current hot or most concerned topics regarding the urbanization (smart city development), e.g., in respect to transportation or air pollution. By utilizing the data stored on the Big Data platform, the project partners are able to conduct various analyses to evaluate the development of a city and to diagnose if the development of a city is sustainable based upon the embedded indicator system.

The current CIUC platform is still at a prototypical stage, and it has not been tested thoroughly such as by high load tests. The platform will be integrated further with other subsystems such as the CoC system. The data collected by the CoC system will be transferred to the Big Data platform, where the sentiment analysis will be conducted. The analytical results will be visualized on the Big Data platform. The government agencies will be able to obtain the information what people (regular residents, urban planning scholars, etc.) care the most for, which problems need to be resolved and which decisions must be made to satisfy the residents. All these functions will be developed.

Furthermore, a user management mechanism will be created so that each user will have his/her associated privilege to access the data, view the data, and conduct the appropriate analyses.

3. The Community of Communities Online Platform

The purpose of the CoC online platform is to enable the collection, integration, and analysis of data of transformative knowledge that represent fundamental issues that emerge in new and existing cities in respect to the governance for urban planning of the urban growth processes.
The CoC platform is an enabling infrastructure for community building both for the consortium itself and for the Urban Living Labs (ULLs) in the near future. The knowledge that will be created and shared, will also serve the project internal communities, e.g., work packages and other self-organized communities, and each such special interest group (SIG) can demonstrate how all stakeholders can be empowered to engage, including citizens of the ULLs.
This platform can support the transition towards urban sustainability and can create socially integrative cities by enabling all stakeholders to create and exchange knowledge in regard to city planning and development, such as infrastructure, regulatory regimes, taxation, health, education and culture that have a bearing on the framework conditions which shape living conditions of residents.
The development and transition approach will be conducted by searching in this transformative knowledge, a common mentality base for community building; the data analysis will be done in order to assess best practices in place-making, quality of public space, public engagement, social cohesion and cultural heritage and to identify major themes that play a significant role in the transition of the communities into a necessarily 'urban' one.
The collection, integration, and analysis of these data pave the way for a quantitatively-based approach, a 'Digital Transition' to urban planning, thus enabling evidence-based governance for urban planning processes.
This bottom-up approach - an online 'Community of Communities' in the ULLs - will be established to collect transformative knowledge from citizens.

The following first steps have been taken to establish the Community of Communities online platform:

- Consider the WeChat platform as an important entry point for Chinese users: WeChat has more than 549 million monthly active users (MAUs) among over one billion registered users, almost all of them in Asia [6].
- Create a list of requirements for CoC, also based on past engagement with this kind of solutions in EU projects
- Look into other SaaS mobile + web platforms in order to complete missing functionalities while keeping WeChat as the main communication tool, if possible
- Make sure that the chosen System/s are compatible with Chinese requirements and are able to pass the Chinese firewall.
- Make sure the SaaS system is open source and that its API is program-friendly
- Create groups and interest topics, and start user engagements.
- Make sure to install a backup in a western server.

3.1 Introduction of the CoC Online Platform

The online platform for the Community of Communities (CoC) is a reboot from scratch (Figure 9),

i.e., an attempt to design customised services for citizens, urban authorities' representatives, real estate developers, private business owners, public service providers, etc.

The platform includes a trust system, which means that the community builds a natural immune system to defend itself from trolls, bad influence, and spammers, and the most engaged community members can assist the governance of their community. The system adds a trash can on every street corner with a simple, low-friction flagging system. Positive behaviour is encouraged through likes and badges.

The platform is 100% open source. It belongs to the community as much as it belongs to its developers. Everything that most communities would want is included and accessible through an Application Program Interface (API).

The platform hides the system complexity and puts just the essential information onto the user screen such as the conversations most cared about, based on the current user interests.

In order to create larger circles of stakeholders and interest by the community, there are some ease-of-use functions that are expected also in the CoC platform and are familiar from big social websites such as Twitter or Facebook, e.g., mention someone by @name, paste in a link or an image, simple quoting and linking of replies and topics, reply wherever you are, online or via email.

