SuMoCoS

Sustainability and Mobility in the Context of Smart Cities

Book of Abstracts

International Conference on Sustainability and Mobility in the Context of Smart Cities

Ulaanbaatar
September 24-28, 2019

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ULAANBAATAR

GOVERNMENT OF MONGOLIA MINISTRY OF ROAD AND TRANSPORT DEVELOPMENT

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Book of Abstracts

International Conference on Sustainability and Mobility in the Context of Smart Cities

Ulaanbaatar Edition

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Overview

The SuMoCoS project (Sustainability and Mobility in the Context of Smart cities) is a travelling conference with project partners in Germany, Uzbekistan and Mongolia. It is funded by the Federal Ministry for Education and Research (BMBF) under the Travelling Conferences grant.
The aim of the project is to strengthen the cooperation between all project partners and to further deepen the understanding of the theoretical and practical challenges of Smart City projects in Central Asia. In addition, there will be an exchange of knowledge between the participants with the aim of deepening and promoting cooperation in research and economic projects.

Project Description

Cooperation on issues such as environmental protection and mobility can lead to new solutions for preventing and reducing air pollution. For cities confronted with the possibility of driving bans, such as Oldenburg, and for cities with high pollution levels, such as Ulaanbaatar, effective methods to reduce exhaust emissions are urgently needed. Other participating cities may be able to proactively apply the findings directly before facing similar problems. In view of this major task, the SuMoCoS project aims to strengthen the international collaboration of researchers and provide relevant scientific contributions for the development of sustainable solutions based on the Smart City approach.
Through the participation of partners from Mongolia and Uzbekistan, the added value arises that the two cities Ulaanbaatar and Tashkent not only get to know practical Smart City applications from German cities, but also from cities in another emerging country with similar (but regionally different) prerequisites, challenges and approaches. In addition, the German partners can compare the approaches in both cities and possibly gain valuable insights from the differences.
The two international partners have similar core interests (including smart city applications to reduce environmental pollution and improve mobility), but also set different priorities: While the Uzbek partners attach importance to issues such as improved security and the reduction of corruption, the Mongolian partners tend to focus on issues such as improved traffic control. These different aspects of Smart City applications complement each other well and are to be synchronized via the German partners.
The following measures are planned to implement the objectives:

- Workshop in Ulaanbaatar: A four-day workshop with lectures by German and Mongolian partners, industry lectures, doctoral lectures and planning meetings.
- Visit of Ulaanbaatar: Exchange with representatives of the city on the topics of sustainability and mobility.
- Workshop in Tashkent: A four-day workshop with lectures by German and Uzbek partners, industry lectures, doctoral lectures and planning meetings.
- Visit of Tashkent: Exchange with representatives of the city on the topics of sustainability and mobility.
- Excursion to Samarkand: One-day excursion and exchange with MAN representatives on the subject of urban mobility.

- Workshop in Oldenburg: One-day workshop at the end of the project and for deeper networking of the German project partners.

The added value of international cooperation lies both in deepening existing contacts (Oldenburg/Uzbekistan and Braunschweig/Mongolia) and in initiating new contacts and partnerships. Young academics are actively supported by one day each of the workshops in Tashkent and Ulaanbaatar being reserved for lectures and discussions by German, Uzbek and Mongolian doctoral students and young academics. Through the workshops and especially through the participation of both scientific and entrepreneurial partners, it will be possible to exchange knowledge and experience on sustainability and mobility in the context of a Smart City with the Uzbek and Mongolian partners. In this context, both the partners in the target countries with their urgent questions in this area and the German partners such as the City of Oldenburg can benefit from the experiences of the other international partners. In addition, it is possible to present the capabilities of German companies and research institutions, which can lead to the testing of joint activities and research and application in the field of Smart City technologies.
The international partners in Mongolia and Uzbekistan support the project organisatically, by providing space and infrastructure, as well as by the participation of competent and experienced scientists, representatives of the cities and representatives of companies.
The planned project strengthens and expands the existing cooperation with two emerging countries. This effect is reinforced by the fact that not only local representatives from the respective cities (Tashkent, Ulaanbaatar), but also representatives from other cities and institutions in the region (Urgench, Nukus, Samarkand, Mongolian Ministry of Roads and Transport, Mongolian Academy of Sciences) participate in the planned international workshops. The international partners include outstanding institutions in research and teaching in the region (TUIT University of Tashkent with several branches, Mongolian Academy of Sciences). The planned project strengthens and expands the existing cooperation with two emerging countries. This effect will be reinforced by the fact that not only local representatives from the respective cities (Tashkent, Ulaanbaatar) will participate in the planned international workshops, but also representatives from other cities and institutions in the region (Urgench, Nukus, Samarkand, Mongolian Ministry of Roads and Transport, Mongolian Academy of Sciences). The international partners include outstanding institutions in research and teaching in the region (TUIT Tashkent University with several branches, Mongolian Academy of Sciences).
The topics of sustainability and mobility in the context of Smart Cities dealt with at the international workshops, but also the protection of personal rights in the implementation of Smart Cities, will occupy the participating cities from a practical point of view and the participating research institutions from a theoretical point of view even longer. Therefore there is a lot of potential for further projects. The DLR Institute of Transport Systems Engineering can draw on very detailed projects on urban mobility, while the University of Oldenburg looks more closely at smart cities from different perspectives (sensor-based environmental information systems, energy concepts, legal considerations, mobility in urban and regional networks, etc.). Together with the partners involved, a competence atlas "Smart Cities" is to be drawn up at the end of 2019.

Introduction

This booklet reflects the Mongolian Issue of that conference series held in Ulaanbaatar in September 2019.

Project partners:

- University of Oldenburg, Department of Software Engineering: Prof. Dr. Andreas Winter (project lead)
- Deutsches Zentrum für Luft- und Raumfahrt (DLR), Institute for Traffic System Technology: Prof. Dr. Frank Köster
- University of Oldenburg, Department of System Software and Distributed Systems: Prof. Dr. Oliver Theel
- University of Oldenburg, Department of Very Large Business Applications: Prof. Dr. Jorge Marx Gómez
- University of Oldenburg, Interdisciplinary Centre for Law in the Information Society (ZRI): Prof. Dr. Jürgen Taeger
- OFFIS Institute for Informatics: Prof. Dr. Wolfgang Nebel, Prof. Dr. Sebastian Lehnhoff
- Oldenburger Energiecluster OLEC e.V.
- embeteco GmbH & Co. KG
- erminas GmbH
- ecology + communication Unternehmensberatung GmbH (ecco)
- Electric-Special Photronicsysteme GmbH
- OECON Products & Services GmbH
- atene KOM GmbH
- Bahnkonzept GmbH
- Tuvd Agency
- City of Oldenburg
- Tashkent University of Information Technologies (TUIT)
- Urgench branch of TUIT
- Nukus branch of TUIT
- City of Samarkand
- City of Urgench
- City of Nukus
- JV MAN Auto-Uzbekistan
- Mustafo Software LDT
- Mongolian Ministry of Road and Transport Development
- Mongolian Academy of Sciences
- Ulaanbaatar City Government

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The atene KOM GmbH was founded in 2007 and currently employs more than 250 permanent staff. The company's headquarter is in Berlin with locations in Germany and Europe.

As a consulting company, the atene KOM GmbH supports cross-industry players from administration, industry, science and politics in the development and implementation of viable solution concepts in various subject areas.

From the broad range of thematic questions a comprehensive expertise was built up, which supports the development of individual and pragmatic solution concepts. This broad knowledge is used locally and regionally, but also at national and European level in projects with different structures. The atene KOM GmbH can rely on a long-standing network of companies, scientific, municipal and supra-regional public institutions as well as decision-makers of all levels throughout Europe.

The atene KOM GmbH successfully initiates and supervises cross-sector and transnational networks, using its specific competences and experience in bringing together differing interests of various stakeholders. In order to achieve a common goal, businesses, scientific institutions and communities are actively involved in the all phases of conceptual and practical work.

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24-Sep-2019, Tuesday, Day 1 (09:00-18:00)

Smart City Foundations

Time	Activities
08:30-09:00	*Registration*
09:00-10:30	**Session 1.1: Opening**
09:00	**Opening speeches** • *Academician Regdel Duger (President of Mongolian Academy of Sciences)* • *Batbold Sandagdorj (State Secretary of Ministry of Road and Transport Development)* • *Khaliunbat Myagmarjav (Deputy Governor of the Capital city in charge on Innovation and Technology, Governor's Office of the Capital City)*
09:30	Introduction to Travelling Conferences *Christian Schönberg (University of Oldenburg)*
09:45	Introduction of MAS and Mongolian Universities *Organizing committee (Mongolian Academy of Sciences)*
10:15	Introduction of DLR and Delegation *Christian Rahmig (DLR)*
10:30-11:00	*Coffee & Tea*
11:00-12:30	**Session 1.2: Introduction of Partners**
11:00	Introduction of University of Oldenburg and Delegation *Johannes Meier (University of Oldenburg)*
11:30	Smart Cities viewed as IoT Systems *Andreas Winter (University of Oldenburg)*
12:00	**Keynote Presentation** Transport Strategy of Mongolia *Mergen Rentsen (Director General of the Policy and Planning Department, Ministry of Road and Transport Development)*
12:30-12:40	*Group Photo*

12:40-14:00	*Lunch*
14:00-15:30	**Session 1.3: Smart City Concepts and Methodologies**
14:00	**Keynote Presentation** Smart City Ulaanbaatar *Khaliunbat Myagmarjav (Deputy Governor of the Capital city in charge on Innovation and Technology, Governor's Office of the Capital City)*
14:30	Mobility platforms as a key element for sustainable mobility *Alexander Sandau, Jorge Marx Gómez (University of Oldenburg)*
15:00	Evaluating Smart Cities *Burmaa Myagmar, Zaya Mashlai (Mongolian University of Sciences and Technology)*
15:30	**Poster Pitches**
15:45-16:15	*Coffee & Tea*
16:15-17:45	**Session 1.4: Interactive**
16:15	Envisioning smart cities & regions, some examples from Europe *Peyman Khodabakhsh (atene KOM GmbH)*
16:30	Panel discussion Topic: Potential of Smart City Approaches in Mongolia Panellists: • *Prof. Dr. Andreas Winter (University of Oldenburg)* • *Hilmar Bunjes (erminas GmbH)* • *Acad. Avid Budeebazar (Mongolian Academy of Sciences)* • *Mr. Khaliunbat Myagmarjav (Deputy Governor of the Capital city in charge on Innovation and Technology, Governor's Office of the Capital City)* • *Dr. Odgerel Ulziikhutag (Senior Officer at Policy and Planning Department, Ministry of Road and Transport Development)* Moderator: *Dr. Christian Schönberg (University of Oldenburg)*
18:00	*Daily Closing*

25-Sep-2019, Wednesday, Day 2 (09:00-18:00)

Use Cases and Industry Solutions

Time	Activities
08:30-09:00	*Registration*
09:00-10:30	**Session 2.1: Infrastructures**
09:00	Dependable Sensor Network for Smart Cities *Oliver Theel (University of Oldenburg)*
09:30	Industrial IoT – Improving manufacturing processes and enhance production machines *Yvette Teiken, Hilmar Bunjes (erminas GmbH)*
10:00	Developing the Smart City based on Internet of Things *Khishigjargal Gonchigsumlaa, Uranchimeg Tungalag, Narantsetseg Yadmaa, Chuluunbandi Naimannaran (Mongolian University of Sciences and Technology), Erdenetuya Dorj (Tokushima University)*
10:15	Digital infrastructure as a fundament for smart cities and regions *Annette Schumacher (atene KOM GmbH)*
10:30-11:00	*Coffee & Tea*
11:00-12:30	**Session 2.2: Mobility**
11:00	Digital Urban Mobility *Christian Rahmig (DLR)*
11:15	Smart Mobility Solutions by OECON *Christian Rahmig (DLR), Fatih Özel (OECON)*
11:30	Conception of a product service management system for the marketing of customer-specific services in the mobility sector *Alexander Sandau, Jorge Marx Gómez (University of Oldenburg)*
11:45	Smart Mobility in the energy system, its features and challenges *Zagdkhorol Bayasgalan, Tsetsgee Bayasgalan (Mongolian University of Sciences and Technology), Muzi Francesco (University of L'Aquila)*

