THE WAY TO PLAN A VIABLE "DEEP CITY": FROM ECONOMIC AND INSTITUTIONAL ASPECTS

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Abstract

While more and more urban constructions are forced to go underground in order to release land surface for development, metropolises world-wide are facing challenges to plan for rational use of underground space and other valuable resources. This article tries to analyse important economic issues and institutional concerns for the development of Urban Underground Space (UUS), based on a comprehensive case study in a Chinese metropolis. In addition, a Swiss concept on sustainable management of Urban Underground Resources (UUR) is presented, in the framework of "Deep City" international research program. Our new urban territory of subsurface deserves an universal attention on spatial planning and resources management, in coordination with the urban regeneration.

Keywords
Global indicator of demand-supply, Cost-benefit Analysis, institutional feasibility, urban planning, resources management.

1. Introduction

Facing the challenges of population growth, energy crisis, land pressure and environmental deterioration, modern urbanization is calling for governance innovation to facilitate flexible spatial transformations and to promote creative city redevelopment [UN-HABITAT, 2009]. Developing Urban subsurface as a sustainable option for renewing congested urban centers and for updating public infrastructures, should be economically viable and politically acceptable [MAIRE, 2011].

Optimization of Urban Underground Space (UUS) use has to take into accounts social-economic demand and possible supply of geo-space resources.

Firstly, from the demand side: since underground construction technologies keep advancing, construction cost as an important part of initial investment is decreasing slightly. However, for urban planning practices, the pattern and quantity of using underground space is not perfectly aligned with engineering innovation. Other dynamic determinants have to be integrated into the comprehensive economic assessment, such as the needs and preferences of the users on spatial and environmental concerns, as well as life-cycle energy consumption concerns.

Secondly, from the supply side: since underground space is an integral part of geo-environment, its development is constrained by natural conditions and exiting built environment. Geological survey provides useful information for land administrators to evaluate potential quality and quantity of underground space to be urbanized.

In this article, a global indicator of UUS potential is put forward, taking into accounts the natural conditions and exploitation potential of the relevant area. A case study based on the pilot city of Suzhou in China is demonstrated for comprehensive evaluation. The aim is to give planners and private developers a concrete idea of how to materialize the added-value of UUS.

Institutionalization of UUS management is integrated in a multi-actor framework. Understanding the institutional dynamics of this framework is useful to guide political decision-making on urban underground projects. An organizational network of public stakeholders will be illustrated in the article.

Four main resources (Fig.1) are in urban subsurface: underground space, groundwater, excavated material and geothermal energy. A holistic approach for underground urbanization should be integrated to land use planning and urban planning. Synergetic development can be promoted, such as integrating geothermal system into underground space structures, in order to benefit a joint development of renewable energy use and UUS; in reverse, conflicting situation have to be avoided, such as groundwater contamination by tunnel construction across the aquifers, in the case where groundwater is a priority protection resource for drinking use by legal regulations.

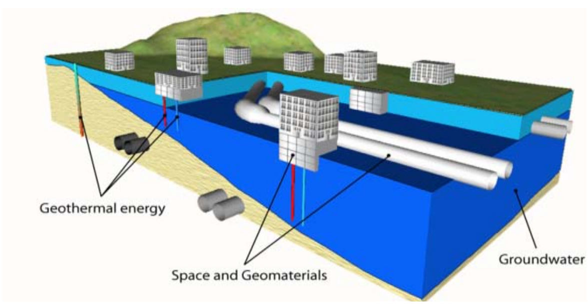


Fig.1 UUR System of "Deep City" Concept

This idea of combined-use exploitation, named “Deep City” concept [PARRIAUX et al, 2010] (Fig.1), has been put forward for this purpose, being reconsidered as part of Swiss federal law of territorial planning (in revision). It is a management methodology which is applicable to other megacities in the world, to guide their governance towards a sustainable use of UUR.

The following discussion is organized in 3 sections: the second section about economic analysis and policy research for UUS planning, the third section concerns “Deep City” concept for UUR management, and the last section with conclusions.

2. Planning the Development of Urban Underground Space (UUS), with a Pragmatic Approach

2.1 Economic Estimation Concept Considering Investment Viability and Construction Feasibility

(1) <u>Urban demand investigation</u>
In big cities, land resource is scarce due to saturated urbanization, high land prices in central city are caused by increasing demand for real estate development for commercial profits. In addition, population growth and urban immigration are the driving forces for excessive urban construction, including housing, transport system, public facilities and commercial spaces. Land use types, as defined in urban land use regulations, could be different above ground and below ground, because of different surface-subsurface functional requirements, as well as legal property rights. With citizens’ desire for a more convenient mobility mode, locations next to rail transit system are valuable for property development by developers.

