Evaluating Smart Cities

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SuMoCoS

Sustainability and Mobility
in the Context of Smart Cities

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МОНГОЛ УЛСЫН ШИНЖЛЭХ УХААН ТЕХНОЛОГИЙН ИХ СУРГУУЛЬ

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Content

1. Introduction
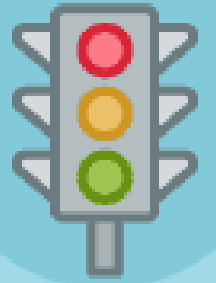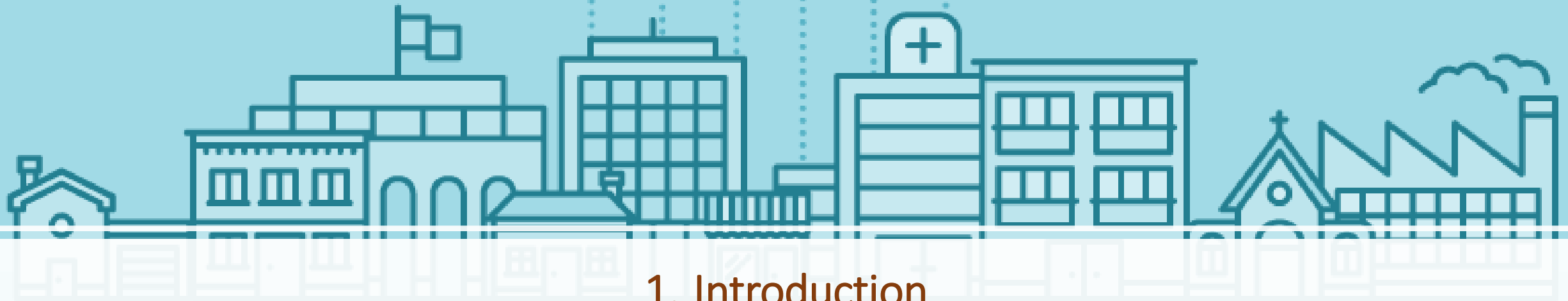
Introduction

1. Urbanization, population concentration and migration

Two-Thirds of the Population Will Live in Cities by 2050

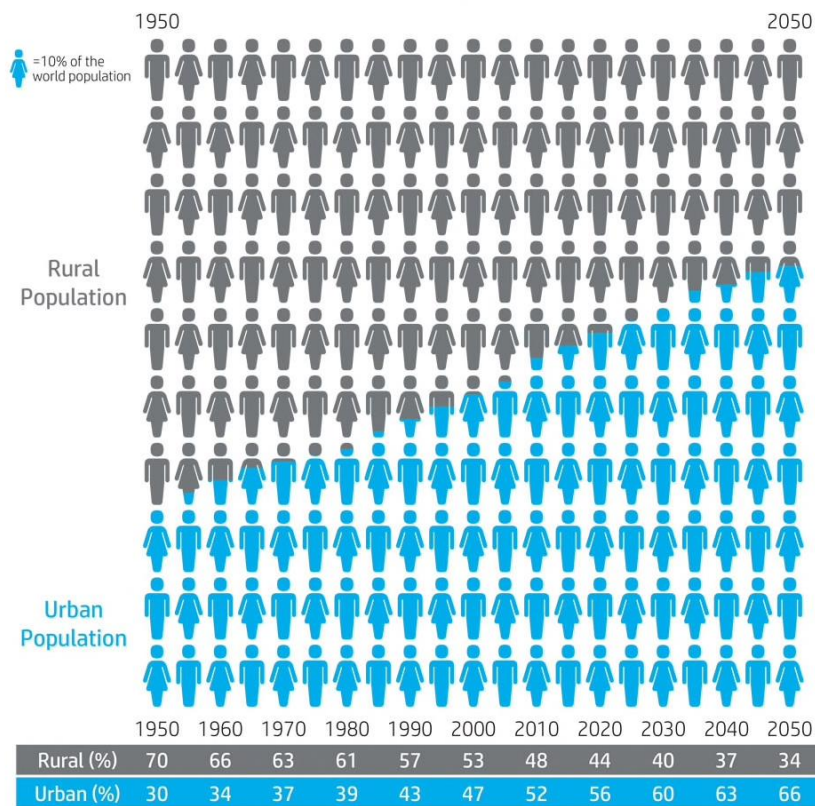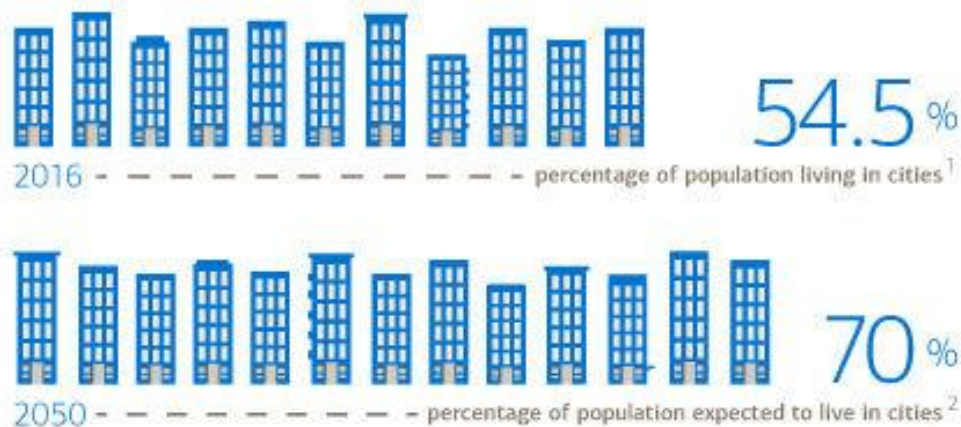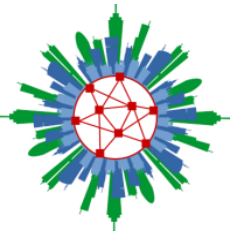1950   2050

= 10% of the world population

Rural Population

Urban Population

	1950	1960	1970	1980	1990	2000	2010	2020	2030	2040	2050
Rural (%)	70	66	63	61	57	53	48	44	40	37	34
Urban (%)	30	34	37	39	43	47	52	56	60	63	66

Source: World Urbanization Prospects: 2014 Revision, United Nations Population Division

The world's population is increasingly urban

2016 - - - - - - - - - - percentage of population living in cities [1]

54.5%

2050 - - - - - - - - - - percentage of population expected to live in cities [2]

70%

Source: 1) UN DESA, 2015, 2) UN World Urbanization Prospects, The 2014 Revision
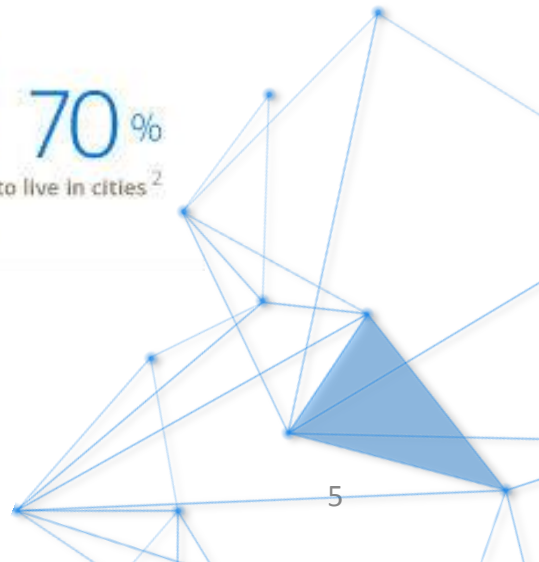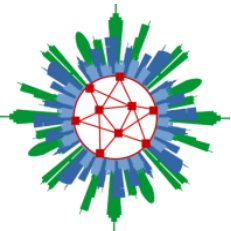
Introduction

1. Urbanization, population concentration and migration

Urbanization Rate in China

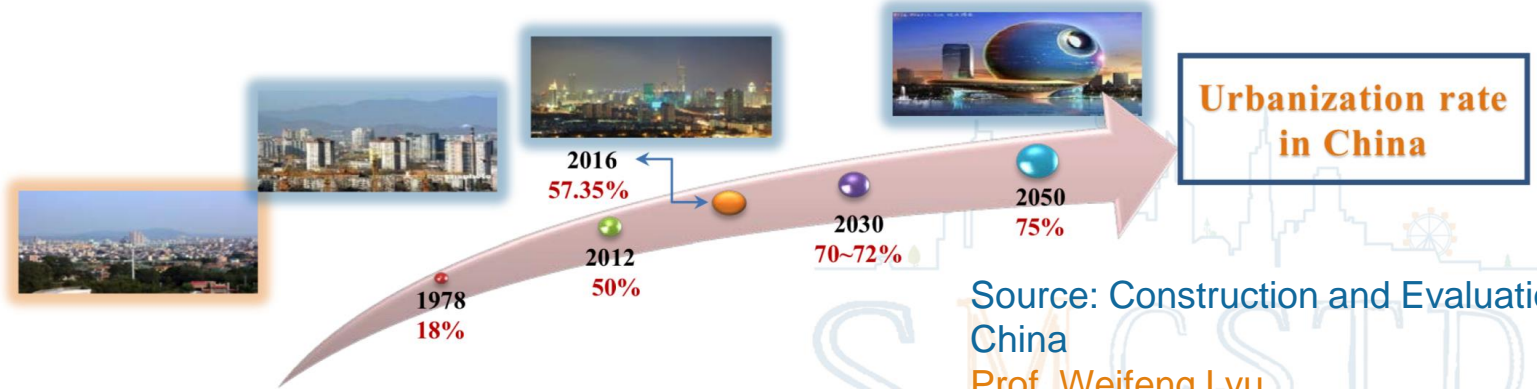Construction

Agricultural Civilization → Industrial Civilization → Post-Industrial Civilization   IT Civilization