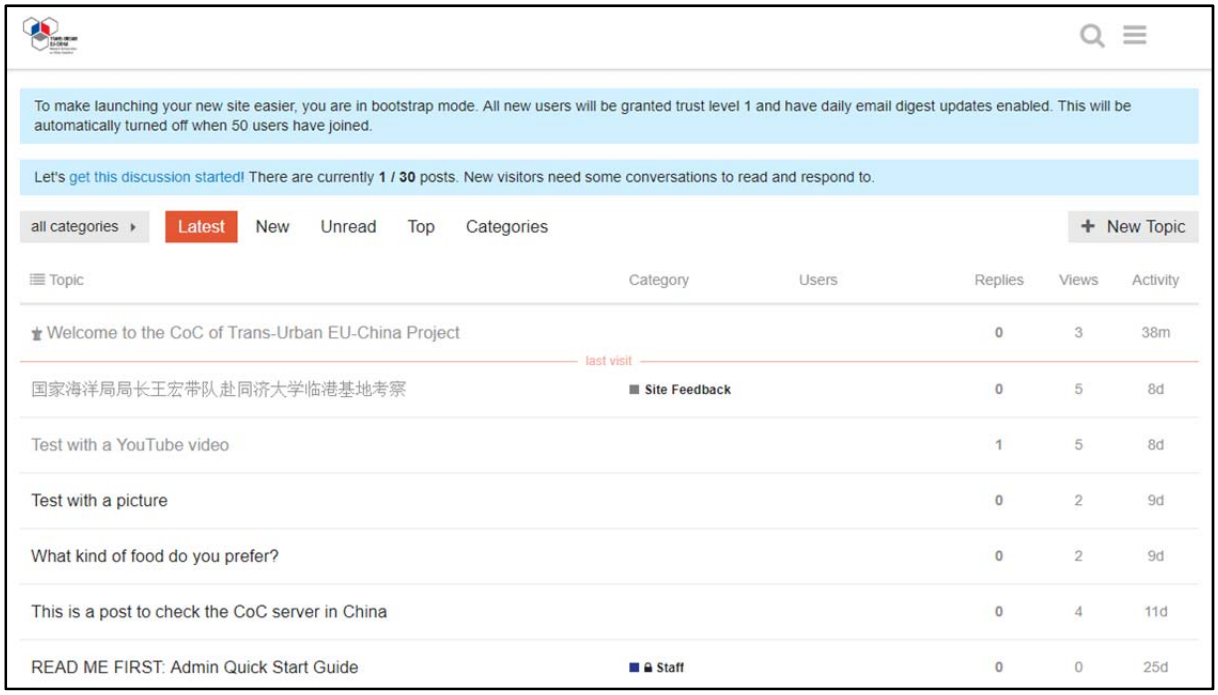

Figure 9: Screenshot of the CoC Platform administration screen

3.2 The CoC Online Platform Objectives

A CoC platform is known to be one of a few efficient tools to create engagement within a defined community [12] [13]. One objective regarding smart cities is to create three types of user groups:

- The researchers, who will share the ongoing topics, publish research, and make conclusions,
- the residents in the chosen cities or living labs,
- different interest groups such as mayors, external experts, and technology leaders.

The major objective for such a system is the creation and upkeep of a vibrant community with relevant data that will allow for extracting insights for future conclusions.

3.3 The CoC Online Platform Requirements

A list of required functionalities must be developed in order to make sure that a system is well suited for the target communities. For the two user groups, the professional stakeholders and the city residents, the following features of the CoC online platform have been identified:

- Discussion boards
- Unlimited number of groups/participants
- Public and private groups
- Categories or tags support (such as R&D, financial, communities, and more)
- Search capabilities
- Unique URL to point to a specific post
- Push notifications and email support
- Newsletter by email
- Mobile compatibility (responsive support and/or native applications)
- Open Source and SaaS (Software as a Service)
- Social login (also WeChat, depending on technical feasibility)
- Data collection (for data collection and analytics)
- Work in Chinese and English
- Translation into Chinese/English
- API connectivity

3.4 The CoC Online Platform Features

Social login

Make sure that the user experience for your audience is as rich as possible. Being an open source system the CoC enables connectivity and to easily add common social logins (Figure 10) like Google, Facebook, Instagram, Twitter, Yahoo, and GitHub. However, it is obvious, that this will work only on a 'Western' server since most Western social networks are not accessible from within China. Therefore, the system will also provide WeChat logins for an easy login procedure of Chinese users (Figure 11).