Therefore, urban indicators such as benchmark land price, population density, land use type, and planned rail transit location, are important determinants to forecast the demand for UUS. As private sector becomes a main stakeholder to finance urban infrastructures, it will be useful to integrate their investment priorities into UUS planning practices.

(2) <u>Natural supply investigation</u>
Different from general building work and infrastructure construction, underground construction necessities various excavation techniques and supporting structures. Construction cost and project risk insurance vary substantially according to the levels of difficulty of civil engineering works. Constructions in a stable and easily excavated subsurface (such as rock foundation) will cost less than in an environment (such as alluvial soil foundation) facing a lot of geological and hydrogeological challenges. Since natural disasters are becoming more and more frequent during recent years, our concerns about urban construction safety should be on the priority agenda of public policy-making.

Evaluation of the degree of difficulty in construction needs to take into accounts various geotechnical parameters and geological data. Therefore, the more comprehensive the information is, the more precise the evaluation will be.

(3) <u>Spatial restriction investigation</u>
Beside natural conditions, a lot of UUS development projects were restricted by the exiting built environment in shallow underground layers. Users occupying most of the underground land are public networks such as utility pipelines (water, gas, waste, electricity, cable, etc). With the coming of subway projects in more and more cities of developing countries, our shallow subsurface is almost saturated [STERLING, 2007], just like the surface of many central city. In order to avoid spatial conflicts, available development volume should be clearly identified and quantified, with a view to preventing misperception of UUS resource and enabling optimized utilization.

However, to register systematically all underground infrastructure units inside the whole UUS requires a lot of administration efforts and time, for the reason that they belong to different private and public owners, and the related administrative bodies usually do not have a shared information platform. As development congestion is gradually extending to shallow subsurface, rethinking the administration mode of UUS becomes urgent for local authorities. Researchers have pointed out that an underground property market will probably appear in the near future [BARLES, 1995; PASQUAL, 2005], which also seems to become a trend in some Chinese megacities. If it is intended to leave it to the market to resolve shallow ground congestion issue, local government should devise management measures to ensure quality development of UUS without delay.

Other spatial restrictions come from the surface, such as special land use type and special building protection zones. While new development area can be intensively exploited for UUS, locations like ecological preservation area and historic heritage zones restrict strongly UUS development. All these spatial factors above also represent a high degree of difficulty for excavation.

(4) <u>Global indicator of demand-supply</u>
To conclude, before initiating development planning of UUS, several investigations and evaluations should be performed in advance. In the first place, urban demand investigation helps to evaluate the potential of creating commercial values and social benefits; then, natural space resource supply investigation helps to evaluate difficulty levels in engineering works, which implies a variation in terms of construction costs; at last, to ensure a harmonious development with conventional urban planning, spatial restriction investigation helps to

identify exploitable UUS resource and its quantity. The process provides input to subsurface land value appraisal in the future land market.

Indicator of demand-supply of UUS exploitation will be translated into monetary terms, being a cost-benefit indicator (Fig. 2).

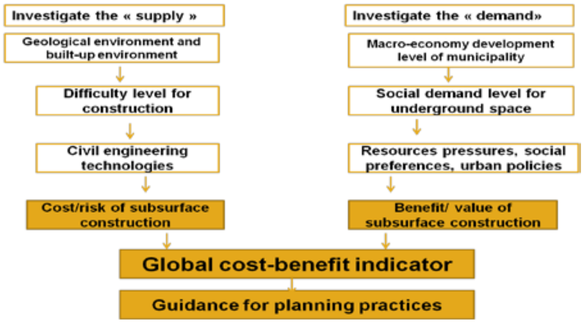


Fig. 2 Framework of Demand-supply analysis

2.2 Case Study for Integral Evaluation[1]

The following demonstrative evaluation is based on a pilot study of Suzhou city for methodological application, under the "Deep City" international research program[2].

(1) Pilot city introduction

The city of Suzhou is a typical fast developing municipality in the east coast of China (Fig.3). Having a traditional urban center with a history of 2'500years, its new development zones (such as Sino-Singapore Industrial park) have been attracting an increasing amount of Foreign Direct Investment for its industrial and commercial business. Under land shortage pressure, the city has planned to limit industrial and commercial land supply in favor of housing land development[3]. Facing the constraint of commercial land provision, commercial developers are searching for alternatives, such as surface-subsurface building integration, and combined development with metro station complex.