Urbanization rate in China

2016
57.35%

2012
50%

1978
18%

2030
70~72%

2050
75%
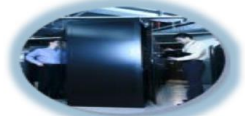
Source: Construction and Evaluation of New Type Smart City in China
Prof. Weifeng Lyu
School of Computer Science and Engineering, Beihang University
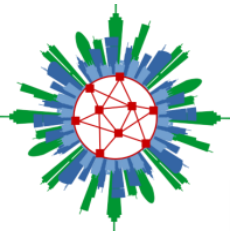
Introduction

1. Urbanization, population concentration and migration

POPULATION OF MONGOLIA, urban and rural

Introduction

4th Industrial Revolution:

2. Industry and technological development trends

Digital transformation – Digitalization wave: 3rd Wave of Digitalization
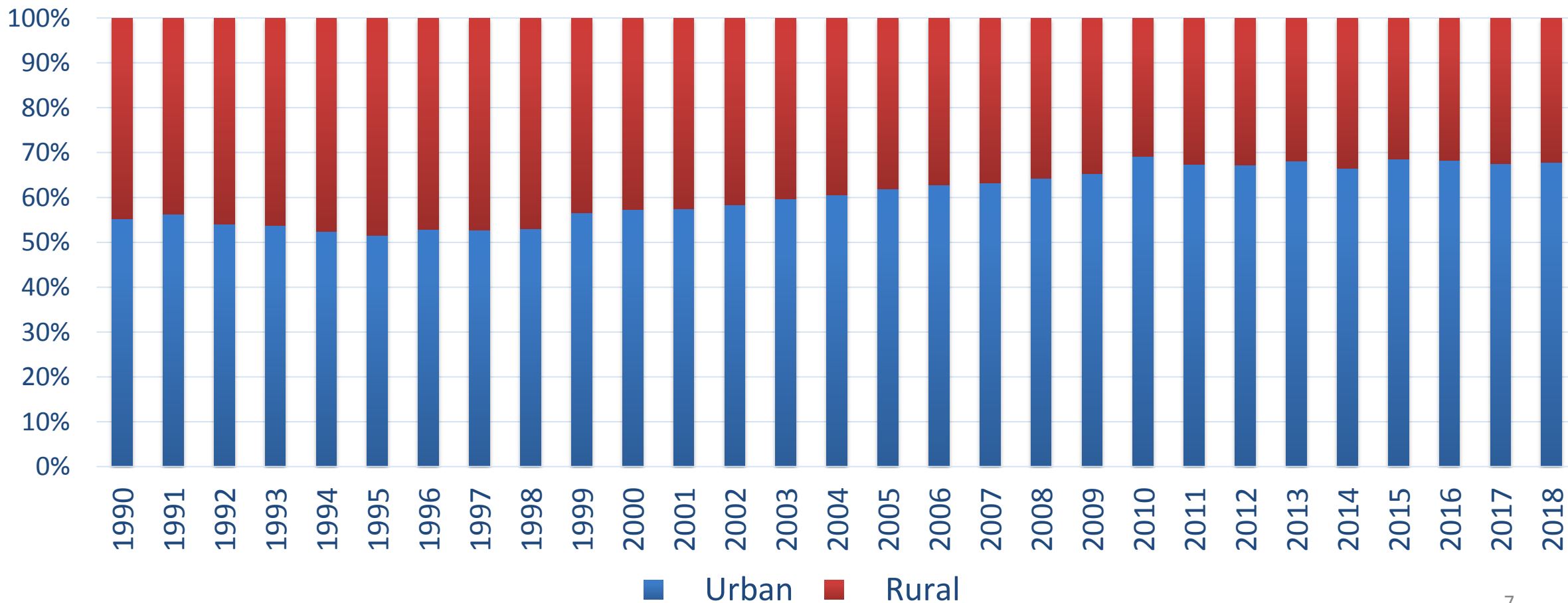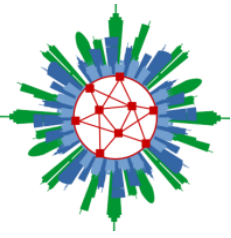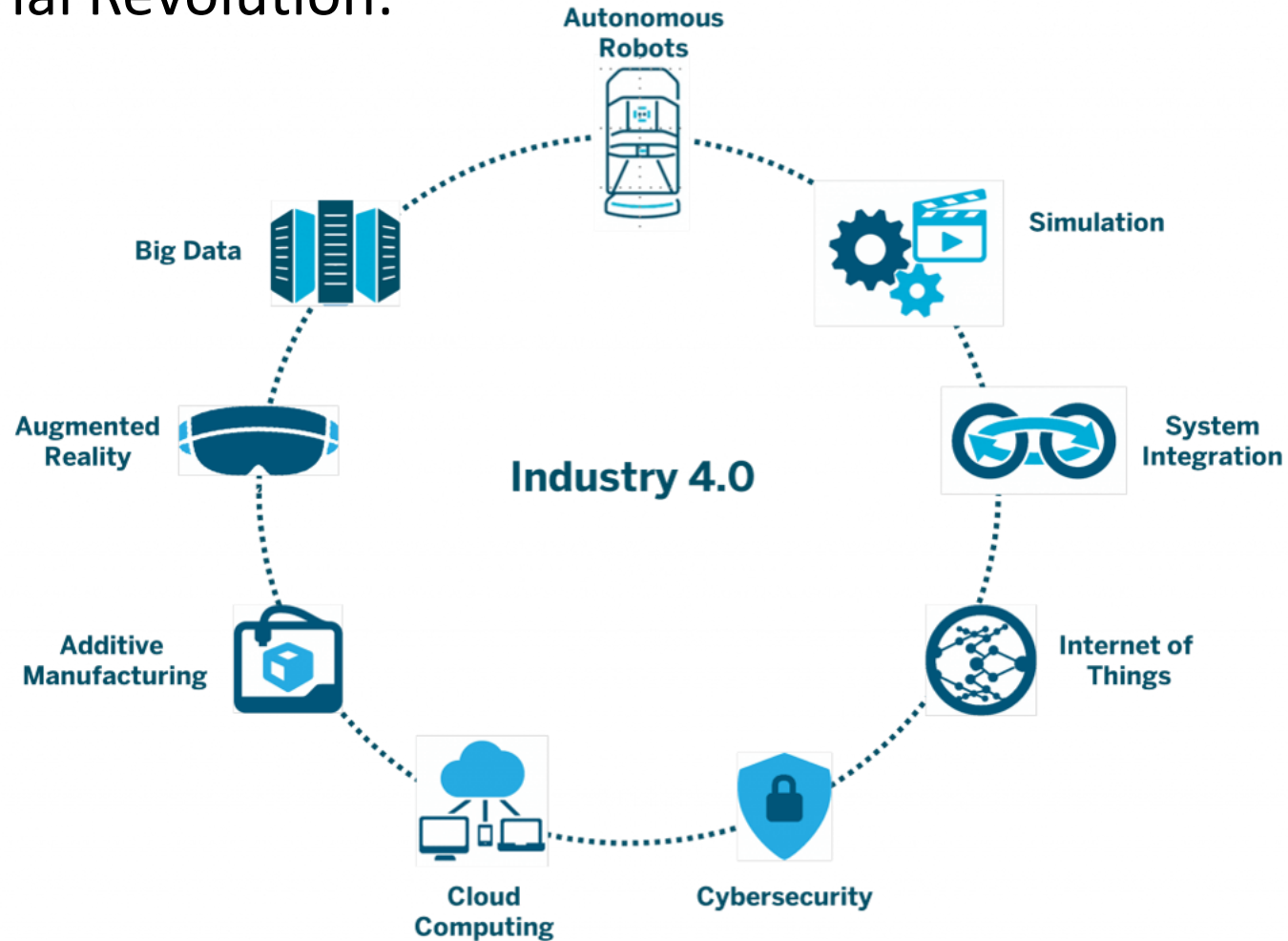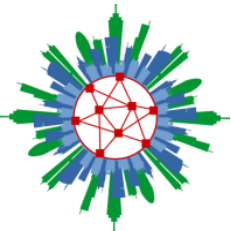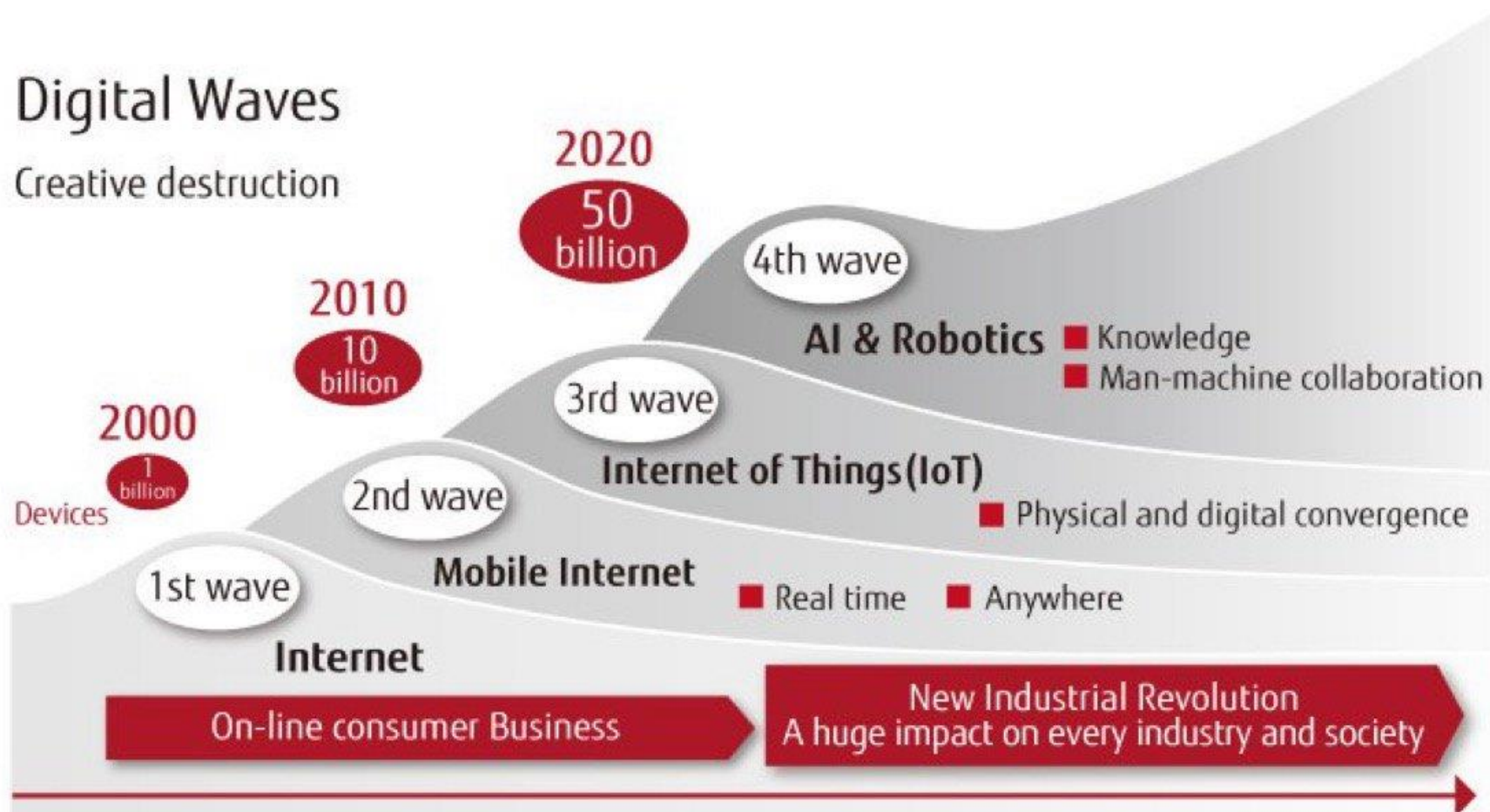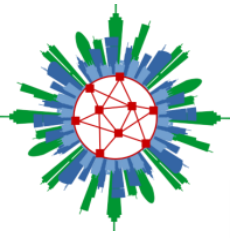
Introduction