12:00	Routing in Oldenburg *Johannes Meier, Oliver Theel, Andreas Winter (University of Oldenburg)*
12:15	Polycyclic aromatic hydrocarbons (PAHs) associated with PM10 among Ger districts in Ulaanbaatar, Mongolia: concentration, distribution, and cancer risk assessment *Khulan Tsermaa, Soyol-Erdene Tseren-Ochir (National University of Mongolia), Günter Bambauch (University of Stuttgart), Amarsanaa Badgaa (Mongolian Academy of Sciences)*
12:30-14:00	*Lunch*
14:00-15:30	**Session 2.3: Education and Privacy**
14:00	Introducing a "SMART" concept in engineering curriculum *Bayarmaa Tsogtbaatar (Institute of Engineering and Technology), Bolormaa Dalanbayar, Lodoiravsal Choimaa, Enkhdul Tuuguu (National University of Mongolia)*
14:15	Towards a system for data transparency to support data subjects *Christian Janßen (University of Oldenburg)*
14:30	Privacy and smart traffic management *Boris Reibach (University of Oldenburg)*
15:00	*Discussion of Legal Aspects*
15:30	**Poster Pitches**
15:45-16:15	Coffee & Tea
16:15-17:45	**Session 2.4: Breakout Session**
16:15	**Poster Pitches**
16:30	Collection of Topics of Interest
17:00	Table Discussions on Collaborations
18:00	Daily Closing
19:00	Conference Dinner

26-Sep-2019, Thursday, Day 3 (09:00-18:00)

Young Scientists

Time	Activities
08:30-09:00	*Registration*
09:00-10:30	**Session 3.1: Describing Smart Cities**
09:00	Integrated IoT Languages *Muzaffar Artikov, Johannes Meier, Andreas Winter (University of Oldenburg)*
09:30	Semantic Technologies for Smart Cities *Christian Schönberg (University of Oldenburg)*
10:00	ECOSense - Collection and analysis of cycling data *Kyra Pelzner, Ronald Bankowsky (baron mobility service GmbH), Christian Stehno, Eduard Sartison (CoSynth), Jorge Marx Gómez, Christian Janßen, Johannes Schering, Rene Kessler, Viktor Dmitriyev (University of Oldenburg)*
10:15	Economic instruments for water management of Mongolia: Analysis of water pollution control by economic instruments *Batsuuri Janyansuren, Gerelchuluun Javzan (Water Service Regulatory Commission of Mongolia)*
10:30-11:00	*Coffee & Tea*
11:00-12:30	**Session 3.2: Environmental Challenges**
11:00	Air pollution study in Ulaanbaatar City *Amarsaikhan Damdinsuren, Jargaldalai Enkhtuya, Enkhzul Natsagdorj, Tsogzol Gurjav (Mongolian Academy of Sciences)*
11:15	Use of Environmental Biotechnology approaches in remediation of soil pollution in Ulaanbaatar city *Munkhtsetseg Tsednee (Mongolian Academy of Sciences)*
11:30	Lead Removal from contaminated soil using electrokinetik remediation method *Khasbaatar Dashkhuu, Nyamtseren B., Undrakh B. (National University of Mongolia)*

11:45	Spatial and Temporal Variations of Sediment Metals in the Tuul River, Mongolia *Soyol-Erdene Tseren-Ochir, Enkhdul Tuuguu, Dorj Daichaa, Ulziibat Bilguun, Enkh-Amgalan Tseveendorj (National University of Mongolia) Saulwood Lin (National Taiwan University), Kuo-Ming Huang (Chien-Hsin University of Science and Technology)*
12:00	*Discussion on matching IoT Approaches*
12:30-14:00	*Lunch*
14:00-15:30	**Session 3.3: Energy and Participation**
14:00	Energetic neighbourhoods & inhouse energy management *Jörg Bremer (University of Oldenburg)*
14:30	Current conditions and simple solutions for a human-friendly mobility in Ulaanbaatar city *Amarjargal Nayanbaatar (City of Ulaanbaatar)*
14:45	Energy efficient Building Refurbishment in Mongolia – Technical Cooperation Project by the German Government *Thorge Ketelhodt (GIZ)*
15:00	Research on Public Electric Transport possibilities in Ulaanbaatar City *Sergelen Byambaa, Otgontumut Gantumur (Mongolian University of Sciences and Technology), Nomuulin Batjargal (Railway Institute)*
15:15	Green area change study in Central Ulaanbaatar using very high resolution QuickBird images *Nyamjargal Erdenebaatar, AmarsaikhanDamdinsuren, Munkh-Erdene Altangerel (Mongolian Academy of Sciences)*
15:45-16:15	Coffee & Tea
16:15-17:45	**Session 3.4: Finalization**
16:15	Presentation of Results and Discussion
17:30	Concluding Remarks
18:00	Conference Closing

27-Sep-2019, Friday, Day 4

Field Trip I

Time	Activities
	Mobility
	Destination 1: New International Airport 
	Energy
	Destination 2: Salkhit Wind Farm 

28-Sep-2019, Saturday, Day 5

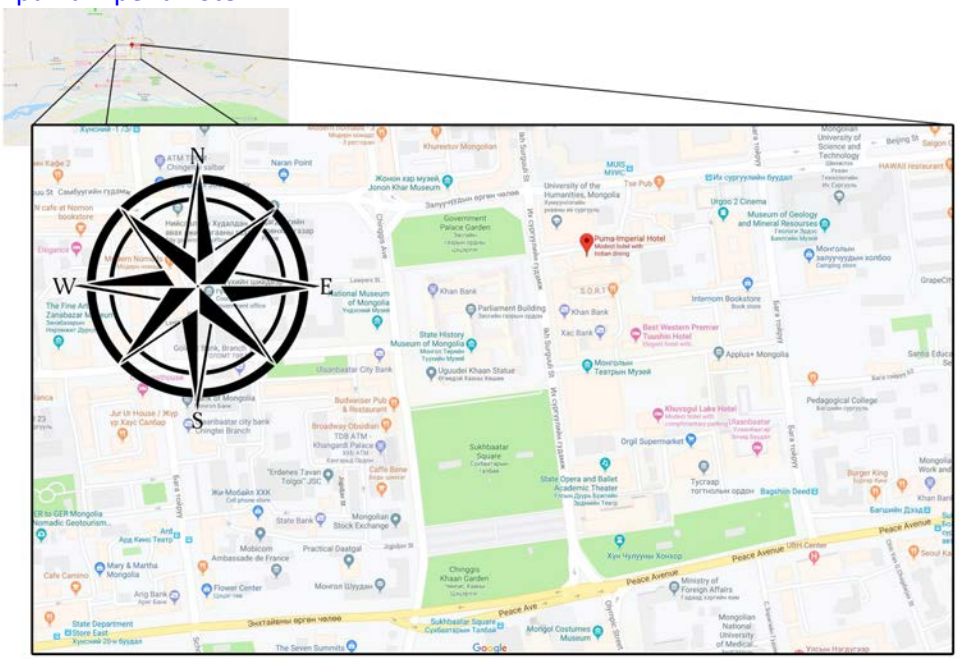
Field Trip II

Time	Activities
	tba

Conference Venue

Puma Imperial Hotel
Imperial Hall, 2F

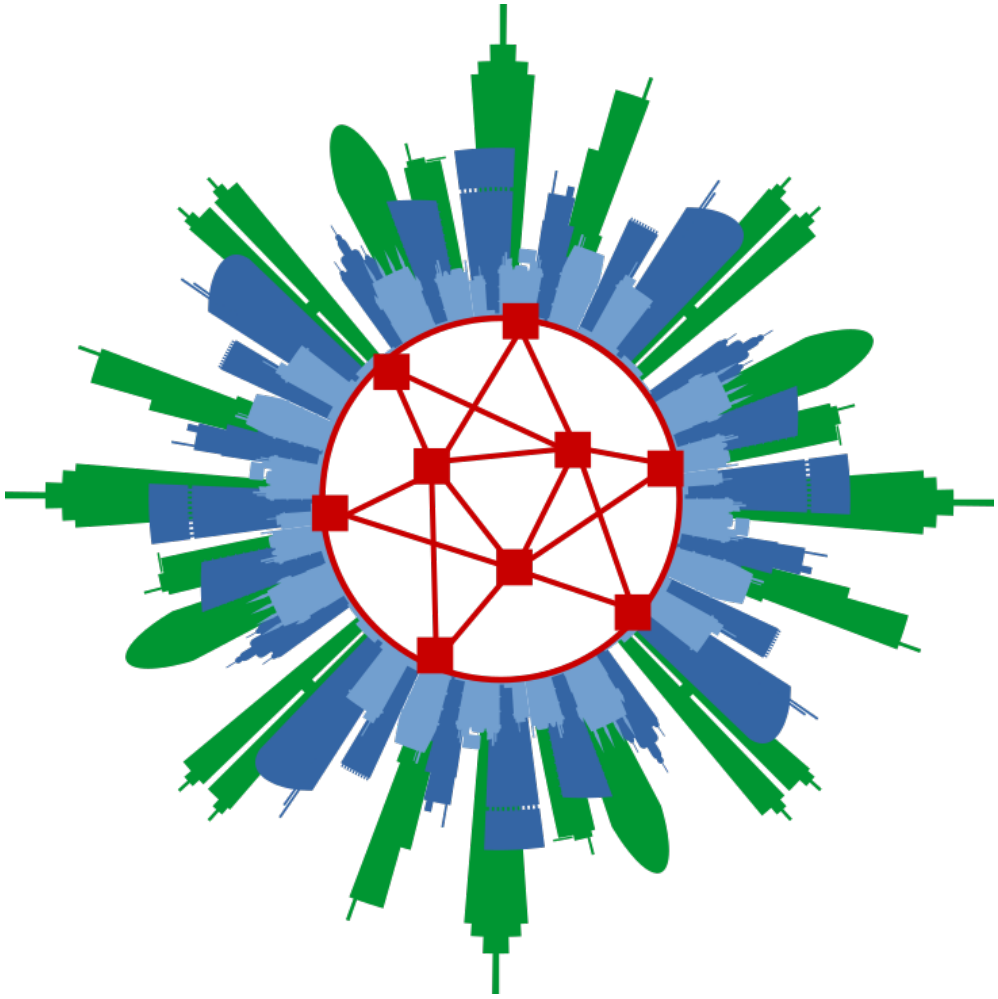
www.pumaimperialhotel.mn



SuMoCos

Sustainability and Mobility in the Context of Smart Cities

Keynote presentations



Transport Strategy of Mongolia

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Ministry of Road and Transport Development, Mongolia
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Keywords: *transport; digital transformation; ITS and sustainability;*

Abstract: Mongolia has a vast landscape, sparse population, and landlocked, it is extremely important to develop transport infrastructure as a key to overcome these challenges. Recently, the Government of Mongolia recognizes that Digital Transformation can improve public services, help to prevent corruption and to achieve Mongolian Sustainable Development Goals.
This paper presents the Legal and Policy Documents of the Mongolian Transport and ICT sectors and introduces some ITS projects and initiatives for improving public transport services.

Smart City Ulaanbaatar

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Keywords: *e-governance; public service; mobility;*

Abstract: We are living in the era of technology and without learning about technological advancements; we are simply unable to talk about any kinds of developments. Using technology, we can simplify many things and provide more innovative and productive services.