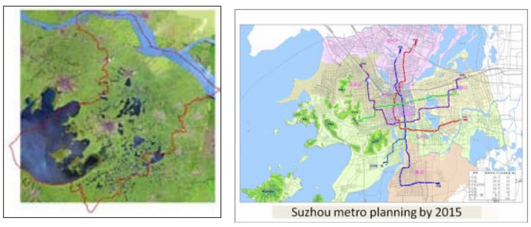


Fig. 3 Situation Maps of Suzhou City (downstream of Yangtze River, next to Shanghai) and Metro Lines

[1] Figures and tables are from internal report of the project in Nanjing University: "Evaluation for urban underground space exploitation potential in Suzhou city", supported by "Suzhou urban geological survey program 2008-2011" of Geological Institute of Jiangsu Province.

[2] This research program is in collaboration with Institute of Underground Space and Geo-environment in Nanjing University (IUSG-NJU).

[3] From internal governmental reports on benchmark land price appraisal of Suzhou city.

(2) Urban demand evaluation

Socio-economic demand for UUS is evaluated through multi-criteria analysis by Analytic Hierarchy Process (AHP) with critical socio-economic factors (Table 1). The evaluation zone covers the central city, with an area of 279.5km^2.

Factors	Weight[4]
Zone bit	0.196
Population density	0.109
Traffic Location	0.191
Commercial benchmark land price	0.112
Residential benchmark land price	0.101
Land usage type	0.137
Civil defense need	0.055
Historic Conservation	0.099

Table 1 Index System for Socio-economic Demand Evaluation

By integrating relative analysis maps of each factor on GIS, results can be showed on 2D plans (Fig. 4). It could be observed that high-valued zones are those near the ancient city center and near metro system (red colored).

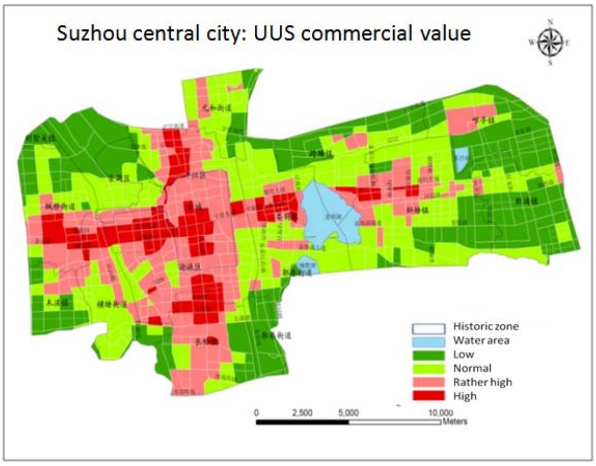


Fig. 4 Spatial Evaluation for Commercial Value

(3) Natural supply evaluation

Difficulty levels for UUS construction are evaluated with the same method above, by selecting important geotechnical and environmental factors (Table 2). In order to forecast a long-term exploitability, each factor is given different weight on different underground development layers (Table 3).

For short-term UUS development scale, difficulty for civil engineering is evaluated on four levels (Fig.5). Brown-colored zones represent the highest level of engineering challenges. In the suburban area, it is due to thick soft soil layers, or risky geological conditions.

[4] The weights in Tables 1 & 3 are assigned through pairwise comparison, consulted from 10 experts from Jiangsu Provincial departments of geology, urban planning, and urban construction.

Investment on supporting structures for construction will account for a large share of total cost estimation. In the central city, the difficulty is due to over-congested underground pipelines or surface buildings conservation. Monetary compensation to owners of surrounding infrastructures or buildings will also be costly.

Factors	Weight (0~-15m)	Weight (-15~-30m)
Fault activity	0.0623	0.0679
Site classification for construction	0.0267	0.0291
Geomorphic unit	0.068	0.063
Properties and thickness of soft soil	0.0784	0.112
Thickness of liquefaction soil layer	0.0336	
Surface water	0.0605	
Thickness of semi-confined aquifer	0.0605	0.0648
Karst area	0.0968	0.1056
Goaf area	0.0968	0.1056
Land subsidence	0.0242	0.0264
Ground fissure	0.0242	0.0264
Ecological sensitivity	0.078	0.072
Distribution underground pipelines	0.092	
Architectural protection	0.101	0.107
Heritage conservation	0.097	0.123