2. Industry and technological development trends

The 5th generation cellular (5G)

Source: https://www.gemalto.com/

Introduction

The following policies and programs are proposed and followed to develop smart cities in Mongolia:

- Concepts of Mongolia's sustainable development- 2030, which was approved in 2016,

- Green development policy, which was approved in 2014,

- The Master plan to develop Ulaanbaatar city until 2020 and the bill of development trend 2030, which was approved in 2013

- Smart Ulaanbaatar program, which was approved in 2014
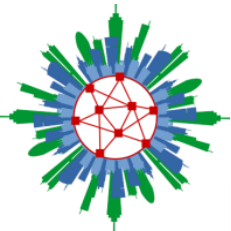
3. Mongolia's development policy and strategy

SMART ULAANBAATAR PROGRAM
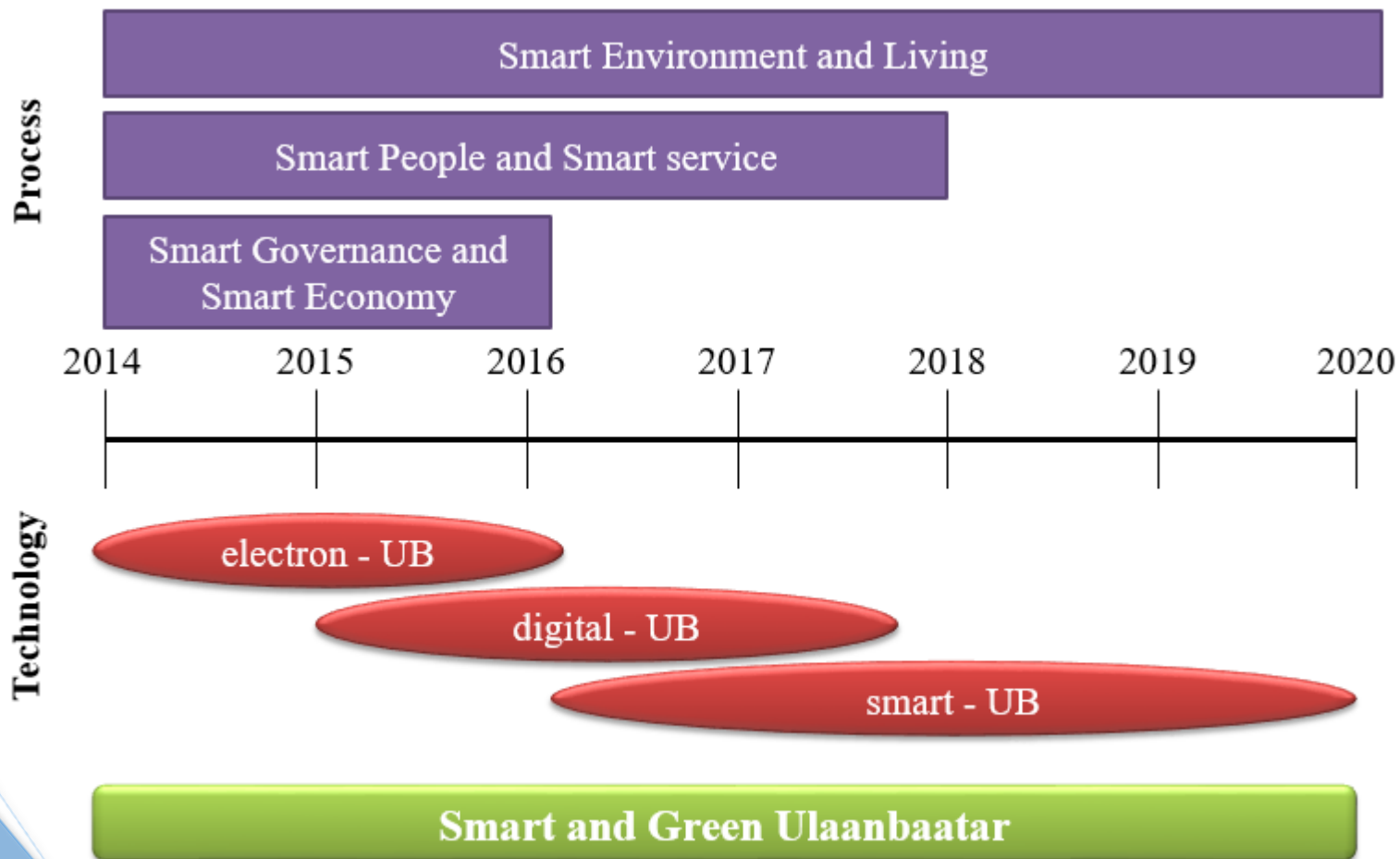
2. What is a Smart City

Development of world cities

Pre-industrial city

The concept of modern urban development mainly focuses on implementing smart solutions of information and communication technology (ICT), technology advancements and innovation achievements through stimulating socio-economical development, forming suitable environment and conditions for its residents, improving state and infrastructure services provided to the citizens and promoting multilateral business for companies.