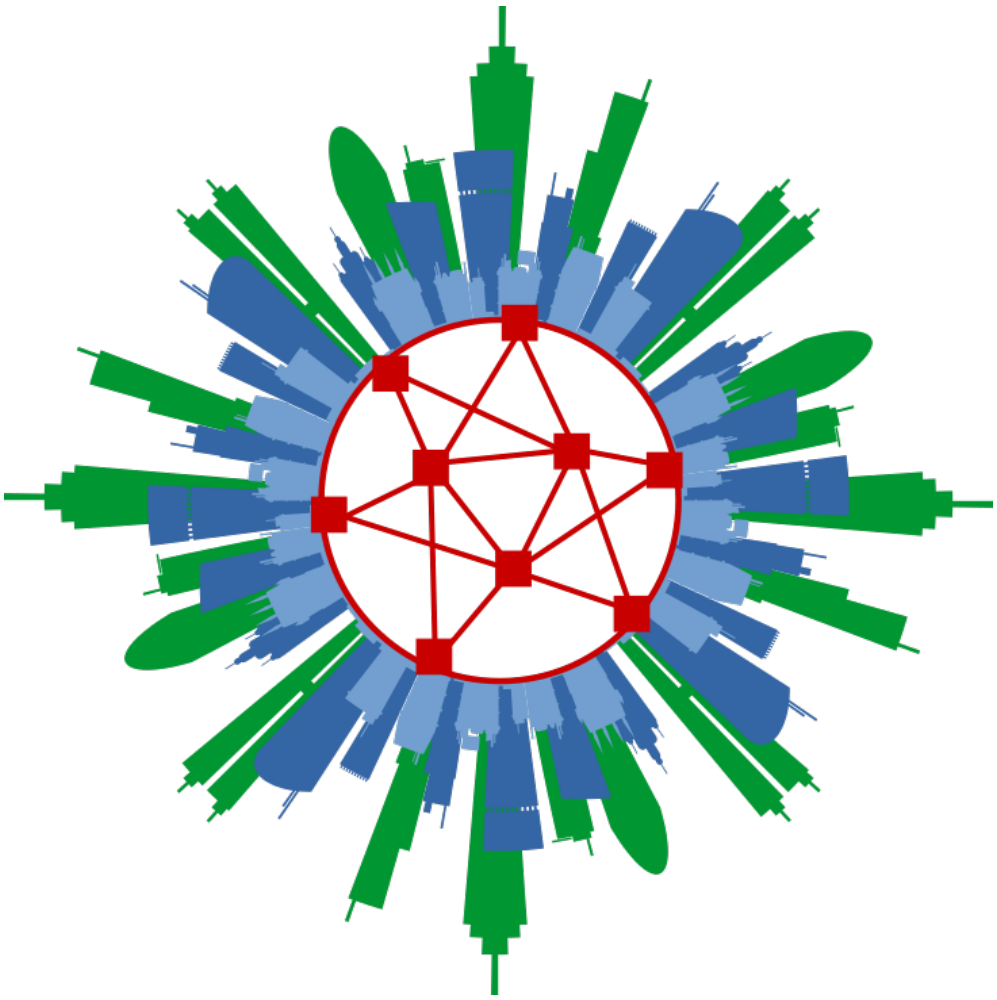
As a former chair of the Smart Ulaanbaatar Committee and current deputy governor in charge of innovation and technology, we are focusing on diversifying e-services provided to the public.

Moreover, cities have multiple problems and challenges they face. Similarly, one of the biggest problems of Ulaanbaatar residents is the traffic congestion. In order to reduce the traffic, the capital city is working to implement several projects with the help of advanced technologies such as RFID and others.

SuMoCos

Sustainability and Mobility in the Context of Smart Cities

Presentations



Smart Cities viewed as IoT-Systems

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Keywords: smart city; internet of things;

Abstract: “Smart Cities” use information and communication technologies to enable more sustainable, social, ecological, economic development of structures in urban and rural areas. From a technical point of view, smart cities are viewed as a network of interacting things, subsumed as “Internet of Things”. Smart cities consist of various sensors that collect data on the environmental and economic impacts of the city and its surroundings, *information systems* that store and analyze this data, and services that use this data and analysis.
In order to coin the term "Smart Cities" for the SuMoCoS traveling conference (Sustainability and Mobility in the Context of Smart Cities), characteristics of “Smart Cities” and the associated research challenges are presented. The talk stimulates the discussion and collection of the competencies required and already existing for the development and operation of Smart Cities.

Mobility platforms as a key element for sustainable mobility

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Keywords: Mobility Platform; Carpooling; Sustainable Mobility; Commuter traffic;

Abstract: Mobility is an essential aspect of a modern society and an efficient economy. On the one hand, an efficient transport system that guarantees the smooth exchange of goods and services is a prerequisite for economic development and a central location factor. On the other hand, mobility is a basic need for the individual because it is a cornerstone of personal freedom. In most cases, participation in working and social life presupposes being mobile. Mobility therefore ensures prosperity and enables social participation.
Ongoing urbanization and demographic change will have a major long-term impact on our society and thus also on transport and mobility. Especially rural areas are affected by the consequences of demographic change heavily: Due to the migration of young people to structurally strong regions and cities as well as low birth rates, the population in many rural regions has been declining steadily for decades. The impact is complex, as the decline in population does not automatically lead to a decline in traffic. In contrast, the changed age structure or new mobility patterns influence the demand for mobility. Therefore, it is becoming increasingly necessary to pay attention to aspects such as user-friendliness, accessibility and age-appropriate mobility chains between rural and urban areas.
The aim of this contribution is to show how information and communication technologies can be used to sensitise and influence the individual regarding sustainable mobility behaviour. A focus lies on the mobility supply between rural and urban areas, due to demographic developments, greater distances and thinner local transport networks must be overwhelmed. Therefore, new mobility offers must be created in which the citizen also becomes a mobility provider. For example, rarely used public transport stops could also be served by private individuals with their own car to take other people with them. Higher passenger utilisation in private cars can close supply gaps and reduce the overall volume of traffic and the associated negative environmental impact. In addition to the coordination and networking of all actors, attention is paid to the self-organisation of citizens (e.g. carpools and neighbourhood carsharing). Economic, social and organisational concepts are being developed to provide a comprehensive and open mobility offer. These concepts are brought together in a networked platform, tested and evaluated in close dialogue with the citizens.

Methodologies in evaluating Smart City approaches

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Keywords*:* Smart; city; innovation; development; assessment; ICT;

Abstract: The concept of urban development is focus on the development of science and technology, innovation achievements and ICT in improving public services and infrastructure and business services for citizens in order to intensify the country's socio-economic development and create conducive environment for the residents. To develop a traditional city as a smart city, first of all, it is necessary to identify and evaluate development levels. In this article, we have developed a version of "Assessment Methodology of Smart City Development Level" based on the 17 commonly used internationally accepted methods.

Scientists and International research institutions develop and evaluate urban development evaluation methods. There are some ways to assess the current situation of development at cities and countries, including the country's economic situation, satisfaction of residents, housing, workplaces and green facilities. Direct selection of these methods has limited access to our country; therefore, it is necessary to develop methodology to suit our country's specifics and conditions based on comparative study on internationally used methodologies.

We compared a number of methods developed by universities, government and international organizations, information technology organizations and research institutes and centres for the assessing and ranking smart cities development.

In comparing this study, we are considering the long-term sustainable development concept of Mongolia, Green development concept and criteria of sustainable development concept of Mongolia in accordance with the Law on Development Policy and Planning (Mongolian Parliament, 2015).

In our view, smart city is determined by 7 key factors: smart economies (innovation, competitiveness), intelligent citizens (creative, human capital), smart governance (power, participation), smart environment (sustainable, resources and wealthy), smart infrastructure (transportation, energy), smart information technology (penetration) and smart lifestyle (quality of life, culture). By developing these factors, any city will become "Smart City".

We have developed a model, consisting of 7 groups, 26 sub-groups and 121 indicators for "Assessing smart city development" based on comparative analysis above methods, overlap analysis and other common analysis (Fig. 1).

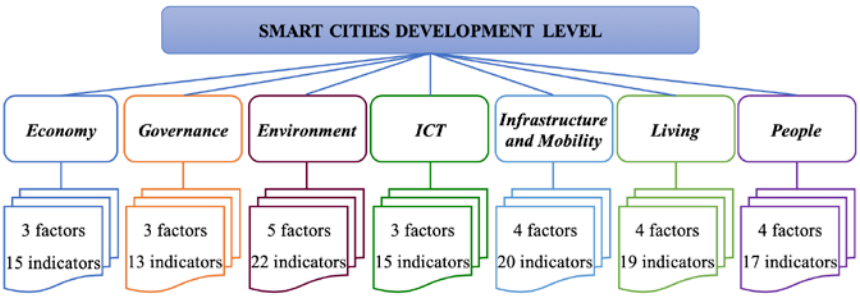

Figure 1. System of assessing smart cities development level

The selection of indicators to evaluate urban development was made by an expert team of scientists and researchers to assess the value. Calculating the concordation W coefficient and its assessment by the Pearson Criteria estimation is higher than theoretical level indicates the high degree of expertise in the experts. Also, Cronbach's alpha is between 0.76-0.92 that the questionnaire study is reliable.
We have developed a practical guideline for how to apply the assessment methodology of smart city development level. Using this methodology, it is possible to evaluate the development level of other cities, settlements and aimag centers, not only Ulaanbaatar, but also internationally.

Evaluating smartness of Ulaanbaatar

Keywords: *Urban; development; smart; assessment; innovation;*

Abstract: Global urban studies have connected with influx, urban development, urban planning, its social, ecological foundation, urban economy, infrastructure, pillar center, urban development and urban development model and regional development. Therefore, urban and urban planning theories are based on regional and local development theories, on the other hand, within the context of urban economic and urban development theories based on the theory of economic geography and innovation theory (Fig. 1).

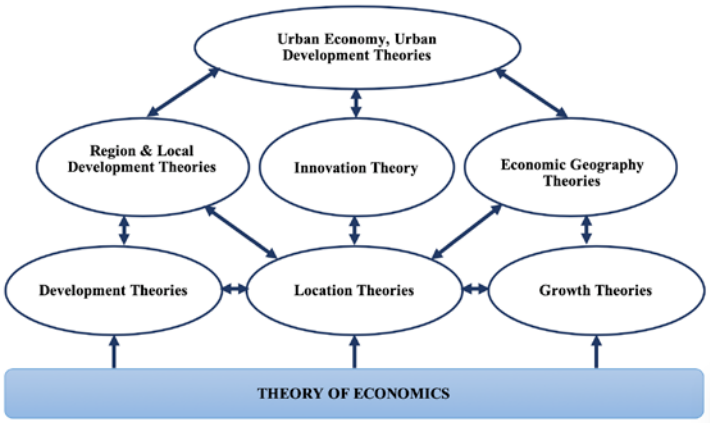

Figure 1. Trends in Urban and Urban Development Theory

The Innovative-smart city is based on information and communications technology, promoting innovation ecosystems, promoting citizen participation, and ensuring quality of life, competitiveness and sustainable development.

Smart city is based on the modern infrastructure of information and communication technology, providing a comfortable and safe residential environment for citizens, promoting socio-economic sectors, science, technology and innovation development ecosystems, populated settlements and societies an independent economic and ecological system (Burmaa Myagmar, 2018).

Based on the methodology, we have studied and analyzed the current situation of Ulaanbaatar's development and the preliminary development of smart cities.

At the present, a large proportion of the population (67 percent) in the city is concentrated on socio-economic, road and environmental issues. For example, the uncertainties in institutional and legal environment; air and soil pollution; unregulated and unmanaged expansion of ger districts and urban areas; road transport infrastructure, municipal engineering infrastructure, lack of housing and social infrastructure supply; satellite town and village development; emphasize weak funding capabilities of the city.

According to the preliminary findings of Ulaanbaatar city, in 2016, the "smart city's people " and "smart city governance" group ratings were the highest, 5.07 and 4.18 respectively, "smart city information technology" group rating 3.11, while the smart city economy, lifestyle, environment, and infrastructure group indicators are lowest by 1.73 - 2.76. According to the integrated evaluation, the Smart City Development Index is 30.15, which can be concluded that Ulaanbaatar is in transition from the start period of the smart city to the growth period.

Table 1. Integrated evaluation of Ulaanbaatar city Development

Dimensions	2012	2013	2014	2015	2016
Smart Economy	2.65	2.87	2.81	2.72	2.76
Smart Governance	3.32	3.33	3.89	4.00	4.18
Smart Environment	3.32	1.78	1.59	1.79	1.73
Smart ICT	2.08	2.06	2.92	3.04	3.11
Smart Infrastructure (mobility)	1.44	1.49	1.76	1.79	2.10
Smart Living	2.17	1.91	1.89	2.10	2.16
Smart People	4.20	4.27	4.54	4.99	5.07
Integrated evaluation of Ulaanbaatar city Development	2.57	2.53	2.77	2.92	3.01

Source: Burmaa Myagmar, "Assessment methodology for Smart cities development level", Ph.D thesis 2018

To develop Ulaanbaatar as a smart city, it is important to consider the following:

- Define the direction of smart urban concepts;
- Formulate principles and development goals;
- Define a smart urban development model;
- Create favourable legal environment;
- Establish stakeholder participation, rights and responsibilities;
- Identify, analyze and evaluate the effectiveness of smart city development;

Envisioning smart cities & regions, some examples from Europe

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Keywords: *smart city concept and components; integrated planning;*

Abstract: The concept of “smart city” has become quite popular in recent years as it promises to provide solutions for higher urban-living quality and making cities more efficient and sustainable. But along with its benefits, the emergence of the “smart city” has posed enormous challenges on cities and their planning. Firstly, the city itself is being transformed from a place dominated by physical actions to one in which such actions are at least complemented by an extensive use of information technologies. Secondly, many routine functions in cities are being replaced by computer controlled systems and various forms of automation are increasingly being blended with human actions. Thirdly, the extensive provision of data offers the prospect of a world in which all information of how the city is functioning are continuously available. This immediacy is compressing time scales in such a way that longer term planning itself faces the challenge of becoming continuous as data is updated in real time. Regardless of whether ICT takes center stage in the development of a smart city or not, it is clear that it acts as a key driver of smart city initiatives and thus needs attention from city planners and the various stakeholders interested in sustaining and improving the quality of life in urban areas.
Considering the complexity of the topic, the presentation provides public authorities, urban development experts and practitioners with a basic overview on smart city concept and components as well as the recently emerged technological solutions helping cities to become smarter. Notwithstanding the importance of individual technologies, one key message revolves around integrated planning as a success key for creating smarter, sustainable and livable cities. Taking into account the fundamental components of smart cities, the presentation puts forward an integrated model for planning and developing smarter cities coupled with good examples of some ongoing European projects.