Table 2 Index System for UUS Difficulty Level Evaluation (example given for two priority shallow layers)

Vertical Layer	Use
Shallow layer (0-15m)	Existing development layer
Sub-shallow layer (15-30m)	Development for short-term
Sub-deep layer (30-50m)	Development for far future
Deep layer (50-100m)	Development for long-term

Table 3 Layered Planning Approach

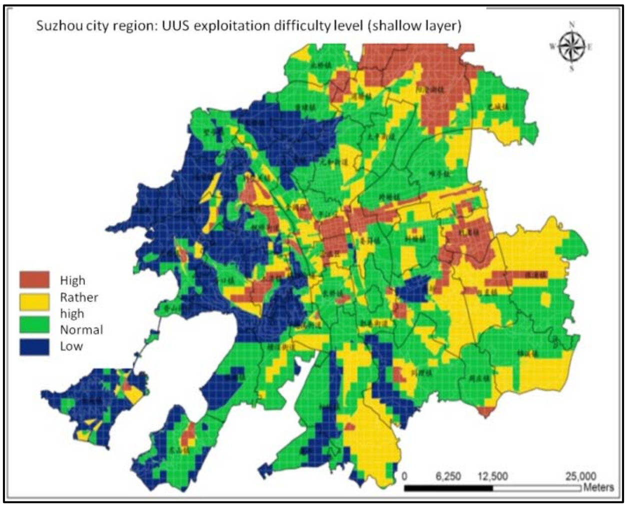


Fig.5 Spatial Evaluation for Difficulty (depth 15-30m)

(4) Spatial restriction investigation

Exploitable UUS volume is calculated by a selective deduction procedure, taking into account the safety depth limits of existing infrastructures, as well as special protection units (ecological belts, urban heritages). Here examples are given for two shallow layers (Fig. 6 & 7). They show locations suitable for excavation in the central urban area. (Green zones meaning "fully exploitable", yellow zones meaning "partially exploitable").

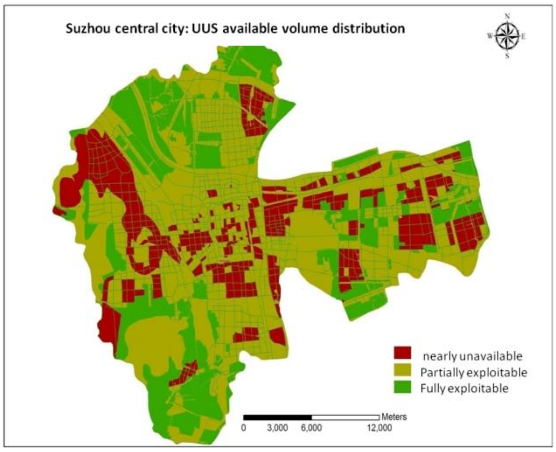


Fig. 6 Evaluation of Potential Volume (depth 0-15m)

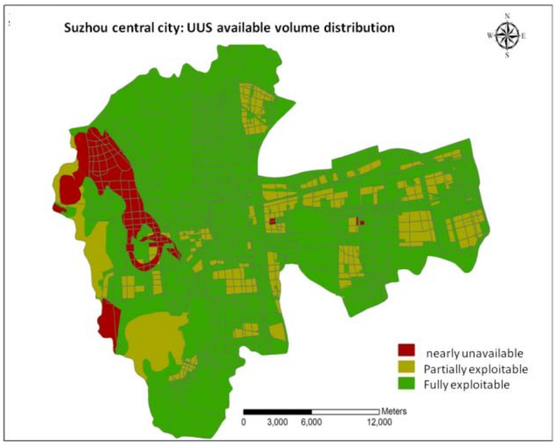


Fig. 7 Evaluation of Potential Volume (depth 15-30m)