Urban and Urban Development Theory

URBAN ECONOMY, URBAN DEVELOPMENT THEORIES

REGION & LOCAL DEVELOPMENT THEORIES

INNOVATION THEORY

ECONOMIC GEOGRAPHY THEORIES

DEVELOPMENT THEORIES

LOCATION THEORIES

GROWTH THEORIES

ECONOMICS

Urban and Urban Development Theory

1776 — А.Смит "Үндэстний баялаг"
1817 — Д.Рикардо "Улс төрийн эдийн засаг, татварын зарчим"
1826 — Ж.Тьюнен "Газар ашиглалт"
1848 — Дж.С.Милль "Үйлдвэрлэл ба төрийн эдийн засгийн үүрэг"
1867 — К.Маркс "Капитал"
1879 — А.Маршал "Аж үйлдвэрийн эдийн засаг"
1890 — А.Маршал "Аж үйлдвэрийн дүүргүүд"
1898 — Э.Ховард "Ирээдүйн цэцэрлэгт хотууд"
1909 — А.Вебер "Аж үйлдвэрийн байршил"
1910 — Ф.Л.Райт "Нам давхаржилттай хотууд"
1913 — Ж.Гелдерн "Эдийн засгийн өсөлт"
1929 — К.А.Пери "Хөршийн нэгж"

1955 — Д.Норт "Байршилтын онол, Эдийн засгийн өсөлт"
1954 — А.Лош "Байршилтын эдийн засаг"
1951 — К.С.Стэйн "Америкийн шинэ хотууд"
1942 — Алкер Трип "Хот төлөвлөлт ба замын сүлжээ"
1939 — М.Жефферсон "Том хотын онол"
1936 — Ж.М.Кейнс "Хөдөлмөр эрхлэлт ба хүү мөнгөний онол"
1934 — И.Шумпетер "Эдийн засгийн хөгжлийн онол"
1933 — В.Кристаллер "Төв цэгийн байршил"
1933 — Э.М.Гувэр "Аж үйлдвэрийн байршлын сонголт"
1930 — Ле Корбьюзе "Гэрэлтэт хот"

1956 — В.Изард "Байршилт ба орон зайн эдийн засаг"
1957 — Г.Мьюрдал "Хөгжиж буй орны бүс нутгийн эдийн засаг"
1957 — Г.Мьюрдал "Кумулятив загвар"
1957 — М.Ж.Бекманн "Хотын орон сууцны нягтрал, түрээс"
1958 — Л.Лефебэр "Орон зайн хуваарилалт, байршилт"
1958 — Э.Боэвентер "Үйлдвэрлэлийн хүчин зүйлсийн байршилт"
1958 — В.Алонсо "Хотын газрын зах зээл"
1960 — Г.Х.Бортс "Бүс нутгийн эдийн засгийг тэнцвэржүүлэх"
1961 — Л.Ж.Винго "Хотын газар, зам тээвэр"
1964 — В.Алонсо "Хотын эдийн засаг"
1964 — Г.Х.Бортс "Чөлөөт зах зээл дэх эдийн засгийн өсөлт"
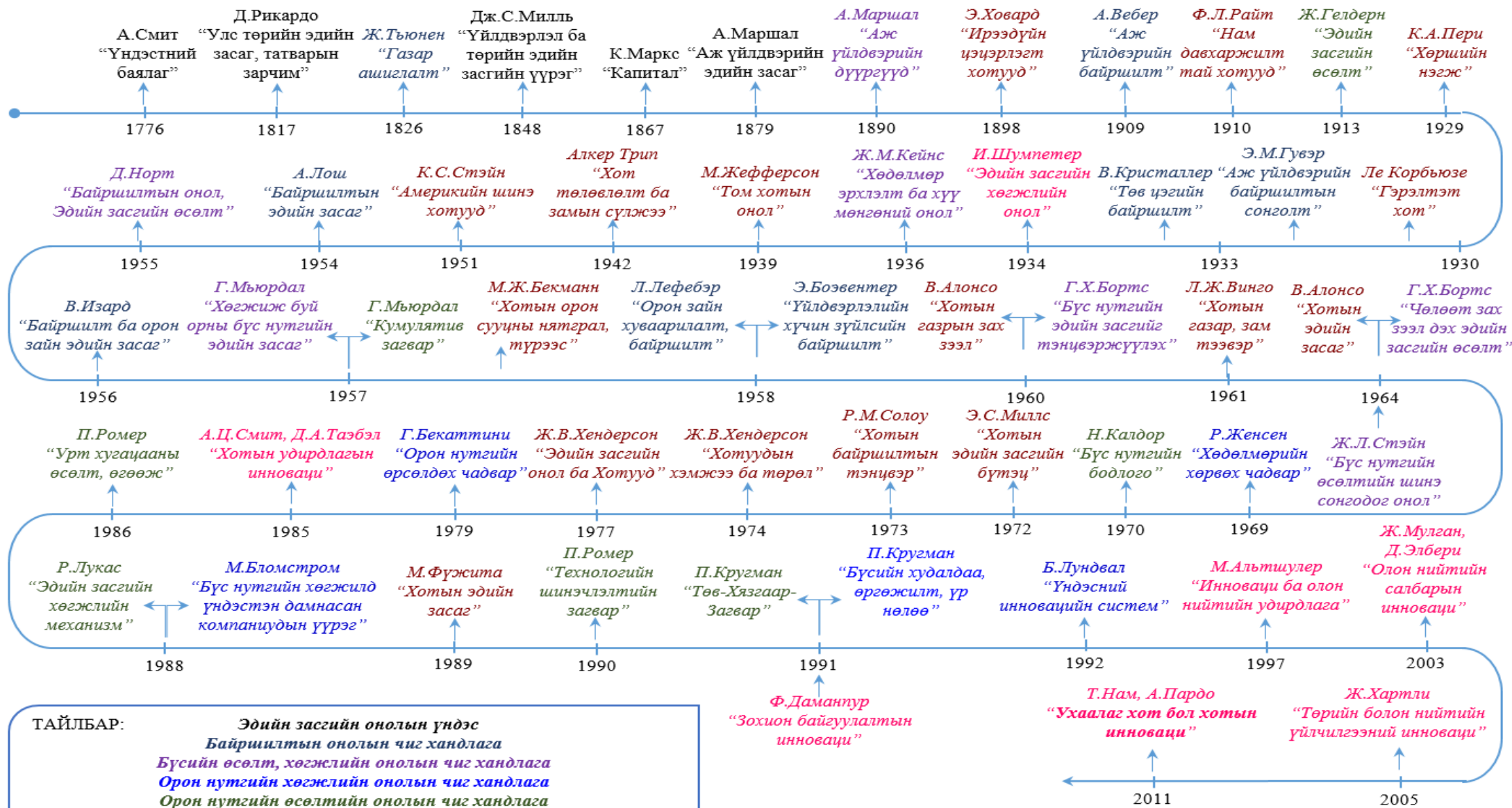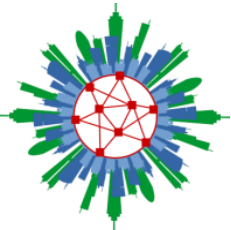
1986 — П.Ромер "Урт хугацааны өсөлт, өгөөж"
1985 — А.Ц.Смит, Д.А.Таэбэл "Хотын удирдлагын инноваци"
1979 — Г.Бекаттини "Орон нутгийн өрсөлдөх чадвар"
1977 — Ж.В.Хендерсон "Эдийн засгийн онол ба Хотууд"
1974 — Ж.В.Хендерсон "Хотуудын хэмжээ ба төрөл"
1973 — Р.М.Солоу "Хотын байршилтын тэнцвэр"
1972 — Э.С.Миллс "Хотын эдийн засгийн бүтэц"
1970 — Н.Калдор "Бүс нутгийн бодлого"
1969 — Р.Женсен "Хөдөлмөрийн хөрвөх чадвар"
1969 — Ж.Л.Стэйн "Бүс нутгийн өсөлтийн шинэ сонгодог онол"

1988 — Р.Лукас "Эдийн засгийн хөгжлийн механизм"
1989 — М.Бломстром "Бүс нутгийн хөгжилд үндэстэн дамнасан компаниудын үүрэг"
1989 — М.Фужита "Хотын эдийн засаг"
1990 — П.Ромер "Технологийн шинэчлэлтийн загвар"
1991 — П.Кругман "Төв-Хязгаар-Загвар"
1991 — Ф.Дамантур "Зохион байгуулалтын инноваци"
1992 — П.Кругман "Бүсийн худалдаа, өргөжилт, үр нөлөө"
1992 — Т.Нам, А.Пардо "Ухаалаг хот бол хотын инноваци"
1992 — Б.Лундвал "Үндэсний инновацийн систем"
1997 — М.Альтшулер "Инноваци ба олон нийтийн удирдлага"
2003 — Ж.Мулган, Д.Элбери "Олон нийтийн салбарын инноваци"
2003 — Ж.Хартли "Төрийн болон нийтийн үйлчилгээний инноваци"
2011
2005

ТАЙЛБАР:
- Эдийн засгийн онолын үндэс
- Байршилтын онолын чиг хандлага
- Бүсийн өсөлт, хөгжлийн онолын чиг хандлага
- Орон нутгийн хөгжлийн онолын чиг хандлага
- Орон нутгийн өсөлтийн онолын чиг хандлага
- Хотын хөгжил, хот төлөвлөлтийн онолын чиг хандлага
- Инноваци, хотын инновацийн онолын чиг хандлага

What is Smart City

A smart city is ecologically, socially and economically independent system with concentrated population, which rests on the modern infrastructure of information and communication technology that promotes a secure and comfortable living environment for its residents and creates ecosystems for the development of socio-economical sectors, science, technology, and innovation.