Dependable Sensor Network for Smart Cities

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Keywords: *Sensor Networks; Dependability; Replication; Self-Stabilization; Region Adherence;*

Abstract: Sensor networks are often an important part of a Smart City's information technology. When applied appropriately, they allow to perceive distributed phenomena, store, aggregate, and forward the sensed data. Subsequently, the data collected may be analyzed by some stakeholders or system components laying the basis for manual or even automatic localization of and timely response to potentially critical situations.
When being at the core of a Smart City's information infrastructure, sensor networks must be dependable. This is all the more relevant when the network is or may become large, observes safety-critical phenomena, or exhibits dynamics with sensor nodes entering and leaving the system autonomously. In the presentation, we indicate how a sensor network can cope with dynamics, scalability, energy efficiency and availability by means of distributed system concepts for system dependability developed or extended by the research group of the presenter, namely replication, self-stabilization, and region adherence.

Industrial IoT (IIoT) –Improving manufacturing processes and enhance production machines

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Keywords: *IIoT; Retrofitting; Intelligence; Production; Communication;*

Abstract: Industrial IoT means using technologies of Internet of Things in industrial environments. Existing machine parks can be more intelligent by using retrofitting to enable them to communicate with each other and other information systems. Using machine learning existing processes and material usage can be improved. Further, by integration IIoT in own products, manufacturers can enhance machines they deliver. We show real use-cases and how IoT helped companies to improve production and their products.

Developing the Smart City based on Internet of Things

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Keywords: *Internet of Things; LTE/LTE-A, smart city;*

Abstract: The capital city of Ulaanbaatar has 1.3 million residents, close to half the country's total population. The population from rural to urban areas is usually searching for a better quality of life. Smart cities affect to make citizens' lives more convenient, more secure and more sustainable. Recently, Mongolian government pay attention to the idea of Smart Cities as researchers and professors have sought to define, develop and deploy the main concept, including management of smart city, technology for smart city. The Internet of Things (IoT) is expected to be the future big thing for developing the smart city including bus transportation, smart parking, smart home, waste management and water management at so all. Enabling technologies for the Internet of Things such as sensor networks, RFID, M2M, mobile Internet (3G/4G/WiMAX), Municipal WiFi, semantic data integration, semantic search, and IPv6, etc. are considered. Urban IoTs, in fact, are designed to support the Smart City vision, which aims at exploiting the most advanced communication technologies to support added-value services for the administration of the city and for the citizens. We considered about the topics titled "IoT based on LTE", "the developing Internet of Things for Smart Transportation System using Municipal Wi-Fi", "the Compared Analysis of Wireless Networks for Developing Internet of Things" and "Security Architecture of Access layer in the IoT network based on WSN". Moreover, we designed the converged network for developing the Ulaanbaatar city infrastructure based on IoT. This research presents the summary of our research works and future concept of development of Smart City based on Internet of Things. Novel design would be included the Wi-Fi and LoRa networks which is used in IoT lately. The most valuable result of compared analysis of wireless core networks for developing Smart city. Our result would be valuable for implementing IoT for smart city.

Digital infrastructure as a fundament for smart cities and regions

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Keywords: *broadband networks; digital infrastructure;*

Abstract: When planning smart city concepts, the first step for any policymaker/planner is to foster the development of a rich infrastructure of broadband networks that support digital applications, ensuring that these networks are available throughout the city/region and affordable to all citizens. Such a network shall offer maximum connectivity and bandwidth to citizens and organisations located in the city or region. Expanding this network across the city/region is an essential part of any smart city/region agenda, especially for so called socio-economic and drivers key areas such as universities, business centres, technical and research institutes, government offices or emergency response units. While, these high capacity networks are the backbone for ensuring all kinds of innovation on the basis of high-speed access to the Internet, they facilitate the installation of connected smart devices and sensors which are key to the development of intelligent city operations. They also ensure access to electronic public services that the city offers its constituents (such as e-mobility, e-health and e-education). In this context and in addition to the wired broadband networks, the demand for wireless broadband has been growing ever more, especially with the exploding popularity of mobile applications, smartphones, the increased connectivity of smart devices and the Internet of Things. Smarter cities need fixed and wireless broadband networks to enable a wide range of smart city applications that enhance safety and security, improve efficiency of municipal services and create an attractive environment for residents, entrepreneurs and visitors. Such a network, provides opportunities for integrated provision and management of smart grids and a variety of energy optimization operations linked to smart meters, smart appliances and renewable energy resources. These integrated networks allow for monitoring, analysis, control and communication within the supply chain to help improve efficiency, reduce resource consumption, optimize the costs and maximize the transparency and reliability of the energy supply chain.
Taking into account the fundamental meaning of “digital infrastructure” the presentation provides a concise overview on critical dimensions in broadband network development (from strategic planning, technical and finance perspective) along with a set of good examples from the European/German context.

Digital Urban Mobility

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Keywords: *smart mobility; integrated traffic management; intermodal transport;*

Abstract: Urban Mobility is undergoing a tremendous change: new mobility services like car-sharing complement the list of existing transport modes and provide new opportunities. As a consequence the private car loses importance. Parallel to this development, the usage of modern information and communication technology e.g. in form of smartphones connected to the internet, continuously increases.
The focus of this contribution is on intermodal transport as a key success factor for the development of an efficient and needs-oriented transport system. Starting with an analysis of the behaviour and the motivation of "intermodal users" and deriving requirements, this work puts the car into focus to determine its role in future urban mobility. It is shown that the borders between private and public transport are getting less strict and innovative public transport operating concepts based on an integrated transport management have the potential to cover the last mile.

Location-based smart mobility solutions

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Keywords: *Location based services; smart mobility solutions; cooperative projects;*

Abstract: Location Based Services (LBS) can be defined as computer applications that deliver information tailored to the location and context of the device and the user. These services play a significant role in the existing information era, and the range of those services are constantly growing due to the advancements in mobile devices and communication technologies. An increasing demand in expanding LBS from outdoors to indoors, and from navigation systems and mobile guides to more diverse applications such as healthcare, transportation and gaming can also be observed. Moreover, the emergence of new interface technologies (i.e. more powerful smartphones, smartwatches, digital glasses, and augmented reality devices) as well as the increasing smartness of cities with deployed sensors make LBS more ubiquitous in general public's daily lives.
OECON has been a reliable partner in numerous projects with its cutting-edge location-based products and services, especially in the transportation domain. Some examples of OECON´s LBS and tracking solutions include vehicle management, logistic tracking and smart parking. In addition, OECON developed assistive solutions to support blind and visually impaired people as well as vulnerable road users at signalised junctions. Furthermore, OECON has developed numerous solutions in the context of connected and automated driving. OECON aims to support safer and greener (lower CO2 emissions) transportation as well as healthier and more active mobility behaviours with its location-based products and services. To achieve that aim, OECON is looking for interested parties to cooperate, develop and deploy smart LBS solutions.

A cloud-based operational platform for launching and managing automated commercial drone operations

Keywords: *Unmanned aerial vehicles; commercial drone operations; cloud-based platform;*

Abstract: An unmanned aerial vehicle (UAV) or more commonly known as drone is defined as an unpiloted aerial vehicle that uses aerodynamic forces to provide

vehicle lift and can fly autonomously or be remotely piloted. Although UAV technology has its roots in military and warfare, its applications have entered into the civilian realm, especially due to the technological development in the miniaturization of sensors and control systems.
UAVs deliver valuable data to make informed decision making; and acts as a force multiplier, eventually leading to safer and more efficient operations. Therefore, it is expected that they will be more pervasively used in future smart cities for a multitude of non-lethal purposes by supporting and optimizing processes in several industries and businesses. For example, they are used for monitoring, mapping, creating 3D spatial models of buildings, structures and geographic areas; for precision farming or wildlife preservation; for recording documentaries or movie sequences as well as for acquiring video footage of public events such as music concerts or sport competitions. Moreover, there are several initiatives to use UAVs for transporting and delivering goods as well as for police forces and rescue services, such as performing surveillance tasks for the police or using ambulance UAVs.
OECON´s cloud-based UAV operations platform unlocks the full potential of drones and meets the requirements of various stakeholders by connecting the required people, processes, and equipment into a single efficient workflow. OECON is committed to work with different sizes of companies and institutions across a variety of industries to improve their workflows through user-friendly software and consulting services designed to strengthen safety and efficiency. We aim to work with interested parties to manage complexity, lower risks, and automate workflows by integrating aerial data into day-to-day operations.

Ecall Test Systems

Keywords: *Ecall; test systems; road transport; safety;*

Abstract: eCall is an emergency call (112) designed to provide quick emergency response in case of a road accident throughout Europe. eCall is generated either manually by vehicle occupants or automatically via activation of in-vehicle sensors, following a collision. When activated, the in-vehicle eCall system establishes a voice connection directly with the relevant Public Safety Answering Points (PSAP). At the same time, a minimum set of data (MSD) is sent to the PSAP operator receiving the voice call. The MSD includes the exact location of the crash site, the triggering mode (automatic or manual), the vehicle identification number, a timestamp, as well as current and previous positions. Therefore, valuable information for emergency responders reaches them as soon as possible. In so doing, protection and safety are increased, and fatalities, related injuries as well as property loss caused by road accidents are decreased significantly.
The harmonised implementation of an interoperable EU-wide eCall service in the EU has been on the agenda of the European Commission since 2005 and has become

now a priority action for the improvement of road safety and the deployment of ITS in Europe. Indeed, all PSAPs in European Member States were required to have completed the necessary upgrade and conformity assessment for eCall by 1 October 2017. Similarly, all new passenger cars registered in the European Union from 31 March 2018 is required to provide eCall functionality.

OECON is the market leader in eCall test systems and provide different solutions including eCall test and development server, eCall simulator, eCall IVS test server and eCall router for OEMs, automotive suppliers, PSAPs and third-party service providers. Owing to the high significance of eCall for road safety, it is expected that similar regulatory regimes will be implemented in other regions of the world. In addition, as eCall is only mandatory in Europe for new vehicles manufactured after the 31st March 2018, the majority of vehicles on the European roads are unable to access the eCall service in the short to medium term. In order to address this challenge and pave the way for deployment of eCall aftermarket systems, project sAFE that is coordinated by OECON was launched in January 2019. OECON aims to use its eCall experiences and cooperate with interested parties to make the roads safer not only in Europe, but also in the rest of the world.

Conception of a product service management system for the marketing of customer-specific services in the mobility sector

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Keywords: *Car Sharing; Added-value services; CRM; Service Science; Product Service Systems;*

Abstract: The marketing of cars has become a central challenge for the automotive industry. This is reflected in steadily decreasing car sales and increasing competitive and margin pressure. New sales and marketing strategies require a rethinking of car manufacturers. Today, the steadily growing German car sharing market comprises more than 2 million customers. In the medium term, it is predicted that the number of mobility services customers will continue to increase.
This results in changing customer requirements that challenge car manufacturers to develop new business models, products and service packages based on mobility services. This requires a critical review of value creation in the automotive industry. In the long term, car manufacturers are expected to transform themselves into mobility providers in order to tap new value creation potential. Previous key differentiating features such as brand image or the performance of the vehicle will lose relevance. When marketing mobility services, the question arises: "How can automobile manufacturers differentiate themselves if the vehicle per se is no longer in the foreground?"
To solve this problem, automotive companies will focus on mobility services in the course of digitization and offer mobility services based on connected vehicles using management systems. This incipient change is manifested by the activities of manufacturers in the area of demand-oriented mobility services. Individuality, such as favourite radio stations, seating position, air conditioning, etc., is of central importance for customer acceptance, especially in this form of service. Due to the increasing connectivity of vehicles, additional services will be added to the vehicle, which must be centrally managed and controlled.
The aim of the research project is the conception and prototypical implementation of a product service management system for the marketing of customer-specific services in the mobility market. For this purpose, components and mechanisms of fleet management and customer relationship management will be taken up. Central user groups are fleet operators and providers of mobility services. The focus of the system lies both on the provision of mobility services and on the marketing of service packages consisting of mobility and additional services (e.g. personalized city tours or music streaming).