Figure 10: Social login options to login into the system

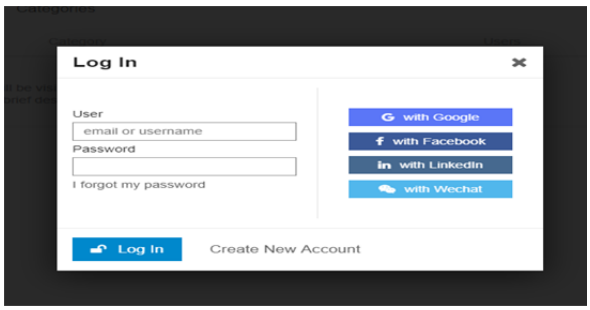

Figure 11: Social login options to login into the system including WeChat

Categories

Categories (Figure 12) provide the context where users can relate to the discussion they would like to join or create - and provide the best way to work both in a synchronous and asynchronous way. The categories will be defined by the administrators as initial topics that are general enough to include as many specific topics as possible. In addition, it might be necessary that a few 'community managers of the ULLs (Urban Living Labs) will have the ability to create more categories in order to allow for a social bottom-up approach of data.

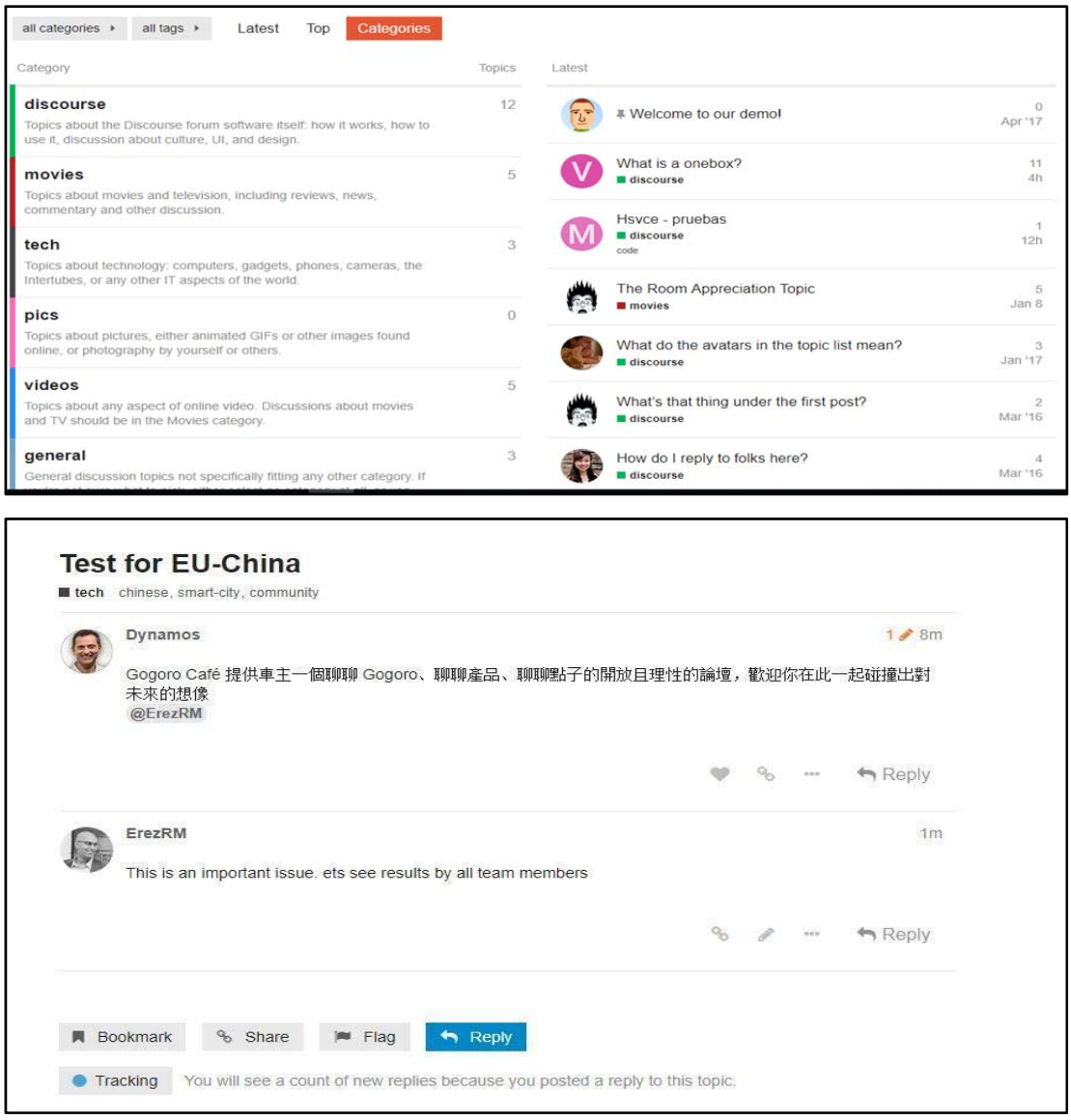

Figure 12: Categories page

Conversations

The platform main feature is a conversation (Figure 13). Opposed to the creation of pages, the conversation is easy to create, join and use. In addition, it is also very easy to find previous data by just scrolling the topic.