"Ухаалаг" хот гэдэг нь мэдээлэл, харилцаа холбооны технологийн орчин үеийн дэд бүтцэд суурилан, иргэдийн тав тухтай, аюулгүй оршин суух таатай нөхцөлийг хангаж, нийгэм–эдийн засгийн салбаруудм, шинжлэх ухаан, технологи, инноваци хөгжих экосистем бүрдүүлсэн, хүн амын төвлөрөл бүхий суурин газар, нийгэм, эдийн засаг, экологийн бие даасан тогтолцоо мөн.

3. Methodologies in evaluating Smart city approaches
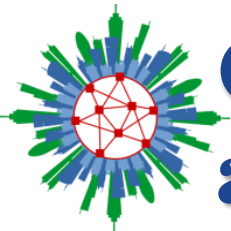
Comparative study on methodologies of assessing Smart cities development

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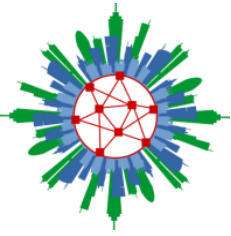
European countries:

Determining the "Smart City Ranking" issued by the University of Technology of Vienna in 2007

In the United States and Canada:

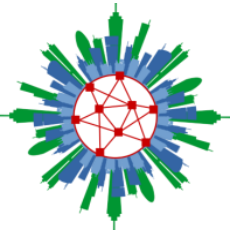**The "Smart City Readiness Indicator", issued by the Smart City Council**
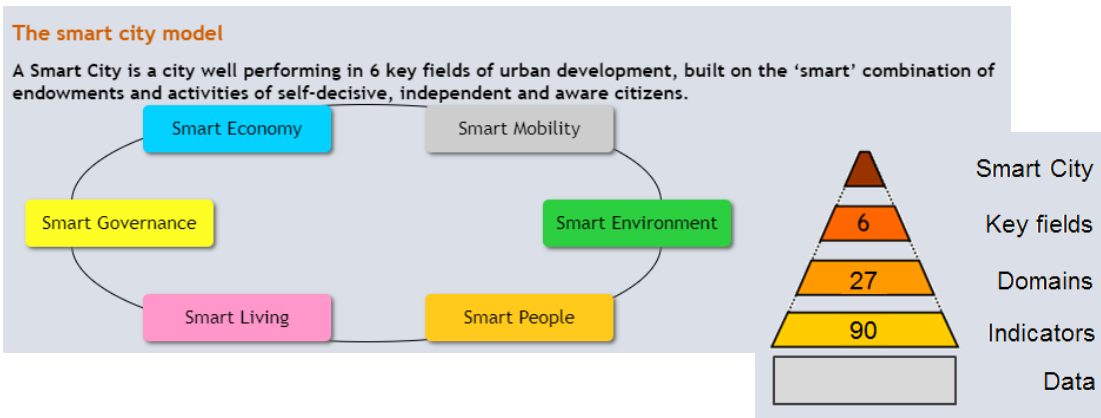
In China:

1. "Smart City Index System" Ministry of Housing and Urban Development of China

**2. "Smart City Index System" Ministry of Housing and Urban Development of China**

Comparative Study On Methodologies Of Assessing Smart Cities Development

№	Name of Methodology	Organization and Researchers	Number of Dimensions and Indicators	Theory Basis
I	"Concept of Sustainable Development in Mongolia 2030	Mongolia	15 dimensions, 103 indicators (http://sdg.1212.mn/)	Concept of Sustainable Development, Concept of National Development
II	"Capital Health Hygiene Index"	Administration of Ulaanbaatar City Mongolia	8 dimensions, 30 indicators	Theory of Urban development and Planning, Concept of Smart and Innovative City
III	KPI of Smart and Sustainable city [2]	International Telecommunications Union -T Focus Group on Smart Sustainable Cities	5 dimensions, 72 indicators	Theory of Urban development and Planning, Concept of Sustainable Development, Concept of Smart City
IV	Smart cities Ranking of European medium-sized cities [3]	Vienna University of Technology	6 dimensions, 33 factors, 74 indicators	Location theory, regional development theory, innovation theory, smart city concept
V	Main criteria of smart cities	AHY, Smart city council https://smartcitiescouncil.com/	6 dimensions, 18 factors, 46 indicators	
VI	European common indicators [4]	European Union	6 dimensions, 15 indicators	Urban planning theory, well-being theory, sustainable regional development concept, smart city concept
VII	City prosperity index	UN-Habitat	5 dimensions	Comparative advantages theory, well-being theory, sustainable development concept, smart city concept

# Comparative Study On Methodologies Of Assessing Smart Cities Development

| №	Name of Methodology	Organization and Researchers	Number of Dimensions and Indicators	Theory Basis
VIII	Index system of smart city ISO/TC 268/SC1	International Organization for Standardization (ISO)	Infrastructure of smart city: 5 main parts, performance: 3 dimensions, 10 indicators	Regional development theory, innovation theory, urban planning theory, well-being theory, sustainable regional development concept, smart city concept
IX	"Sustainable development of communities– Indicators for city services and quality of life" ISO 37120:2014	Олон улсын стандартын байгууллага (ISO)	17 factors, 100 indicators	
X	Green city index [5]	Unit of economic news and information, Siemens company	8 factors, 30 indicators	Urban planning theory, sustainable development concept, green development concept
XI	Safe city index [6]	Unit of economic news and information, NEC company	4 factors, 43 indicators of output and input	Sustainable development concept
XII	Index system of smart city and smart statistics	Italia	6 dimensions, 12 factors, 33 indicators	Well-being theory, Urban planning theory, innovation theory
XIII	GCIF: Global city indicators facility[7]	World Bank	5 main, 40 sub-indicators Performance: 20 main, 40 sub-indicators	Well-being theory, Urban planning theory, competitiveness theory
XIV	Index system of SSC [8]	Japanese telecommunications technology committee	I level 4, II level 6, III level 16 indicators	Innovation theory, sustainable development concept
XV	Index system of smart city [9]	China institute of telecommunications	I level 4, II level 19, III level 57 indicators	Urban planning theory, sustainable development concept, smart city concept
XVI	Index system of the national pilot smart city[10]	Ministry of Housing and urban-rural development of China	I level 4, II level 11, III level 57 indicators	
XVII	Networked society city index [11]	Ericsson company	6 factors, 15 main, 36 sub-indicators	Innovation theory, sustainable development concept
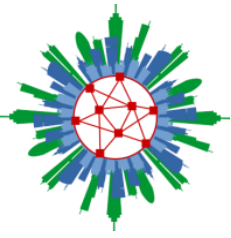
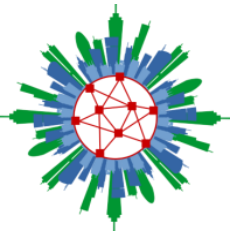# System of assessing smart cities development level
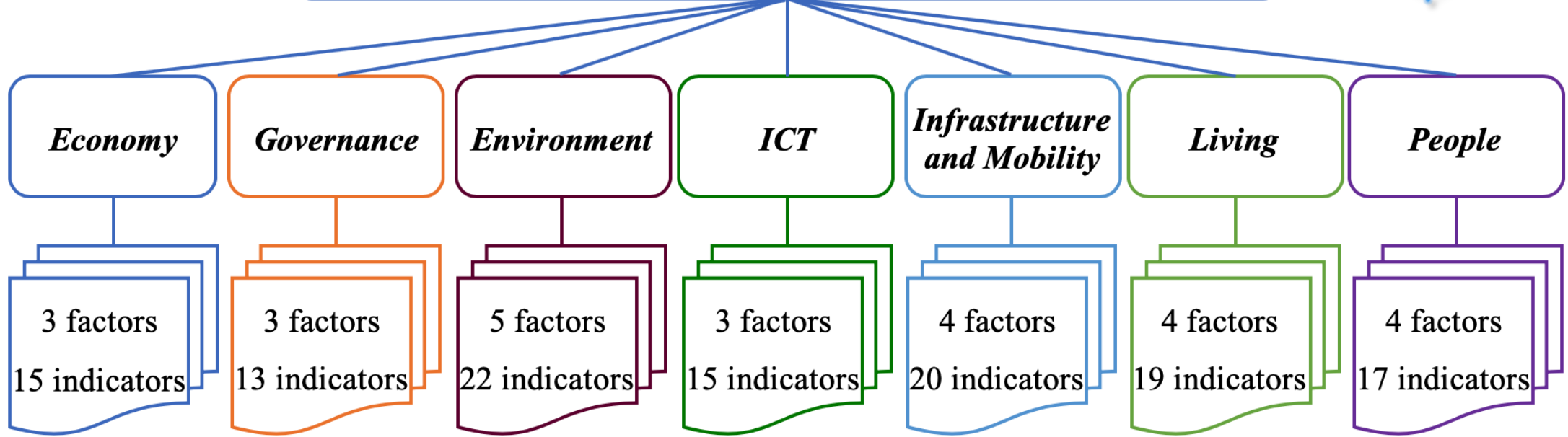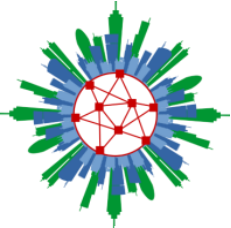
Reliabilty Analysis