Smart mobility in the energy system, its features and challenges

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Keywords: *smart grid; smart user; hydrogen; contract; development concept;*

Abstract: Smart mobility is one of the main essential characteristics of the Smart grid concept. The future integrated energy system will be fundamentally different from the present system, based on renewable energy source and should include high flexibility and mobility to supply customers with economical, environmental and social factors. Organise and regulate this technology requires a new approach in the not only electricity system but other infrastructural systems such as transportation, ICT and industrial systems. Nowadays electric and fuel cell cars implemented as a new element in the power energy system, and they are already determining and supporting the mobility into the energy system as the leading technology for electric driving and energy storage.
In the urban areas, fuel cell cars becoming a power plant [1] in the future and all services will be digitally connected and controlled. These changes cause technological and system challenges: 1. IoE for Energy and Transportation, 2. New Business models in Services and interaction of the companies into the smart city, 3. Regulations, standards, safety and tax issues, 4. Consumer perception – all users becoming a smart user as prosumer [2-3]. Developed a conceptual model of the future energy system focused on the circular economy.

Routing in Oldenburg

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Keywords: *routing; navigation; fine dust; pollution; sensor; sensor node; project group; data quality; Oldenburg;*

Abstract: Today, there is already a wide range of route planning applications available. Users can plan the fastest or shortest route from one location to another. However, there are hardly any applications that take environmental data into account when planning a route. Therefore, the project “Routing in Oldenburg” aims to develop a sensor-based environmental information system which offers the user the possibility to observe environmental data and to plan a route which, for example, takes into account current fine dust data in order to avoid polluted areas.
The overall system consists roughly of two parts: 1. A flexible sensor-based environmental information system that measures environmental data, reads it from external systems and evaluates it. 2. A navigation application that incorporates environmental data into route planning in order to avoid areas of high environmental pollution. Therefore, a sensor network must be set up so that environmental data can be measured. The data is then sent to an IoT platform and processed there so that measurement errors and other influences can be corrected and qualitatively and quantitatively good data can be made available for further use. The navigation component then accesses the data provided by the IoT platform and uses it for route planning with subsequent navigation.

Polycyclic aromatic hydrocarbons (PAHs) associated with PM10 among Ger districts in Ulaanbaatar, Mongolia: concentration, distribution, and cancer risk assessment

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Keywords: *PAHs; Ger districts; coal combustion; distribution;*

Abstract: During the long cold season, air pollution level in Ulaanbaatar (UB) is among the highest in the world. As a result of rapid urbanization and population growth, air pollution of UB have got worsen dramatically in recent several decades. Intensive rural-to-urban migration resulted sharp increase of traditional Ger settlements are in UB. Approximately 60 percent of city's population of total 1.5 million people live in Ger (traditional circular dwelling) district and 180 thousand of traditional stoves are working and burning raw coal and wood during the winter season.

Household coal combustion has been identified as main source of air pollutants including particulate matters and toxic organic pollutants. Among the various toxic compounds, polycyclic aromatic hydrocarbons (PAHs) have taken great attention and widely studied globally due to their carcinogenic and mutagenic properties. In this study, PAHs associated with PM 10 (particulate matter with aerodynamic diameter less than 10 μm) in ambient air of Ger districts were investigated in order to determine concentration level of PAHs and to evaluate its cancer risk. Approximately one hundred PM10 samples were collected from four different sites in Ger districts during February to April in 2019. Samples were extracted and analyzed with Gas Chromatography with Mass Spectrometer detector (GC-MS). Results showed that average concentration of total PAHs associated with PM10 is 199±115 ng/m^3 (49–439 ng/m^3) and is relatively higher than other measured values around the world, but similar with that in the most polluted cities in China. PAHs with 4–5 rings are dominant and PAHs ratios revealed that they mainly emitted from biomass combustion and petroleum. Carcinogenic PAHs is accounted for 46 percent of the total PAHs. Benz[a]pyrene cancer equivalent factor is estimated to be 32±17. In approximately 90 percent of analyzed samples, benz[a]pyrene concentration

exceeded national permissible level of 1 ng/m^3. This project has been carried out in cooperation with the Advisory Assistance Programme for environmental protection in the countries of Central and Eastern Europe, a program of the German Federal Ministry for Environment, Nature Conservation, Building and Nuclear Safety.

Introducing a “SMART” concept in engineering curriculum

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Keywords: *curriculum development; CDIO; smart building; learning outcome; assessment;*

Abstract: With the technological development and rapid change of their function, it is necessary to equip the general population with the necessary skills and knowledge for this rapid change. Traditional engineering courses solely focused on certain engineering theoretical knowledge and skills while in current society it is urgently needed graduates who have interdisciplinary knowledge and skills.
Engineering curriculums- electronics and environmental engineering programs at the National University of Mongolia and electrical and construction engineering programs at the Institute of Engineering and technology has adopted Conceive, Design, Implement and Operate (CDIO) framework which supported the revision of learning outcomes and teaching-learning approaches, through the introduction of multidisciplinary projects.
Introduction of Multidisciplinary project on Smart Building with collaboration between students from four programs to design a smart energy-efficient building was successfully implemented. The ideas of tasks were to design a building with the following requirements: energy efficient with low heat loss, selection of suitable low cost, eco-material, and 80 % of energy production should be from solar panels. Also, students should choose an appropriate technology for the treatment of greywater and sludge from toilets.
During the implementation of the project, students were able to expand their problem reasoning and solving, teamwork and communication skills.
Acknowledgment: This project was supported by the ERASMUS+ project "Modernization of the Curricula in the sphere of smart building engineering-Green Building-GREB" which implemented at the National University of Mongolia.

Towards a system for data transparency to support data subjects

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Keywords: *Data Ownership; Data Transparency; Data Sovereignty; Data Science; GDPR;*

Abstract: Data Transparency is one of the major challenges that comes with the new European General Data Protection Regulation (GDPR). After the adoption in April 2016 and the ratification by May 25th, 2018, the goal of the GDPR is to accelerate the economic and social progress of the EU society. Also the GDPR stipulates obligations of protection with respect to the processing and sharing of personal data between various entities. In the age of Digital Transformation, more applications and processes generate data that needs to be regulate under the requirements of the GDPR. This can easily adopted and transferred to questions regarding to Smart Cities. Despite the legal situation, it is often unclear how the stored data will processed or used for further purposes. Third parties that interacts with data processor or data controller, needs to clarify what happens with these data. Because of this, concepts like Data Ownership and Data Sovereignty becomes more popular and enable independent legal decisions for the data subject. In combination, Data Transparency ensures, that all privacy related data processing include the legal, technical, organizational and procedural settings can be understood and reproduced at any time. This PhD work-in-progress aims to develop a data transparency system that assists data subjects and data controller. Therefore a research roadmap, which includes research questions and the design, has been developed.

Privacy and smart traffic management

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Keywords: *data protection; personal data; data security; profiling; privacy by design;*

Abstract: Every individual participating within the concept of smart cities will generate lots of personal data. These data will be collected and processed by public bodies as well as private companies enabling them to interfere with privacy expectations of the user, especially by profiling user's behaviour. Dealing with these privacy rights and challenges needs to be addressed by legal, technical and organizational means in order to enable a trustworthy relationship between the users and the service providers.

Integrated IoT Languages

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Keywords: *Internet of Things; IoT; Languages; Integration; Consistency; Modeling; SmartOffice;*

Abstract: Internet of things (IoT) is a nascent technology that envisages connecting everything to the Internet and intends to improve people's lives by providing intelligent services ubiquitously. As IoT comprises heterogeneous technology stack it is difficult for developers to describe IoT components in a consistent manner. Therefore, there is a need to develop a set of languages, which models IoT systems from different perspectives and keep those models consistent. This talk sketches an integrated multi-viewpoint approach to develop IoT systems and applies it to a SmartOffice example.

Semantic Technologies for Smart Cities

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Keywords: semantic technologies; smart cities; ontologies; taxonomies; knowledge representation;

Abstract: Semantic technologies such as taxonomies or ontologies enable the representation of information and knowledge with semantic connections and context. Smart Cities produce large amounts of unstructured and separate data. These data can be categorised and put into relation using ontologies for semantic interpretation and using taxonomies as structured vocabularies. The application can be shown via several ontologies that have already been developed for Smart Cities.

ECOSense –Collection and analysis of cycling data

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K**eywords:** *Cycling Data; Data analysis; Sensor development; Smart City; Sustainability;*

Abstract: Against the background of increasing traffic and environmental problems in city centres, the promotion of cycling is important. Appropriate data is needed to improve cycling conditions and infrastructure especially in the context of Smart Cities. So far, data-centric approaches to cycling have mainly based on information generated by smartphones. The existing database only concentrates on leisure traffic and provides little information on the use of bicycles in the daily traffic. The goal of ECOSense is the development and testing of a sensor platform that collects various parameters (e.g. position, speed, vibration and environment) for bicycle in daily situations. The newly generated and refined data sets leads to improved information based on the bicycle traffic. The use of measurement technologies enables decision makers from municipal and urban planning a better understanding of the specific needs of cyclists. This also results in an improved infrastructure planning and a better integration in the existing infrastructure. The to be developed sensors will be used e.g. by bicycle friendly companies and cities. Several hundred bicycles will be equipped with the measurement technology during a survey period. The prototypically generated and completely anonymous data of the sensors will be refined with other data sources. Because of this, an evaluation can be carried out with the regard to the use of bicycle infrastructure, traffic safety and environmental aspects. At the same time, concepts for integration as well as communication within Smart City infrastructures and data-based business models will be developed.

Economic instruments for water management of Mongolia: Analysis of water pollution control by economic instruments

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Keywords: *Integrated Water Resources Management (IWRM); economic instrument; water management; polluter pays; water pollution fee; wastewater tariff;*

Abstract: Since 2004s, IWRM approach was introduced in Mongolia. And in 2013, the IWRM plan of Mongolia was approved by Government of Mongolia (GoM) and started to implement. The IWRM plan of Mongolia included objectives to develop the economic instruments for water management.

Most of the economic instruments for water management are used in Mongolian water sector. However, the desired results are not always achieved. For example there despite implemented the water use fee (similar to water abstraction fee), but water losses are still high in some provinces and cities in Mongolia, reaching more than 50%.

This paper analyzed the implementation of the polluter pays principle in IWRM of Mongolia, the introduction of the water pollution fee, and current condition of the wastewater tariff of Mongolia.

In 2012, the Law on Water Pollution, which is main implementation Act for the polluter pays principle, approved by Parliament of Mongolia. However, this Law couldn't be implemented until 2019. The reasons for non-compliance of the Law on Water Pollution are high payment rates and the lack of additional legal documents etc. And in 2019, the Law was adopted. Under this Law, water pollution charge will be introduced in Mongolia. The pollution charges are based on economic incentives to limit water pollution. Pollution charge sets based on type pollutant and limit (standard). If wastewater pollutants concentration exseed limit a polluter have to pay levies, which are higher than 2-5 times of the pollution charge.

For the analysis were reviewed about 20 years' data of the Water Utilities of Ulaanbaatar that are tariffs, waste water amount, pollution load, main polluters and WWTPs condition, and assessed tariff type and rate on effluent pollution load. Authors are seeking effective wastewater tariff structure that could be influence on effluent pollution.

Until 2019, polluters paid wastewater tariff, only for the service. The wastewater tariff divided by 4 type, which is based on effluent concentration. By tariff rules

polluters can’t change type when decrease pollution. Moreover, if pollutants exceed limits there is no mechanism for accountability.
Due to the polluter pays principle is not fully implemented Ulaanbaatar’s and most of provinces WWTPs are couldn’t work effectively. Of course, the consequences are increasing water and environmental pollution.
This study emphasizes the need to take into account the impact of the introduction of the pollution fee and change wastewater tariff rules and structure.