This main feature is a simple, flat forum, where replies flow down the page in a line. Expand context at the bottom and top of each post, and also in quotes, to reveal the full conversation without losing one's place.

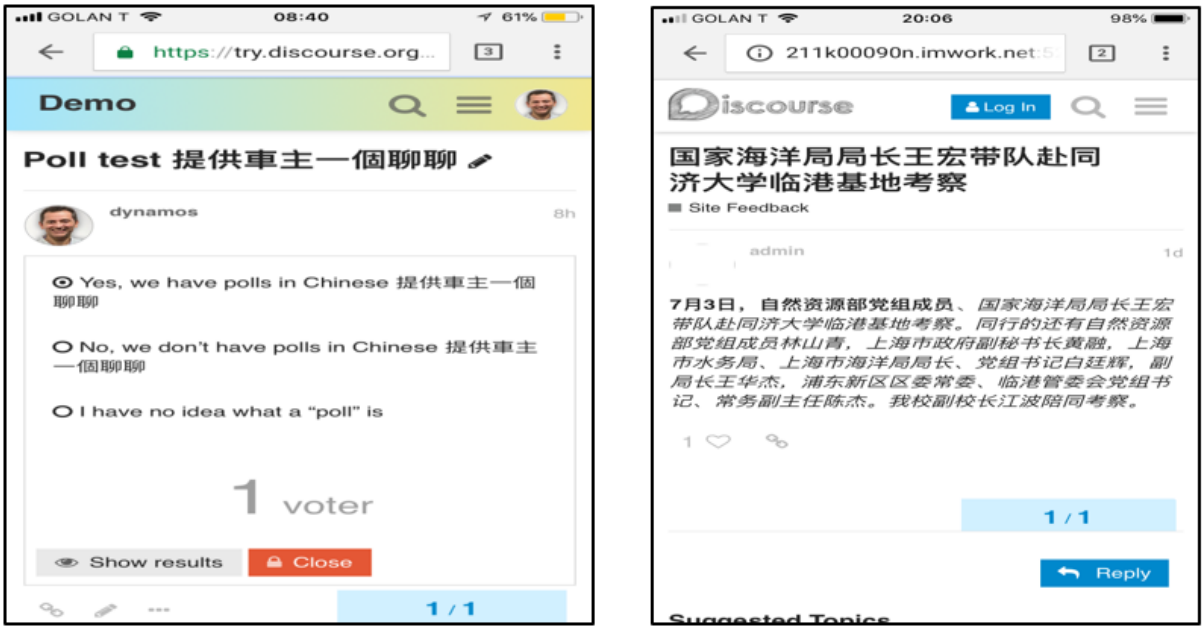

Figure 13: Conversation examples

Mobile compatibility

The CoC is designed for high resolution touch devices, with a built-in mobile layout. It can be read or posted from a laptop, tablet, and phone in a browser via link of choice, or native apps, on both IOS and Android. Since a CoC platform is a community tool, and the objective is to maximize engagement of its users, a mobile interface must be provided

Admin dashboard

One most relevant and essential community health metrics are only a click away for the administrators. This feature allows them to extract what is mostly unstructured data and output of structured data (such as daily active users <DAU> and monthly active users <MAU>) for later data analysis and better results (Figure 14).