№	Dimensions	χ^2	N	Cronbach's alpha	N_{item}
1	Smart City's Economy	23.57	7	0.861	13
2	Smart City's Governance	60.67	11	0.900	12
3	Smart City's Environment	40.81	5	0.887	22
4	Smart City's ICT	20.80	7	0.923	15
5	Smart City's Infrastructure and Mobility	53.65	7	0.823	20
6	Smart City's Living	44.65	6	0.781	19
7	Smart City's People	51.91	7	0.765	17

4. Assessment of the development of Smart Ulaanbaatar

Some current information of Ulaanbaatar city, 2018

Territories: **4735.1 км²**

Resident population: **1.44 million**

Share of GDP: **66.2%**

Population aged 16-35 : **576 811**

GDP per Capita: **14957.3 thous.tug**

Source: NATIONAL STATISTICS OFFICE OF MONGOLIA
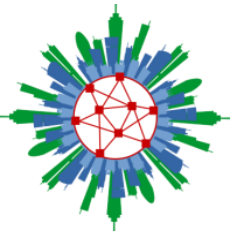
Common Challenges of Cities in Mongolia, 2018

Unemployment Rate

7.6%

Registered crime

263
Crime rate per 10000 population aged 16 and above

68
Resolved by Court criminal case rate per 10000 population aged 16 and above

Density 1 км²

317.3 person

In Mongolia 2.1

Death due to air pollution /One year, 2015/

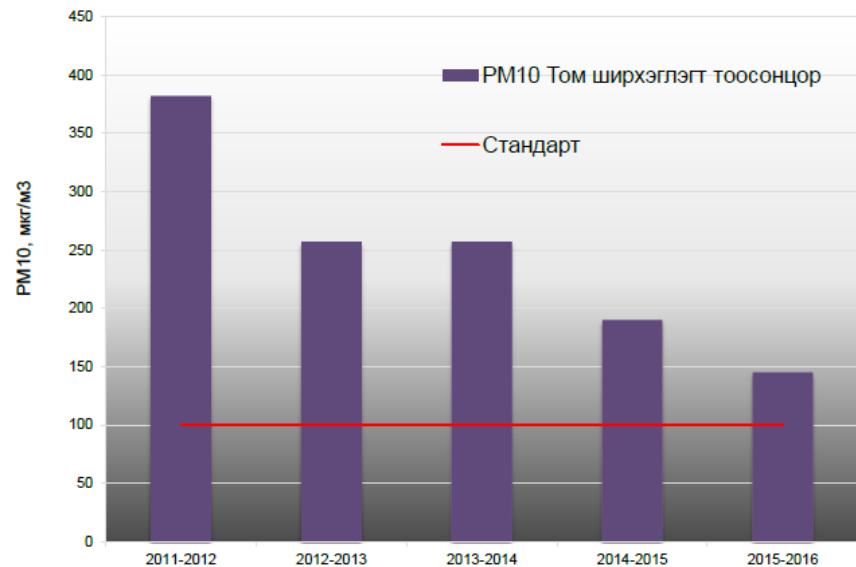Aged 0-5 **120 children**

Adult **1200 people**

Poverty Headcount

25.9%
Daily average expenditure per household 17.7$

Source: NATIONAL STATISTICS OFFICE OF MONGOLIA

28
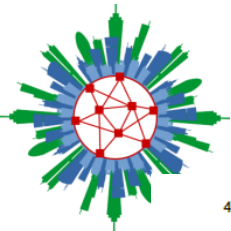
Air pollution in the capital city
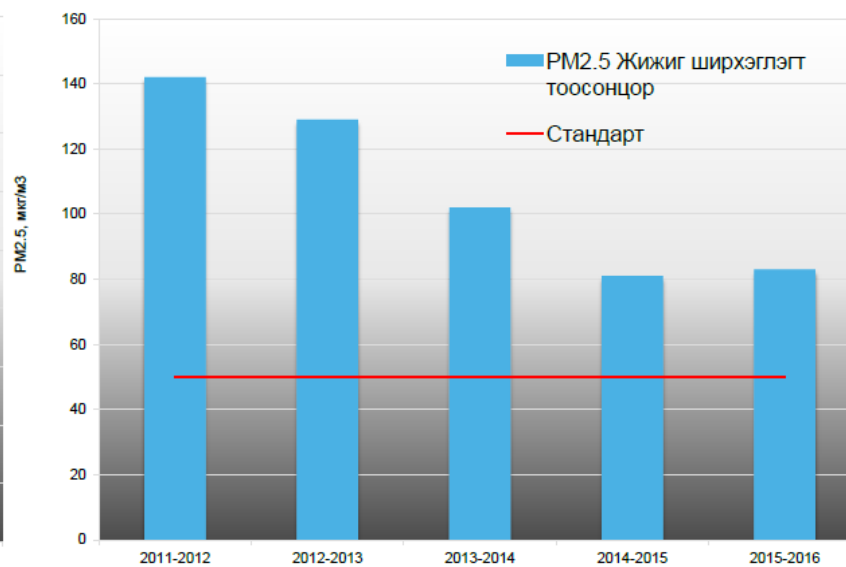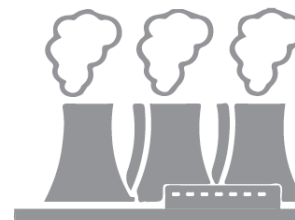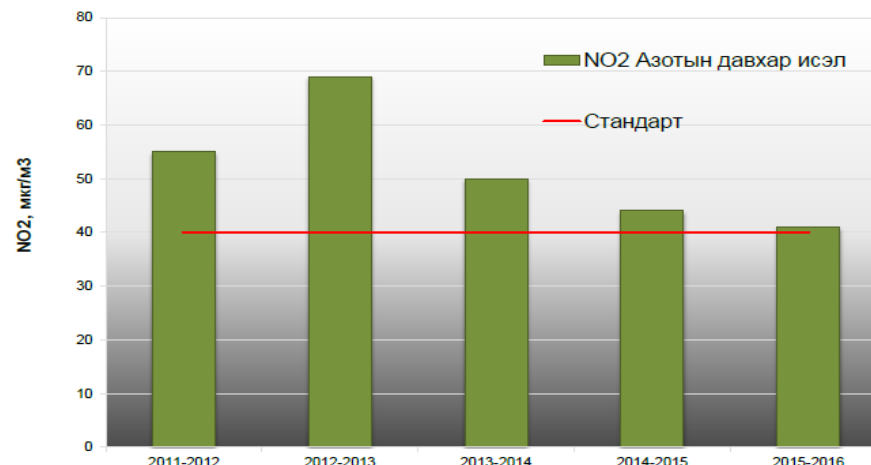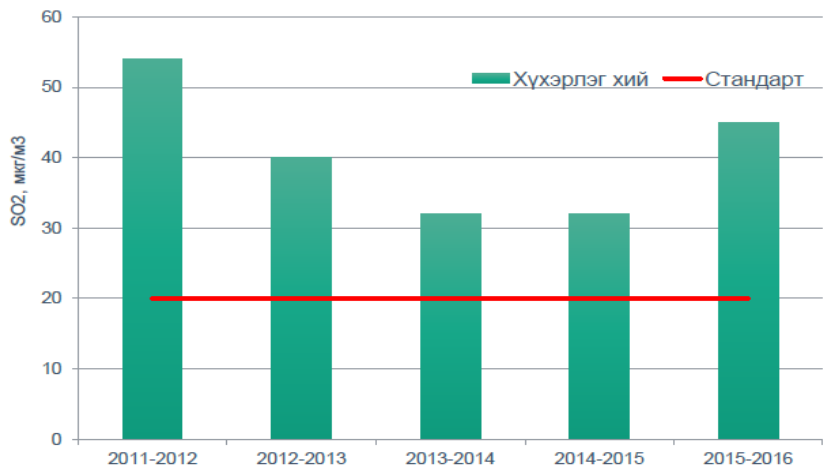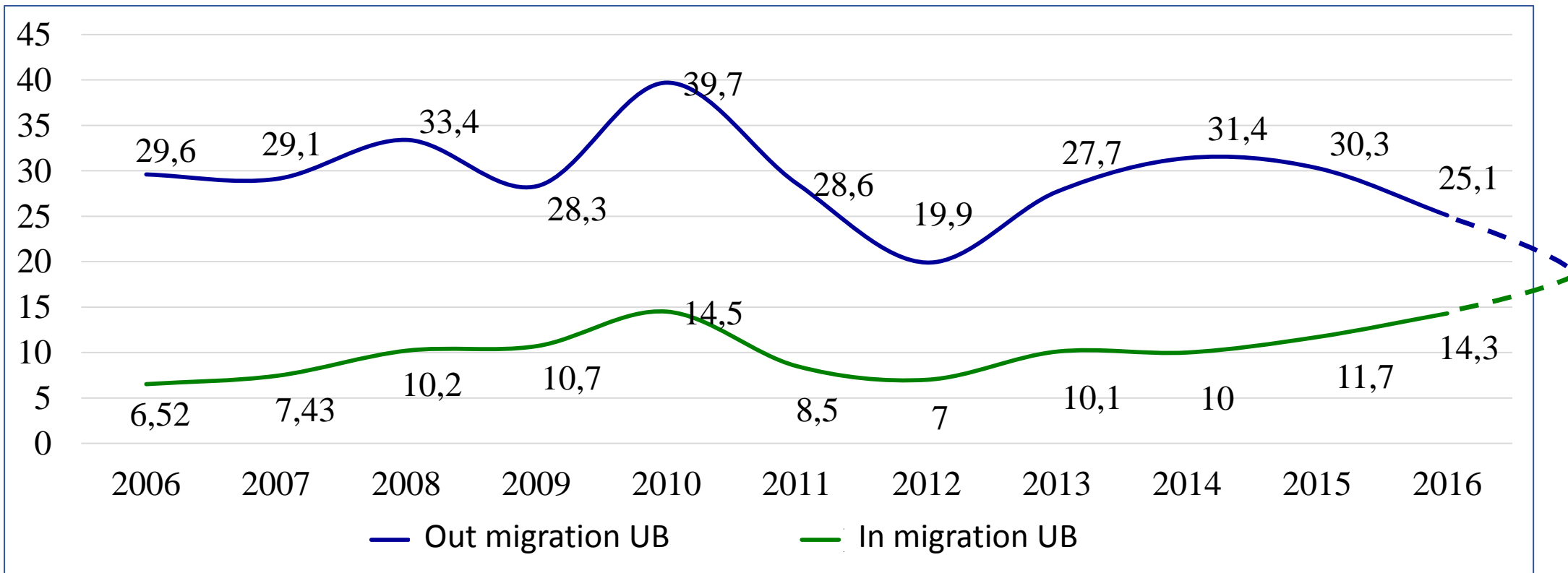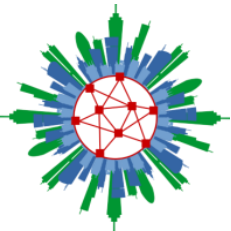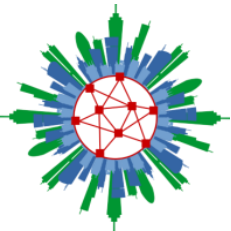
Population migration in Ulaanbaatar