Air pollution study in Ulaanbaatar city of Mongolia

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Keywords: *Air pollution; concentration level; Ulaanbaatar city;*

Abstract: At present, air pollution has become the main problem in many developed and developing countries. Especially, in Ulaanbaatar city of Mongolia, it has become one of the most tackled issues of every citizen living in the capital city. According to the World Health Organization, six major air pollutants include particle pollution, ground-level ozone, carbon monoxide, sulfur oxides, nitrogen oxides, and lead. Long and short term exposure to air suspended toxicants has a different toxicological impact on human including respiratory and cardiovascular diseases, neuropsychiatric complications, the eyes irritation, skin diseases, and long-term chronic diseases such as cancer. Several reports have revealed the direct association between exposure to the poor air quality and increasing rate of morbidity and mortality mostly due to cardiovascular and respiratory diseases. Air pollution is considered as the major environmental risk factor in the incidence and progression of some diseases such as asthma, lung cancer, ventricular hypertrophy, Alzheimer's and Parkinson's diseases, psychological complications, autism, retinopathy, fetalgrowth, and low birth weight. This study aims to investigate the concentration levels, dust and the heavy metals found in snow in the metropolitan area of Ulaanbaatar, Mongolia during the winter. It has a number of different emission sources, but motor vehicles, ger area and industrial processes contribute the major part of air pollution. Snow samples were collected at 68 locations of Ulaanbaatar's metropolitan area in February 2016 , in which the concentration levels of Cr, Mn, Fe, Co, Ni, Cu, Zn, Zn.X, As, Se, Se.X, Cd, Sn, Sn.X, Sb, Pb, CI, NO, SO3, PO4, Na, NH4, K, MG and Ca were measured the heavy metal elements and anions. Test results showed that the concentrations of dust heavy metals Pb, Cr, Cu and Zn in the urban areas were significantly higher than those in the suburbs. Air pollution revealed that the degrees of ecological harm of dust heavy metals were very strong in both urban and suburban areas, but especially in urban areas. Overall, the study indicated that the air pollution in Ulaanbaatar city is a very serious problem and for its reduction, rapid and thorough measures should be taken.

Use of Environmental Biotechnology approaches in remediation of soil pollution in Ulaanbaatar city

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Keywords: *environmental biotechnology; soil pollution; phytoremediation; bioremediation;*

Abstract: Due to recent increasing number of populations of Ulaanbaatar city, the environmental pollution has become an urgent issue to be solved together with joint contributions from the policy makers, scientists and publics. Soil pollution issues require particularly the advanced remediation technologies since it has double negative consequences to transmit the pollution into ground water and the air.
In Ulaanbaatar city, near the factory area at Khan-Uul district, soil contents of heavy metals such chromium, cadmium, zinc and lead has been estimated to be increased continuously in last few years.
In order to reduce the soil heavy metal contaminations in Ulaanbaatar city, this study introduces a cost-effective, eco-friendly, innovative engineering-based approaches called Environmental Biotechnology approaches. Based on our research studies obtained from natural metal hyper-accumulating plants, we have recently generated transgenic plants those can able to grow on the contaminated soil areas with several different heavy metals. The transgenic plants could further show to accumulate the heavy metals in their tissues from the surrounding soil rhizosphere. We therefore aim to explore our approaches into Mongolian native plants to effectively remediate the soil heavy metal contaminations.
Moreover, as a part of Environmental Biotechnology approaches, the use of bioremediation technologies will also be introduced to remediate the soil organic and toxic bacterial contaminations that have spread heavily in Ger-horoolol area of Ulaanbaatar city.

Lead removal from contaminated soil using electrokinetik remediation method

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Keywords: *Electrokinetik remediation; lead; soil; soil contamination;*

Abstract: Lead occurs naturally in soils, typically at concentrations that range from 10 to 50 mg/kg. Because of the widespread use of leaded paint before the mid-1970s and leaded gasoline before the mid-1980s, as well as contamination from recycling lead-acid battery, urban soils often have lead concentrations much greater than normal background levels.

In this study, we took 5 samples of soil near a place where is “Zalamt gol” LLC located in “Khonkhor Urtuu” of Bayanzurkh district. The activity of the company is recycling lead-acid battery to produce lead bar using a method of melting lead. Moreover, the vapor of the melted lead can be spread out near the company. The maximum lead content in the sample is 5127 mg/kg.

The highest contaminated soil sample is selected for further study of electrokinetik remediation method. Electrokinetik remediation method was taken under the condition of 100 V, 0-0.1 A, time, and in a room temperature. Generally, this method is usually taken a long time. Duration of the experiments is 78 h. After the experiments, the content of the lead in the sample is decreased to 70%. Additionally, in the initial 24 hours, 50 percent of the lead was removed from the soil. Total energy consumption was 163 watt for 1 kg of soil.

Spatial and Temporal Variations of Sediment Metals in the Tuul River, Mongolia

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Keywords: *metal pollution; sediment; aerosol; sewage waste; ash pond*

Abstract: Mongolia is a major source of Asian dust. Our objective is to study a section of the Tuul River to evaluate present condition of this pristine environment. Sediment metals (Al, Fe, Cu, Zn, Pb, Ni, Cd, Hg, and Cr) concentrations and Pb-210 were sampled and analyzed.

Results showed that metal concentrations are much higher at areas near the capital city and near the municipal sewage outlet, with enrichment factor values up to 18 for Cu and 26 for Cr. Furthermore, higher copper concentrations were found at sites about ~50 km downstream from the source, an indication that pollutions are spreading further down the river. Vertical heavy metal concentration profiles show unusual accumulation of metal pollution that could be traced back to 1960s', reached the highest level when coal-fired power facilities and ash ponds started.

Inefficient sewage treatment plants and the power plants ash ponds were major sources of metals leaking into the study Tuul River. Poorly treated sewage waste water is carrying metals through Tuul River to the lower river basin. Dusts from ash ponds are airborne and transport to greater area. These findings indicate that new and alternative measures have to be enforced to prevent further pollution entering the Tuul River drainage basin and airborne dust to other broader regions of the Asia and ocean.

Energetic neighbourhoods & inhouse energy management

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Keywords: *energy; locality; climate change;*

Abstract: As climate change and environmental pollution make it inevitably necessary to find cleaner resources to cover the growing demand for energy, integration of renewables is the most promising approach. These are small in size and flexibility, volatile, and thus hard to control. Successful integration demands bundling, new decentralized control strategies, and co-control of different energy flows. Energy neighbourhoods as part of the smart city concept as well as in-house energy management concepts are discussed regarding theory and application.

Current conditions and simple solutions for a human-friendly mobility in Ulaanbaatar city

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Keywords: *human friendly mobility; cycling and walking environment; public transport; sustainable transport;*

Abstract: Ulaanbaatar is a growing city which has 1.49 million inhabitants, experiencing severe traffic congestion because of large car mode share and poor public transport service. Private transports such a walking and cycling are very effective ways of traffic calming as a public transport. In order to encourage the environmentally and human-friendly private transport, it is important to recognise the roles of private transport as one of the urban transport methods.

Energy Efficient Building Refurbishment in Mongolia – Technical Cooperation Project by the German Government

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Keywords: *Energy Efficiency; Building Sector; Ulaanbaatar; Local Energy; Efficiency Action Plan; Air Pollution Reduction;*

Abstract: Mongolia is characterized by extreme climatic conditions with short summers, and long, extremely cold winters. Due to outdated coal-based heating facilities, poor building insulation and a lack of incentives to invest in energy efficiency measure, the capital Ulaanbaatar is covered in smog during the cold season. The poor insulation of buildings also results in low room temperatures of public and private buildings and present an acute health hazard during harsh winters.
The Federal Republic of Germany has supported Mongolia in the energy sector for the past 25 years. While in the beginning of the cooperation the focus was on the supply side, it switched to demand focused projects, including the support of the development of a policy framework for energy efficiency.
The Energy Efficiency Project (EEP) in Mongolia supported by the Federal Republic of Germany started operating in 2019 and introduces a greater level of energy efficiency into the building sector of Ulaanbaatar. This approach helps to reduce energy loss, lower CO2 and fine particle emissions and improve the living quality of residents.
Against this background, the current project's four main components will be described:

- Good governance in Public Investment Management
- Local Energy Efficiency Action Plan for the Municipality of Ulaanbaatar
- Providing support to the private construction and finance sectors
- Piloting thermo-technical retrofitting of public buildings

Research on Public Electric Transport possibilities in Ulaanbaatar City

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Abstract: Nowadays, Monorail is ideal transportation method which is mostly constructed in densely populated areas such as Tokyo, Moscow, Dusseldorf. In this paper, 9.6 km extended monorail is planned in Ulaanbaatar. Electrical power supply of this construction is carefully considered by using a hybrid system which consists a main power grid and wind turbines. By using wind turbines, it becomes an innovative solution. Furthermore, the research method is dynamic modelling using MATLAB program. On the program, wind farm for electrical power supply of monorail is simulated and modelled.

Green area change study in Central Ulaanbaatar using very high resolution QuickBird images

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Keywords: *green area; object-based image classification; QuickBird image;*

Abstract: At present, nearly half of the world's population lives in urban areas. As the urban population grows, major environmental concerns for cities range from quality of air, limited land resources and loss of green areas. Recent studies have shown that in urban environments, green areas have largely been replaced by impervious surfaces such as asphalt, road highways, and roofs. This brings more serious environmental problems such as air pollution, flooding and urban heat island effects. The aim of this research is to conduct a green area change study in CBD area of Ulaanbaatar, the capital city of Mongolia using multitemporal very high resolution remote sensing (RS) images. Today, higher resolution sensor systems are being increasingly used for monitoring the spatial effects of urbanization that provide spatial information content that is hundreds of times better than coarse spatial resolution dataset. The RS data sets selected for the present study consisted of four QuickBird imagery, acquired on Aug 4 of 2006, July 5 of 2009, July 2 of 2014 and July 11 of 2019. To conduct the green area change study, the selected QuickBird imageries were classified using an object-based technique. Unlike the pixel-based classifications that are based on the information of each pixel in the data, the object-based classifications are based on the information from a set of similar pixels called image objects. The image objects are groups of pixels that are similar to one another based on the spectral properties, size, shape, and texture, as well as context from a neighbourhood surrounding the pixels. eCognition Developer 8.64 software which was specifically created as a powerful instrument for object-oriented image analysis was chosen for the purpose of this study.
In the study, firstly, the multiresolution segmentation has been performed. Then, the image objects were assigned to the three main classes, impervious surface, bareland and green area using a rule-base. To develep a rule-base, the evaluated indices and band ratios were set. Finally, the vegetation cover maps extracted from multitemporal satellite images were compared with each other using ArcGIS 10.0 software. The results showed that the green areas have been reduced in between 2006 and 2019, while, the impervious surfaces have been increased. Overall, the study indiacted that implementation of green city policy and related thorough planning are necessary in Ulaanbaatar city.

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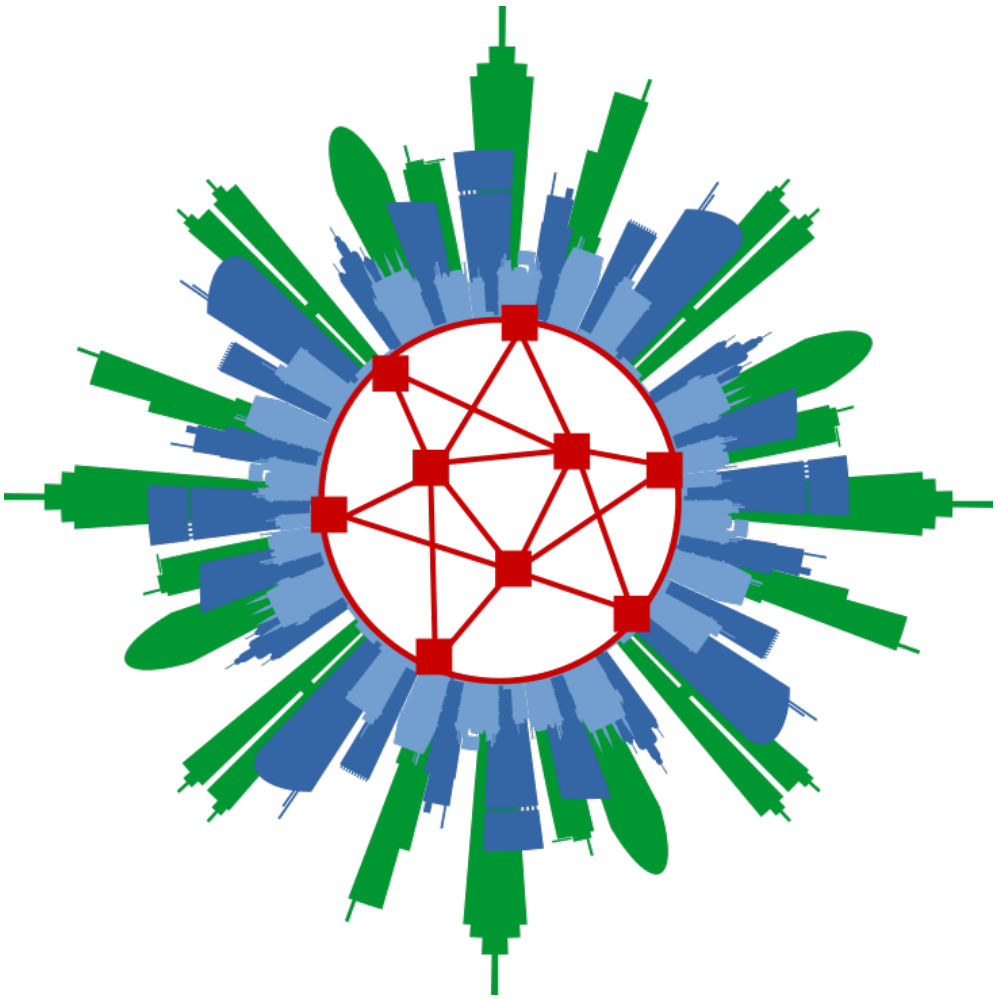