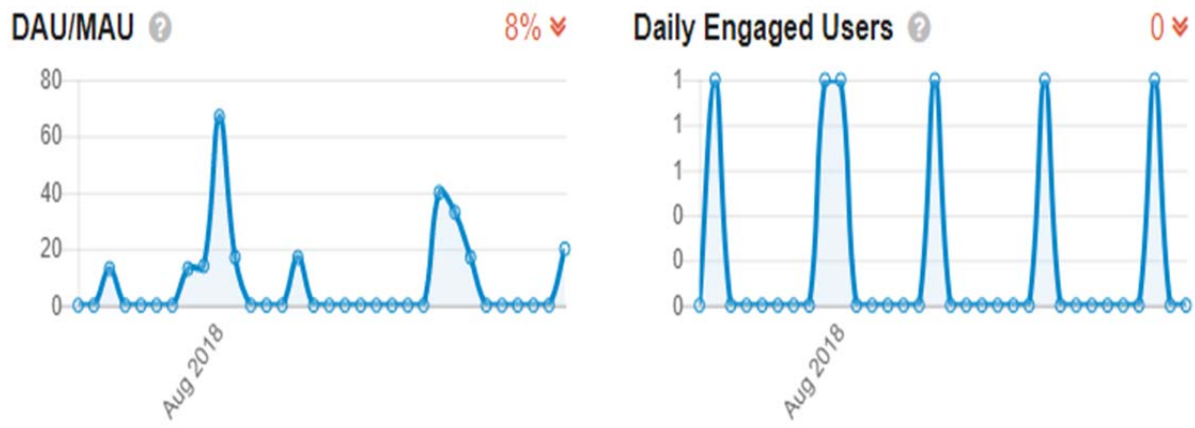

Figure 14: Infographic example for admin on user behaviour

Multi Language Interface

As mentioned before, a major goal of the CoC online platform is to address residents and communities that are living in the chosen area. Therefore, the interface of the system will have to change to the relevant languages the target communities feel comfortable with. This can be determined via IP identification, in order to let the system adjust the language. The system supports above 87 project languages. Up to now the system is 87% translated, and we have access to a tool to complete the 800 strings we need to add in case it is a must.

3.5 The Backup CoC Online Platform Server

The CoC Online Platform tests revealed some technical and regulatory communication features for a server located in China suggesting that it would be helpful to pilot also a version of the server outside of China (Figure 15).

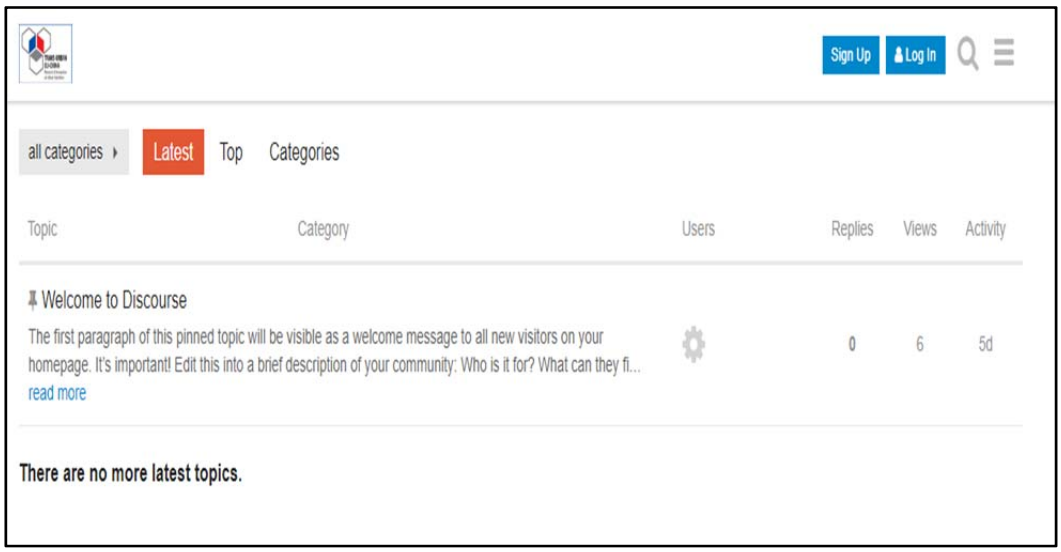

Figure 15: Discourse user interface of the CoC pilot outside of China

This EU CoC pilot can be accessed through the dedicated URL www.LivingSmartLab.com that can be changed if/when relevant.