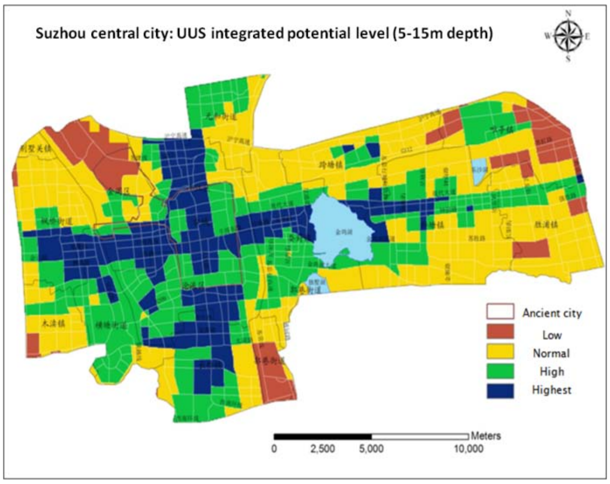
At the scale of city region, it is estimated that, for existing development layer (0-15m depth), exploitable UUS can reach 5'533 mio m^3 (61% of total UUS at that depth range); for short-term development layer (15-30m), exploitable volume is 8'166 mio m^3 (90% of total UUS at that depth range); for the far future, exploitable volume between the depth of 30 and 100m will be about 40'231 mio m^3 (95% of the whole deep layers).This volume estimation could be expressed in available subsurface area (m^2) to be urbanized, serving as a tool to quantify UUS floor area in UUS planning. For urban subsurface land appraisal, the pricing hierarchy should take into account the depth ranges among others. This potential volume estimation of UUS supply could be presented in 3D scale [5] for easy visualization.

(5) Integral potential evaluation

Urban zones with high demand for commercial development and good quality of natural resources

[5] On-going research project is to visualize the 2D evaluation at 3D scale.

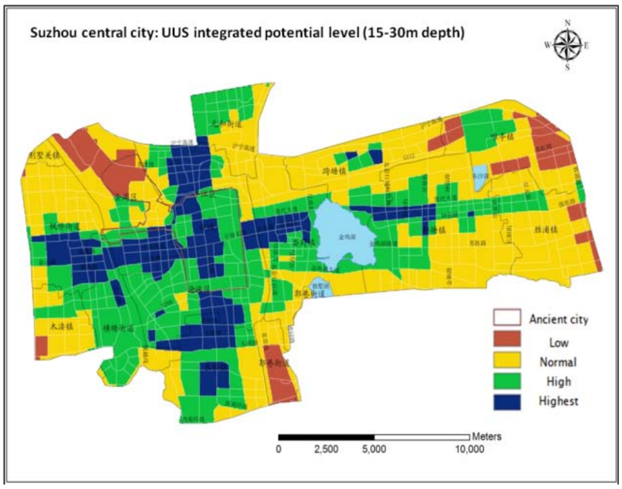
supply (low engineering difficulty), are considered as high integrated potential for UUS use. Integral evaluation is also based on a layered approach (Fig. 8 & 9); potential is classified at 4 levels.



The statistics about the volume in different levels (Unit:km², 10⁸ m³)

total area	total volume	Highest volume	High volume	Normal volume	Low volume
279.5	27.95	5.19	8.85	11.51	2.4

Fig.8 Integral Demand-supply Evaluation (5-15m depth, pipeline layer excluded) and Estimated Volumes



The statistics about the volume in different level (Unit:km², 10⁸ m³)

total area	total volume	Highest volume	High volume	Normal volume	Low volume
279.5	41.92	6.24	13.88	18.88	2.92

Fig.9 Integral Demand-supply Evaluation (15-30m depth) and Estimated Volumes

This comprehensive evaluation for UUS reflects the philosophy of "Deep City" concept, which advocates an urban governance innovation: "**rethinking supply capacity of natural resources before meeting urban construction needs**". Our rapid urbanization process is aggravating the provision pressure of natural resources; a more considerate manner of space exploitation should be integrated into urban planning and land management.

2.3 Cost-Benefit Analysis

Demand-supply evaluation helps city administrators/ professionals/business to understand the operational feasibility of using UUS. A quantitative assessment for project's sustainability should be further developed to balance investors' profits and citizens' social benefits.

(1) Benefits revealed from demand evaluation

Private benefits for investors to develop UUS in urban area with land use pressures and high development value, could be examined from several aspects:

- Gain from commercializing more floor space area
  Because of the fact that underground Floor Area Ratio (FAR) is not always considered as part of regulated land parcel FAR. Along with urban economic growth, the development of UUS will be required to change from unique use (such as parking or civil shelters), to multiple use (such as commercial complex, shopping center, cultural exhibition hall, theater, etc) [CARMODY & STERLING, 1993]. The vertical scale of UUS could also be expanded to include multiple functions. This is a trend of investment adopted by many Chinese real estate developers.

- Gain from land acquisition cost savings
  Urban land use policies seek to limit commercial land provision so as to release more land for housing. Moving towards multi-functions underground development helps save the investment in land purchase which usually accounts for a largest share of total project investment.