Measurement and Evaluation of electromagnetic pollution from Telecommunication towers in Ulaanbaatar city

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Keywords: *Electromagnetic Field; Radiation; Human Exposure; Exposure Limits;*

Abstract: As a result of technological developments there has been a substantial growth in the use of mobile communication services and number of base stations over the last few years. Increasing demand for communicating from any place pushes cellular system operators to install more base stations. With the increase in the number of base stations, electric field strengths have also increased in Urban. As a result of this increase in the number of base stations, and electromagnetic (EM) exposure levels have become inevitable. Considering the public debate about possible health hazards caused by electric field strength (E), in this study, evaluating the effect of establishment of Cellular systems on existing E levels is aimed. Thus, accurate measurement and assessment of electric field strength (E) levels caused by base stations accordingly are very crucial to take precautions for human health. For this reason, Electromagnetic radiation were measured at more than 1000 different locations in Districts of Ulaanbaatar city with TENMARS-TM196 field meter then assessed. We visualized current situation of electromagnetic pollution in Ulaanbaatar by ArcGIS geographic information system tool. Exposure limits are determined by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) and Mongolian National Standard. For the Exposure limits on Mongolian National Standard are same to ICNIRP's limits. However we have concluded this exposure limit should be revised in the future.

Zero Waste Mongolia NGO

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Keywords: *waste management; social media; plastic; public awareness; municipality;*

Abstract: Zero Waste Mongolia, is a independent, national, non-profit, non-governmental organization, works that help facilitate achievements in influencing and raising public awareness on waste and carrying out an adequate waste management in Mongolia. Until today unseparated waste generation of households and industries are still delivered to open and uncontrolled dumpsites conducted by municipal solid waste management (MSWM) body whereas, the amount of waste is dramatically increased as a result of a growing urban population in last decades. Improper management of waste leads to public health hazards, pollution of water bodies and furthermore contributes to global greenhouse gas emissions. Unfortunately, still using old, traditional and inadequate waste disposal (landfilling) represents a lack of knowledge, attitudes and practices towards solid waste management of urban settlers and citizens.

Zero Waste Mongolia NGO concerns as a social media is definitely a strong tool to reach people and the most cost-effective way of reducing household waste include public education and citizen encouragements. Over the period of setting up NGO has not only given waste training to approximately 7000 people including young generations and adults but also made 45 contents for social media users and has an estimated over 15000 followers at the page called **No Plastic Initiative**, which proactively developing and designing linen bags named “Bogtshon” instead of using plastic bags, disposable items that will minimize the environmental impact of consumption. This campaign has been successful in increasing demand for one permanent reusable bags. Initiative has played a significant role in making a resolution by the Government of Mongolia to ban single-use disposable plastic bags since March 1, 2019. Publishing a book for kids is the next achievement of the Zero Waste Mongolia NGO which will be a simple guide for children aims at creating awareness among children on waste make them socially responsible. NGO is also achieving in establishing recycling materials collection points at each towns, provinces with the involvements of citizens, local government and other groups and it will be one of the best ways to reduce waste.

Ulaanbaatar city's environmental noise pollution observation study

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Keywords: *smart city; noise pollution; Internet of Things; public health; transportation;*

Abstract: The urbanization phenomena has been taking place for the last three decades in Mongolia. The capital city of Mongolia, Ulaanbaatar faces challenges of a variety of environmental pollution issues such as air, soil, water, and noise pollution. Research institutions and government organizations pay less attention to the invisible public health damages like noise pollution while they consider visible issues more.

Most of the major cities have observed noise pollution, these types of studies are continuously researched by institutes, and the results often used for public policymakers, city authority decision-making procedures. Also, noise detection system based on Internet of Things/IoT/ is counterpart of Smart city concept. Unfortunately, Ulaanbaatar has not done its noise pollution investigation research. Therefore, this study aims to investigate citizen knowledge about noise pollution, the impact of the public health, major noise source and define sampling locations in the city.

The study examined the main reason and effects that cause noise pollution, 19 questionnaires designed to gather demographic data and information on attitudes about noise pollution, its impact on people's activities, and noise source annoyance were randomly distributed among the people living in Ulaanbaatar city. The data was analyzed by SSPS software.

According to the results of this study, (63%) of the respondents considered the environmental noise affected their productive life and criticized it as very annoying. The noise sources were attributed to (55.8%) in public areas like streets, (71.2%) in traffic, (21.2%) in the workplace, (23.1%) in the service area. Furthermore, The most critical effects noise pollution had on the people studied was stress (86.5%) and loss of productivity (28.8%). In this study, traffic noise was reported as the most important source of noise pollution in Ulaanbaatar city.

Generally, the study found that noise pollution in Ulaanbaatar is negatively affecting public health. More research is necessary and action is needed to involve people's attention to the issue, in order to control and prevent the effects of noise pollution. Moreover, the study suggests a future action plan which collects and store solid data from IoT devices located in investigated pollution maps as advised by the results of this study.

Air pollution reduction potential of electrostatic dust precipitators for stoves in the ger areas of Ulaanbaatar

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Keywords: *Ulaanbaatar; air pollution; particulate matter (PM); electrostatic dust precipitator (ESP); pollution reduction;*

Abstract: Air pollution with particulate matters (PM) is a serious environmental and public health problem in Ulaanbaatar. During the winter months, WHO air quality guidelines are exceeded most of the time, sometimes and in some locations by a factor of 100 or more. The simple stoves which are used to heat gers are the main source of these emissions. Because filter systems have proven to be problematic in the past, electrostatic dust precipitators (ESPs) have been investigated as one promising alternative. Even though the functional principle has been known for more than a century and ESPs are in common use (e.g. in coal-fired power stations) worldwide, their application for ger stoves is a novel but challenging approach: systems need to be not only effective and operationally safe under adverse environmental conditions, but also inexpensive and easy to maintain and operate. During the winter of 2018/2019, 70 units of a tailor-made ESP system for stoves were pilot-tested in Bayankhoshuu area of Ulaanbaatar in a project funded by the German Federal Ministry for Economic Cooperation and Development via GIZ. While some scope for technical improvements could be identified, the potential of the system to significantly reduce PM emissions could be demonstrated. Calculations based on the setup tested in the pilot trial showed that a large-scale implementation of such systems have the potential to avoid atmospheric emissions of harmful elements in orders of several tens of kilograms (Cd, Cu) to more than a hundred kilograms (As, B, Cr, Ni, Pb) per year. For Al and Zn, avoided emissions would even have a magnitude of several tons per year.

Improved Stove Program to reduce PM air pollution of Ulaanbaatar City

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Keywords: *Air pollution; PM2.5; stoves; emission; Population Weighted Exposure*

Abstract: The current severe air pollution with high particulate matter concentration in Ulaanbaatar in winter continues to be predominantly a household energy problem due to space heating and cooking in the *ger* areas, where households live in traditional *ger* tents and small houses. Other sources of pollution including vehicle traffic and road dust also need to be controlled, but they contribute significantly less to the problem currently. The introduction of improved stoves at scale was successful while it lasted in cutting the population weighted exposure to $PM_{2.5}$ in Ulaanbaatar by half in only a few years.

Together with the Government of Mongolia (GoM) and other development partners, the World Bank has supported decreased coal consumption in the *ger* areas building on baseline analytical work conducted in 2008/9 (the Air Monitoring and Health Impact Baseline – AMHIB). Specifically, the UB Clean Air Project (UBCAP) introduced over 40,000 clean stoves between 2013 and 2015, complementing activities co-financed by the Millennium Challenge Corporation and GoM Clean Air Fund which delivered close to 128,000. In total, over 168,000 stoves were distributed between 2011 and 2015, representing 82% of *ger* households. However, in parallel, UB has continued to grow in population and there have been no new systematic analysis of the impact of the increased number of polluting sources.

Stove change program had a significant achievement but one that would need to be sustained so that this positive impact is not reversed. However, pollution levels, even after this reduction, remain too high above WHO and Mongolian standards for air quality for health benefits to materialize, and for stakeholders to experience improvement in their quality of life. This can lead to the perception from some stakeholders that clean stoves have not led to the desired outcomes, and therefore risk losing their support for the program.

Research basics for improved stove program made in 2008/9, implimentation, achievements, costs of measures, lessons learnt on this issue are discussed in this presentation.

Energy efficient “city” ger with thermal storage electric heater

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Keywords: *Mongolian ger; energy efficient design; on-site measurement;*

Abstract: For thousands of years, Ger, the Mongolian traditional dwelling has been evolved into its’ current form for adapting extreme environment condition of Mongolian plateau. Ger structure is sturdy, easy to assemble and disassemble, thus adapted to nomadic lifestyle very well, and is still widely used nowadays.
Ulaanbaatar city experiences an annual average temperature of -1.3°C, which makes it the coldest capital city in the world. During the long cold season, air pollution levels in Ulaanbaatar, are among the highest in the world. Over 600 000 tonnes of raw coal are burned for heating in the city’s approximately 200 000 households living in “Ger District”, accounting for about 80% of Ulaanbaatar’s winter air pollution. Since detached houses and gers in ger district has a very poor building-insulation, residents burn large amount of coal, in average, 3 to 5 tonnes per winter per household.
In order to contribute to solve one of the hideous problem in Ulaanbaatar, and to bring Mongolian traditional dwelling into next generation, energy efficient design for gers in a sedentary lifestyle are in need of developing. The study was carried out in Gandan, one of the ger districts in Ulaanbaatar during November 2018 to April 2019. In this study, the well-insulated ger, fitted with a thermal storage electric heater as well as experiments to measure U value of ger envelope parts are presented. The on-site measurements were conducted to define U values of of a study ger and a reference ger (the typical ger with traditional insulation) and to understand temperature changes of indoor environment. The study estimated that the study ger has energy consumption of 70 kWh/m2 a, whilst in case of the reference ger, it was 401 kWh/m2 a, both considering only fabric heat loss. Thus, the study ger has found to be 5.7 times more energy efficient than the reference ger. In addition, the high thermal inertia of study ger envelope increased a stability of the indoor temperature. During the coldest period of winter 2019 (4 Feb- 14 Feb), the average ambient temperature was -24.3°C while the average indoor temperature of the study ger was 16.9°C with 2°C average temperature difference between a day and a night.

Current State and Tasks of Legislation on Autonomous Vehicles in South Korea

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Keywords: *Autonomous Vehicles; Motor Vehicle; Autonomous Driving; Korean Motor Vehicle Management; Road Traffic;*

Abstract: With the emergence of the Autonomous Vehicles, the world is becoming an era, where the 'human driver' is becoming obsolete. An advent of the autonomous vehicles has an important key to solve Urban Problems in the 20th century and is a new paradigm for 'Smart City'.
Major countries are consistently in carrying out related policies based on the technological development of autonomous Vehicles in parallel with the institutionalization including the legislation of related laws they have achieved. South Korea is also in process under the global trend.
This Paper is dealt with the current system and some issues of legislation on Autonomous Vehicles in South Korea.