Source:

Assessment of the development of Smart Ulaanbaatar

Readiness of Information Technology by Infrastructure Sectors

Survey on the satisfaction of citizens living in Ulaanbaatar
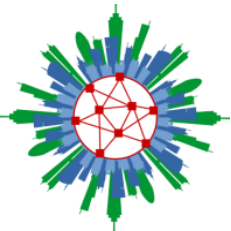
Measurement of indicators
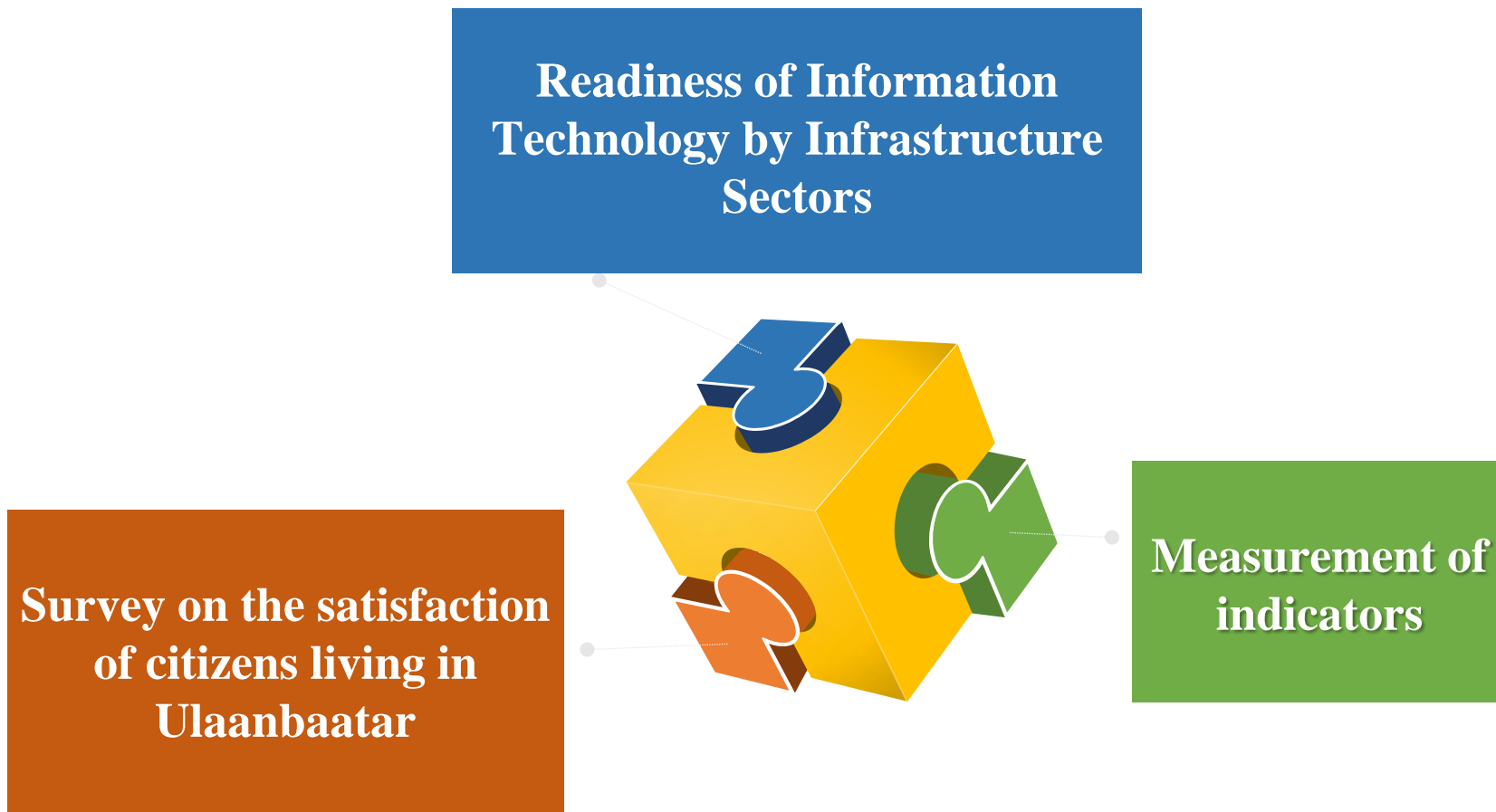
Readiness of Information Technology by Sectors

| Indicators	Overall point (max 3)	Education	Health	Transportation	Energy	Social services	Environment	Payment system, bank	ICT
Instrumentation and control	1.07	1.14	0.50	1.00	1.33	0.67	0.75	2.20	1.00
Connectivity	1.01	1.00	0.75	1.00	1.00	0.33	0.50	1.80	1.67
Interoperability	1.01	1.43	0.75	0.67	0.33	0.67	1.25	1.80	1.17
Security and privacy	0.91	0.86	1.00	1.33	0.33	0.33	1.00	1.40	1.00
Data management	0.87	0.71	1.25	1.00	0.33	0.33	0.50	1.80	1.00
Computing resources	0.88	1.00	1.00	0.67	0.33	0.33	1.50	1.40	0.83
Analytics	0.85	0.57	1.50	0.67	0.33	0.33	1.00	1.60	0.83
Integrated evaluation	-	**0.96**	**0.96**	**0.90**	**0.57**	**0.43**	**0.93**	**1.71**	**1.07**

Cronbach alpha was 0.82 and concordance W coefficient 0.91. According to the results of the expert survey, it is possible to conclude that the overall assessment of the capital city is based on monitoring, connectivity and interconnection as the average, while information security, confidentiality, data management, computing capabilities, analytical and analysis capabilities have not yet been established.