A key success factor of TRANS-URBAN EU-CHINA will be the interdisciplinary working and sharing of knowledge among the different work packages and partners. The ULLs will bring together researchers involved in WPs 1-4 along with urban authorities, developers, planners, citizens and other stakeholders. New theories, definitions, working processes, business models, services and products will be developed, tested and refined through iterative processes between WPs 1-4 and the ULLs. The Online CoC will help to gather and analyse this data. Furthermore, it enables the WPs to share knowledge with other WPs in special conversation groups.

Current limitations of the CoC online platform:

- User cannot Login via WeChat yet
- User cannot translate English to Chinese and vice versa

Next steps:

- Removing the WeChat limitation
- Adding a translation feature to all languages
- Creating online events (e.g. workshops) to expose all ULL participants to the CoC platform.

4. The Data Analysis Platform for the CoC Online Platform

The constant growth of real-world “human behaviour” data (e.g., governmental data, mobility data, mobile call data) is an opportunity to address fundamental issues that emerge in new and existing cities with respect to the governance and planning of the urban growth processes: transport and mobility, avoidance and mitigation of environmental risks such as air pollution, ensuring of public health and well-being, and inter-municipal cooperation. The collection, integration, and analysis of these data pave the way for a quantitatively-based approach, a ‘Digital Transition’ to urban planning, thus enabling evidence-based governance for urban planning processes. This top-down approach is complemented by a bottom-up approach: an online ‘Community of Communities’ in the Chinese Living Labs will be established to collect transformative knowledge from citizens. The outcome of Big Data analysis and of the data collected by ‘Community of Communities’ online platform will be combined, thus providing a picture of transformative knowledge from all stakeholders in the researched areas.

Together with the ISCI, the CIUC has set up the CoC online platform on a CIUC server and the data analysis environment (see chapter 2) that is necessary for the analysis of the data originating from the CoC online platform:

- A virtual machine (server) with the required resources to host the CoC platform
- The server was tested to ensure it works as desired
- The required software was installed to support the CoC platform
- The testing accounts for partners were set up to test the platform
- Trouble-shooting was performed upon partners’ requests
- A solution was provided to resolve the issues in sending email confirmations upon registration on the CoC online platform.

The CIUC will create a portal for open data and Big Data analytics based upon the ArcGIS portal technology [1], which will be communicating with the CoC platform. In this case, the information captured by the CoC online platform will be transferred to the portal, where the data will be analysed, mined, and displayed. The users of the portal are able to access, view, and analyse the corresponding information upon their concrete privileges. The research results can be shared within proper groups in order to facilitate the research process and the cooperation. This portal facilitates the data and user management since it allows the system administrator to create the groups, and to assign appropriate privileges to various users. All user activities will be monitored and logged.