Assessment of the water quality by means of fouling indexes

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Keywords: *water treatment; membrane technology; carbon footprint reduction;*

Abstract: Silt density index and modified fouling index are extensively employed as a fouling indication in membrane systems. However, there are several disadvantages in terms of reliability and accuracy. The exact relation between two indexes and other water quality parameters is still uncertain. The results from different measuring instruments show incomparable results. Lastly, it is under question whether the indexes can accurately predict the membrane system performance. The objective of this research work is to compare the MFI and SDI values with each other and with other water quality parameters and to assess performance and the chemical removal rates in a reverse osmosis pilot plant. The result will help to reduce unnecessary costs by predicting the pre-treatment types, which maximize the efficiency of the membrane technology.
For this a reverse osmosis membrane pilot plant was constructed to run experiments with different water matrices, where pollutant removal rates are examined for Zn, Cu, diurone, atrazine and nitrate. In addition, experiments were conducted with a biocide. SDI and MFI measuring unit was arranged at BOKU and compared with the INSPECTOR apparatus.
Calculation of the MFI from the BOKU instrument, show that the system requires at least 45 seconds to reach the cake filtration. SDI15 values are on average 1.7 times higher than the MFI values. Experiments with filters with different pore sizes approve that the main mechanism of the filtration process is size exclusion. SDI and MFI have high correlation to turbidity, conductivity and TDS. The comparison of MFI generated from 2 different instruments show statistically significant differences ($p=0.28$). The removal rate of the pollutants is not lower than 87%. Rejection rate is highest for the heavy metals (>98.9%). The biocide efficiency depends on the fouling of the membrane. The new membrane has higher efficiency (99.5%) than old membrane (88%) in terms of live microbial cells.

Characteristics of Sludge and its utilization as compost

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Keywords: *sludge; perlite; composting; cardboard box; carbon to nitrogen ratio;*

Abstract: Sludge, from the wastewater treatment plant, is a source of energy and nutrient, however, in Mongolia, we sought it is a waste that should be discarded. A total of 125 wastewater treatment plants were counted, from which 51 were operating normally, 27 were abnormal and 27 were not operational in 2015. More than 900 thousand cubic meter sludge generated and air dried in central wastewater treatment plant resulting in air, soil pollution and affecting to general population health.
This study investigated the characteristics of sludge from the wastewater treatment plant in Biokombinat, which treats wastewater from only households. The sludge then used for the production of compost in a lab-scale reactor. Freshly discharged sludge had 92.9% moisture content, 76.1% total volatile solids, 21.9% organic matter and 1.4% phosphorus.
Two lab-scale reactors with 85 -81% sludge, 5% perlite, 10% sawdust (R1) and 4 % cardboard box (R2) were studied for an over a month in summer of 2019. Parameters such as temperature, moisture content, organic matter, total nitrogen, C/N ratio and elements were monitored weekly.
The results of this study will be useful to develop a method for safe disposal and treatment of sewage sludge for resource recovery and reuse in Mongolia.

Acknowledgement: This study was supported by Asian Development Bank, “TA9100-MON: Management and Reuse of Sewage Sludge from On-site Sanitation Facilities and Decentralized Wastewater Treatment Plants” funded by Bill and Melinda Gates Foundation.

Experimental research on collecting the ash from the ash fund of "Thermal power plant-IV" SOE in dewatering bags

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Keywords: *ash; ash fund; dewatering technology; Geotube;*

Abstract: Ash and dregs of the Ulaanbaatar TPPs are accumulated in tens of millions of tons at the ash funds located along the Tuul river basin, covering nearly 100 hectares of land. Water in the ash funds is evaporated naturally and consequently, the dry ash containing radioactive substances and heavy metals is raised up to the atmosphere generating dustiness which in turn impacts adversely all of humans, animals and plants.

In the international practice, the technology of dewatering the ash of TPP funds is extensively used. As such, we have decided to conduct an experimental research on dewatering the ash of the TPP-IV using the dewatering pillows (small bags) and the standard dewatering bags.

Dewatering bag is a woven product made of lightweight polypropylene material highly resistant to ultraviolet rays and high temperature. So, the bag is easy to transport, simple to use and the most efficient solution of engineering technology.

The size of ash particles of the ash of the TPP-IV plant was relatively large and such a large size and big specific weight allow the ash particles to be precipitated themselves onto the bottom of the bag without any additional chemicals. During the initial experiment, ash-containing water was poured into the 60*60cm dewatering pillow via a glass tube. The pillow was filled and closed three times until the water was completely filtered out of the bag. Then, the pillow-bag was placed at a place freely accessible to the sun and wind to be naturally dried up. After 14 days, the ash in the pillows got quite dry. The ash easily crumbled and lost its form when it is rubbed between the fingers. The dry ash in the pillow weighed 42.5 kg. The weight of the bag is 0.560 kg. So, the net weight of the 20-25% moisture ash accumulated in the bag was 42 kg.

Then, a specially-designed 29.4m long and 3.2 m wide dewatering bag was used in the semi-industrial experiment. As it was determined through a relevant analysis that the ash in the ash-containing water accounts for 13-15% of the total weight, it was assumed that approximately 69 tons of dry ash can be accumulated in the dewatering bag.

In addition, the atmospheric dustiness or ambient air pollution will be reduced equivalently to amount of ash accumulated in the bag, and the period of exploitation of the ash fund will be prolonged notably. All of these positive impacts have been proved by our experimental research or testing, and consequently, it is suggested that the technology can be effectively introduced into the practice.

Biological Treatment of Leather Tanneries Wastewater Effluent - bench scale modelling

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Keywords: *Leather industry; effluent; chemical toxics;*

Abstracts: Environmental pollution is major problem of the global around and it is increasing day to day due to urbanization and industrialization. The current pattern of industrial activity alters the natural flow of materials and introduces novel chemicals into the environment composed of water bodies, soil, plants, vegetables, human, and different living organisms. Nowadays, one of a serious problem faced by the modern world is water pollution due to the increase in number of industries and this cause for other environmental pollution. Next to water, soil and air is the 2nd most important component of the environment, but it is the most undervalued, misused and abused earth and atmospheric resources respectively. Soil contamination has become a serious problem in all industrialized areas of the country. Soil is equally view as the ultimate sink for organic and inorganic form of contaminants discharged into the environment from industrial effluents. Most plants and animals depend on soil as a growth substrate for their sustained growth and development. The contamination of soils with heavy metals or micronutrients in phytotoxic concentrations generates adverse effects not only on plants but also poses risks to human health. High accumulation of metals affects both growth and metabolism and Increases the production of reactive oxygen species in plants.
Tannery industry is a primary pollutant of the environment and has a strong potential to cause soil and water pollution owing to the discharge of untreated effluent.
It uses more than 250 chemicals for leather production and release a complex mixture of toxic organic chlorinated phenols, toxic Cr (VI), and other toxic pollutants such as sulphides, phenolic compounds, magnesium, sodium, potassium, azo-dyes, cadmium, cobalt, copper, antimony, barium, lead, selenium, mercury, zinc, arsenic, PCB, nickel, formaldehyde resins, pesticides residues, mineral salts, dyes and solvents like grease and oils. Cr (VI) and chlorinated phenols are the basic prominent sewage toxic to biota and humans as well as other environments or ecosystems.

Improvement of Power Conversion Efficiency in Organic Photovoltaic Cells with Electron Donor/Acceptor Semiconductors

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Keywords: *self-assembly monolayer; organic photovoltaic cells; efficiency*

Abstract: The world energy is supplied from sources as fossil fuel (83%), nuclear power (6%) and renewable energy (11%). Energy production has started to shift from fossil fuel to diverse range of clean and carbon-neutral sources. One of widely used source of renewable energy is solar cells. The first commercial solar cells were monocrystalline silicon cells which are highly efficient, but their manufacturing process is slow and labour intensive, making them more expensive than their polycrystalline or thin film counterparts.

In order to enhance the power conversion efficiency and device performance of OPVs, we fine-tuned the work functions of anode and cathode by using self-assembly monolayer (SAM) and doping materials respectively.

The dependence of the work function of anode materials and dipole moments of SAM on the ITO was investigated by using different terminal groups such as benzene sulfonyl chloride with NO_2-terminal group. ITO(NO_2-)(160 nm)/ZnPc(20 nm)/C_{60}(40 nm)/BCP (10 nm)/Al device was obtained with V_{oc}=0.54 V, J_{sc}=3.93 mA·cm^{-2}, FF=0.41 and η_p=0.86%. The efficiency was 4 times higher than that of standard OPVs (ITO/ZnPc(20 nm)/C_{60}(40 nm)/Al device which has V_{oc}=0.54 V, J_{sc}=3.93 mA·cm^{-2}, FF=0.41 and η_p=0.22%). By inserting SubPc which is as electron donor with high HOMO level, the Voc was reached from 0.54 V to 0.71 V due to formation of non-Ohmic contact. Based on the result, electron donor material which has high value of HOMO should be used when the Ohmic contact was formed in OPVs.

Subsequently, when Alq_3/C_6H_5COOLi/Al was used as cathode, LUMO level energy decreased, resulting in a efficiency higher than that of Al as a cathode material

Furthermore, It is revealed that the most suitable and surface active SAM molecules can be specified based on theoretical calculation. OPV device with structure of ITO(NO_2-)(160 nm)/SubPc(20 nm)/C_{60}(40 nm)/BCP (10 nm)/C_6H_5COOLi (2 nm)/Al (100 nm) with efficiency of 1.56% was successfully designed in this work. The efficiency of the device was 7 times higher than that of standard OPV device.

Improving Resource-Efficiency and Cleaner Production in the Mongolian Construction Sector through Materials Recovery

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Keywords: *Construction and Demolition Waste (CDW); Waste Management; Recycling; Construction Sector; Small and Medium Enterprises;*

Abstract: The construction and demolition sector has expanded rapidly in recent years in Mongolia, in particular in Ulaanbaatar. This development is the consequence of rising urbanization and demand for new and modern apartments. Eventually, demand for other types of construction products have increased and it is estimated to escalate even more in the upcoming years. According to our research, CDW represents 20 to 25 percent of overall solid waste in Mongolia. Most of the construction materials are, however, imported, mostly from China. Even though the government's policy supports the increase in local production, there is a lack of affordable local products. A huge amount of CDW in Ulaanbaatar and other cities is dumped in landfills or illegally. Furthermore, construction SMEs do not prepare waste management plans or assign a professional to supervise the waste management process and the process of separation of CDW from other waste is currently not introduced in Mongolia. Therefore, the objective of our project and research is to promote sustainable CDW management, resource-efficiency and production among SMEs, in particular construction and demolition SMEs and construction material producers. Furthermore, the goal is to promote 3R approach (Reduce, Reuse and Recycle) in the construction sector and to promote CDW as having economic value and to use it again for the production of recycled construction materials. A very positive sign is an interest of construction companies, small or big, in this approach that will lead to the more sustainable construction and demolition sector in Mongolia. In cooperation with main stakeholders and partners, including universities, CSOs, state institutions and SMEs, the first CDW-based product has been developed in Mongolia and is currently being tested and verified in terms of economic feasibility to be prepared for commercial production. Moreover, sustainable CDW management practices and advantages of CDW-based products are widely shared with the main stakeholders and public. Finally, the research has been conducted to improve the current legal framework on CDW management and a Working Group (WG) established under the project is finalizing more sustainable CDW management regulations.

Car free zone in Ulaanbaatar city and plan for attract tourist

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Car free zone in CBD

The capital of Mongolia, Ulaanbaatar city, has been developing rapidly in recent years with dramatic increase of population and vehicles over past years, and the traffic congestion and air pollution situation has been extremely worsened. This increase is expected to continue in response to economic growth.
Our organization plans a "car-free zone" in the center of the city to support sustainable urban development and public transportations. This is also an aim to attract tourists. If there is a "car-free zone" as in like overseas city, it will be domestic economic activity and many activities will enjoyed by tourists.
UB City has strengthened the policy of Non-motorized transport, and services such as bicycle rental have begun. Therefore, if make some sections of the city center "car free zone", various benefits are expected. Furthermore, domestic tourists can also spend time comfortably.

UB City problems

- Poor public transport
- Traffic congestion
- Air pollution (Winter)
- Street road network
- Pedestrian and bicycle road not enough
- Sightseeing spot, street event missing

Car free zone effect:

Difficult point

- Some Residents' Oppose
- Parking
- Land regulation
- Restrict street for car

Good point

- Public space
- Human scale street
- Bicycle & pathways
- Barrier free
- Culture event, festival

- Restaurant, coffee shop, shopping store
- Communication of people
- Shifting eco city (Cities for car shifting cities for people)

Car free zone benefit:

- Reducing congestion & environmental pollution
- Attract tourist
- Economic growth
- Happier life
- Labor increase
- Shifting urban transport

Keynote Presentations

Presentations

Poster Presentations