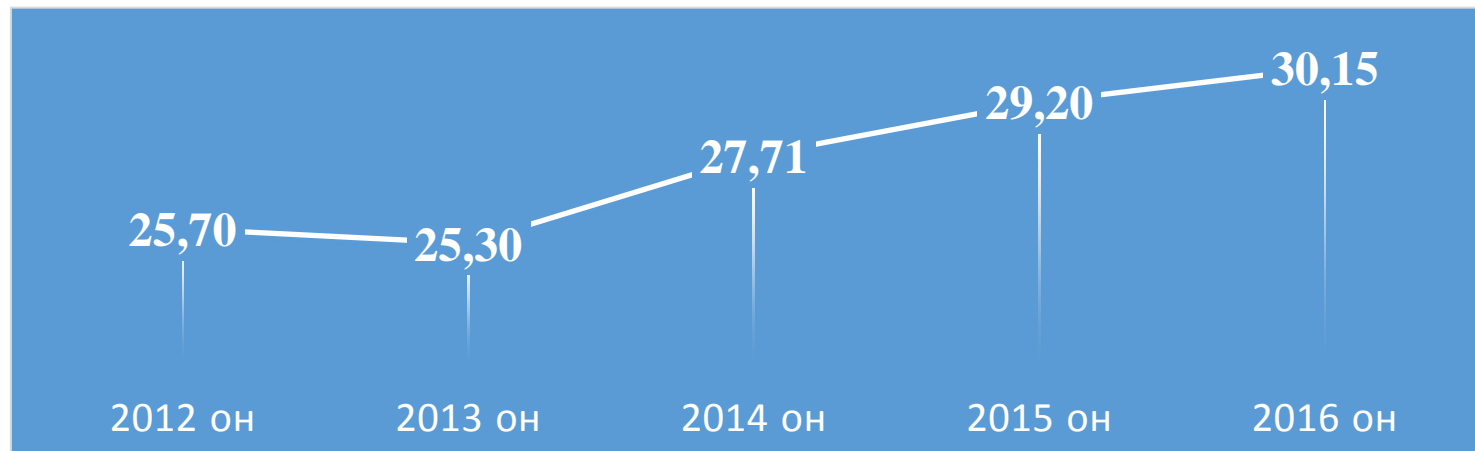# Survey on the satisfaction of citizens living in Ulaanbaatar

Governance	City Service	Security	Individual skills and participation	CSI	HCSI
0.62	0.72	0.61	0.78	**2.73**	**2.77**

Citizens' satisfaction surveys were conducted to determine the satisfaction of urban residents and the quality of life and safety of the city.
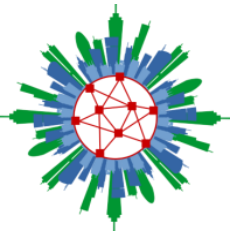The survey covered 1600 citizens.
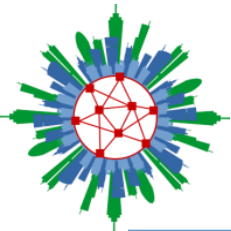
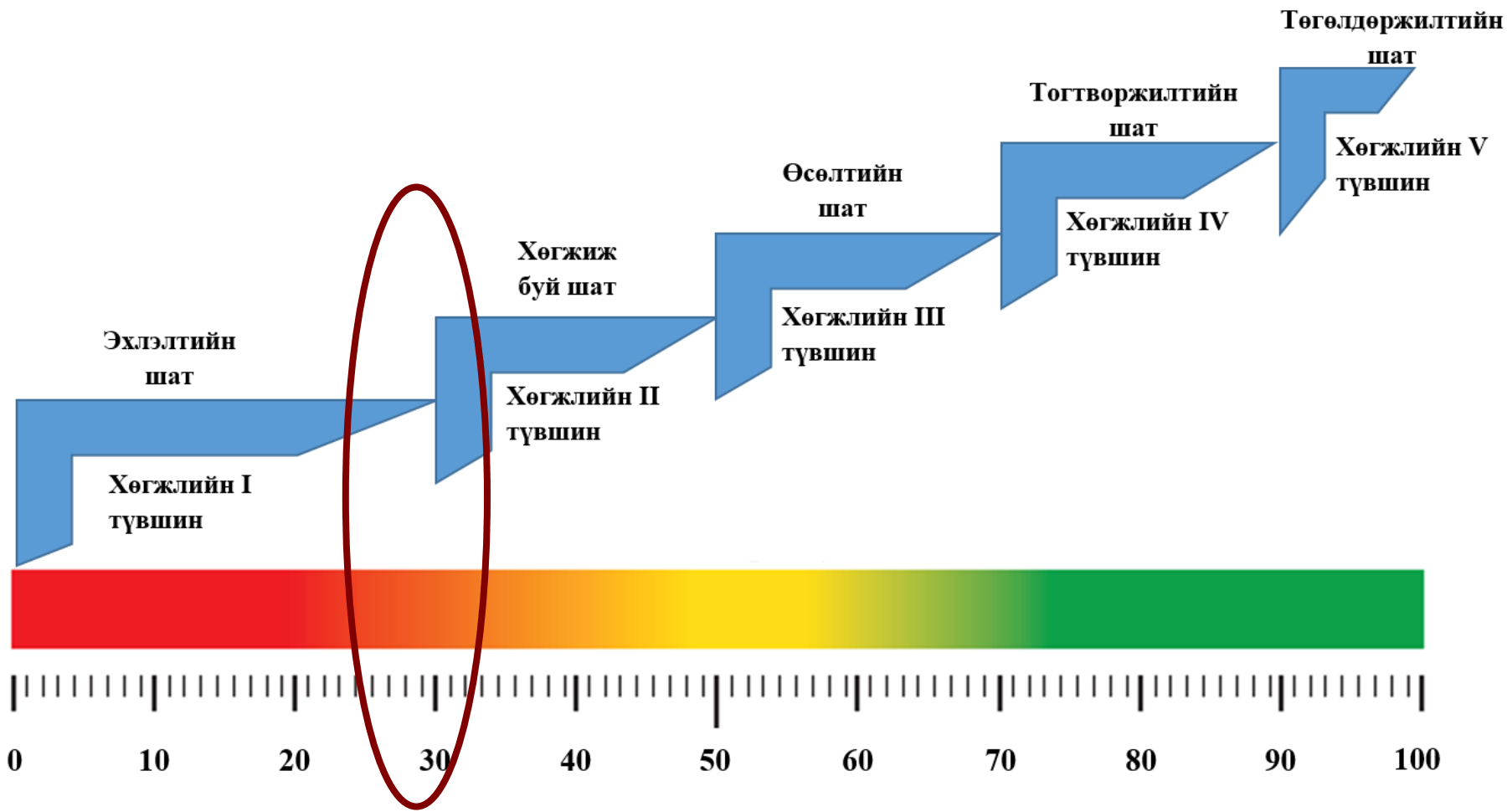# Integrated evaluation of Ulaanbaatar city Development

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**

25,70	25,30	27,71	29,20	30,15
2012 он	2013 он	2014 он	2015 он	2016 он

The level of development of the Smart Ulaanbaatar city

Төгөлдөржилтийн шат

Тогтворжилтийн шат

Хөгжлийн V түвшин

Өсөлтийн шат

Хөгжлийн IV түвшин

Хөгжиж буй шат

Хөгжлийн III түвшин

Эхлэлтийн шат

Хөгжлийн II түвшин

Хөгжлийн I түвшин

0 10 20 30 40 50 60 70 80 90 100
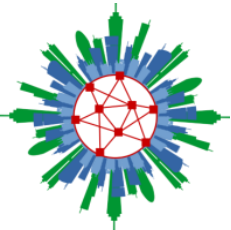
Conclusion

Therefore, the city, especially smart city's theoretical approach, is based on urban planning theory, city economic and system theory, regional theoretical and theoretical innovation theory.

Most countries in the world have developed and developed methodologies for evaluating the development of a smart city that suits their specific needs. There are currently no studies on assessment Ulaanbaatar city by methodology of assessment smart city development.

Therefore, we have introduced the results of the development of the capital city by our own methodology.
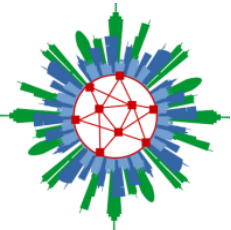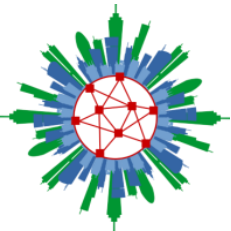
Conclusion

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 a favorable legal environment

- Establish stakeholder participation, rights, and responsibilities

- Identify, analyze and evaluate the effectiveness of smart city development

The method of assessing the development level of the smart city we are developed can be used to evaluate the development of large cities, cities and province centers. Furthermore, that methodology can be used in similar countries in our country.

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If you have any questions,

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THANK YOU FOR YOUR ATTENTION