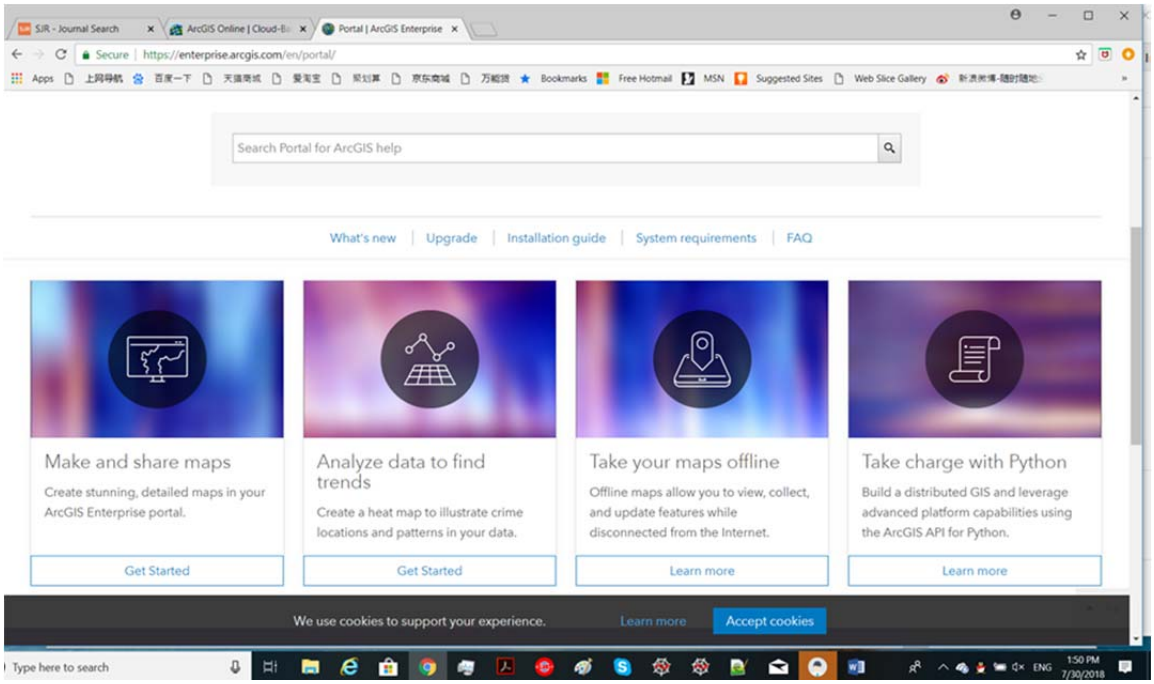

Figure 16: Overview of the ArcGIS portal.

The functions provided by the ArcGIS portal (Figure 16) will be used to share the data (information) streamed from the CoC online platform. The portal will also integrate other open datasets (Figure 17). Currently, it already contains the Big Data platform and other features developed by CIUC.

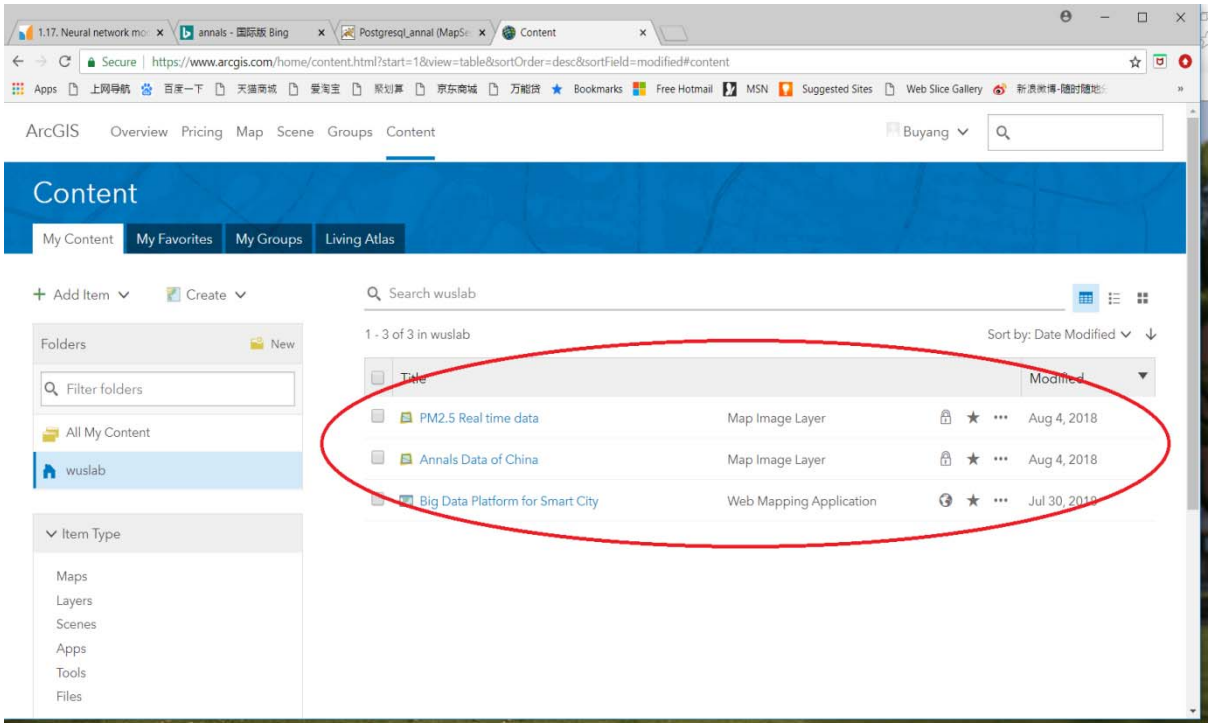

Figure 17: Data set integration in the ArcGIS portal

A user group will be created consisting of different users with various privileges. Currently three resources are added to the group, which will be shared with the users within the group correspondingly. One of them is the annals of each city in China (Figure 18), which can be shown in a table (as depicted in the following diagram) and also in other forms (e.g., maps and hot-spots):

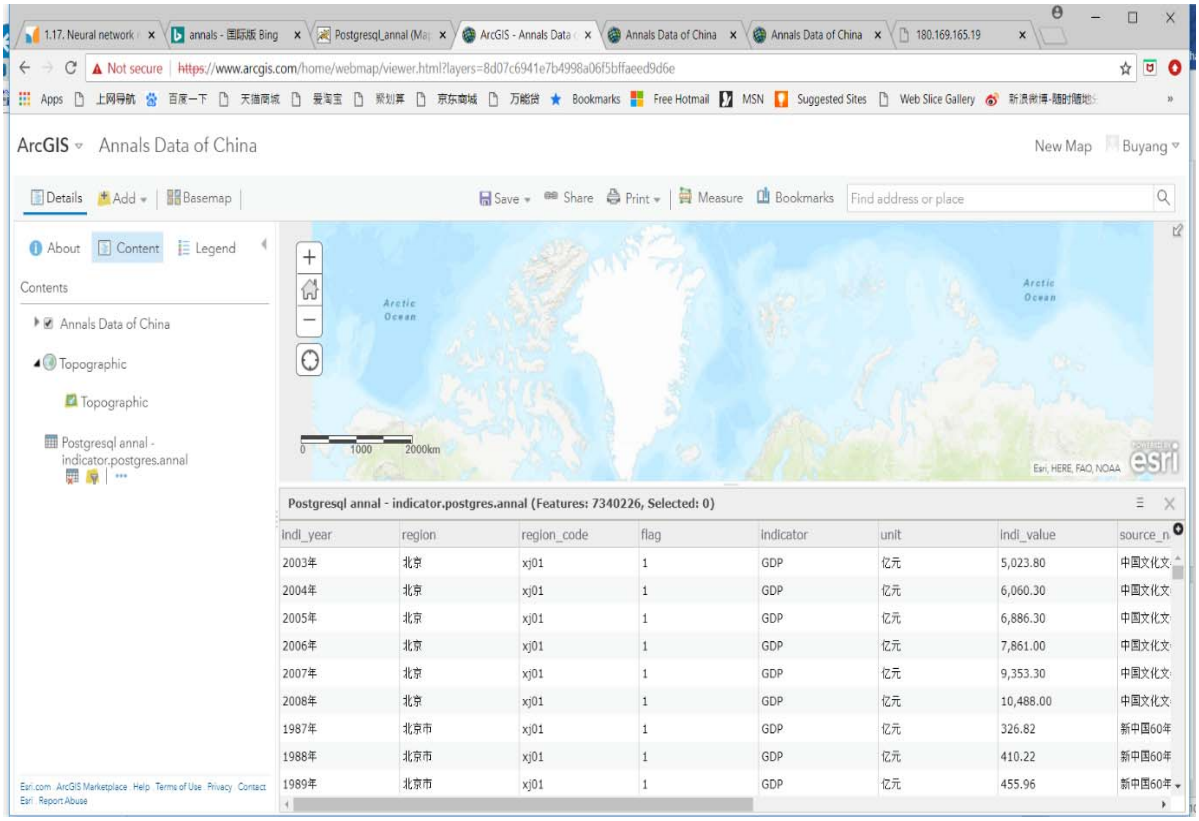

Figure 18: Annals Data of China interface

As soon as the CoC online platform data will be available, maps can generated to show the trends or hot topics in certain areas combining spatial data with the data from the CoC online platform. The Big Data analytics will be performed by applying the underlying functions of the ArcGIS portal. Any authorized researcher from the TRANS-URBAN-EU-CHINA project team can use the data to create various reports and share them with other project members.

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