- Gain from customer patronage through enhanced pedestrian network
  It is a valuable opportunity to link private commercial space with metro system, by reducing pedestrian's travel distance to a business area. In dense urban area, due to surface traffic congestion, travel time and pedestrian comfort are common concerns in daily life. The form of indoor city with underground pedestrian network is typical in Canadian cities [BARKER, 1986], serving by convenient connection under buildings and roads in a comfortable walking environment. Therefore, the reduction of intangible "travel cost" of customers and increase in patronage to shops are seen as mutual benefits to pedestrians and business.

The three factors mentioned above will increase investors' "willingness-to-pay" for developing UUS, all contributing to the attractiveness of UUS development projects.

Public benefits to citizens could be assessed from several living quality related aspects:

- Livable city and compact city style

For land resource management, preservation of farmland for food production has to be well coordinated with commercialization of urban land. Therefore, urban expansion has to be limited. Many researchers have been advocating against urban sprawl [WISSEN HAYEK et al, 2010], because land resource is scare and deserves a rational allocation. In addition, sprawling city requires more public investment on transport system and related urban services, which is not a sustainable way for long-term growth. With urban surface-subsurface 3D compact development, urban land will be used in a more efficient way, avoiding unlimited urban expansion.

- Gain from green open space and ecological asset
  Megacities are usually described as "concrete jungles". In order to revitalize city centers, green spaces and ecological parcels should be reintegrated into our daily life. Developing UUS helps to release more surface land, which could be planned for urban parks, serving citizens as leisure places. The intangible value of green space was estimated based on hedonic pricing models of housing market, revealing an increase in rental price due to proximity to green space [BARANZINI & SCHAERER, 2007].

(2) Costs revealed from supply evaluation
Based on the natural supply evaluation of geological conditions and engineering difficulty, costs comparison could be made on land parcels with different quality to reveal the differences of initial UUS construction investment. An example of cost estimation under three scenarios is prepared for a commercial building project based on Swiss context, including geological context and economic context. [6]

- Commercial building model as showed in Figure 10

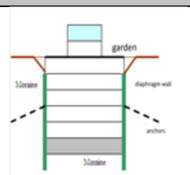
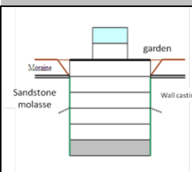
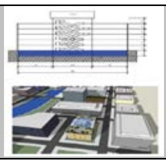
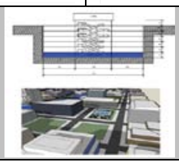
Scenario 1	Scenario2	Scenario3
Surface building (with Swiss Minergie energy standard)	Underground building in bad geological condition	Underground building in good geological condition
Basic dimensions: 30m x 50m, Floor height: 4m, 6 floors in total, with 1 floor for technical maintenance.		
		

Fig. 10 Building Model for Cost Comparison

- Construction costs as showed in table 4

Table 4 Construction Costs Comparison, with Land

Scenario1	Scenario2	Scenario3	S2/S1	S3/S1
30'464'000	37'563'000	33'437'000	1.23	1.11

Price Excluded (in CHF, estimated by Economic Institute of Construction, SA)

It is estimated that construction on land parcel with higher difficulty level costs 23% higher than construction on the surface.

- Energy consumption during 50 years is showed in Table 5.

	Scenario 1	Scenario 2	Scenario 3
Lighting	192.3	192.6	192.6
Ventilation	20.5	20.5	20.5
Devices	22.5	22.5	22.5
Heating	47	25.7	29.7
Cooling	15.9	12.3	9.5
Auxiliaries	1	1	1
Total	299.2	274.6	275.8

Table 5 Energy Consumption of the 3 Scenarios ($MJ/m^2/year$)

Life-cycle energy consumption is much lower in the underground building scenarios than in the surface building scenario. This is a long-term benefit for investors.

- A comparison of total costs (4^{th} row) composing construction costs (1^{st} row), life-cycle energy costs (2^{nd} row) and land acquisition costs (3^{rd} row), is showed in Table 6.

	S1	S2	S3	S2/ S1	S3/ S1
Construction cost	30'464'000	37'563'000	33'437'000	1.23	1.11
Energy cost	2'988'200	2'852'400	2'866'500	0.95	0.96
Land price	15'465'000	15'465'000	15'465'000	1	1
Total cost	48'917'200	55'880'400	51'768'000	1.14	1.06

Table 6 Total Life-cycle Costs Comparison (in CHF)

Taking into account the capital costs and maintenance costs during the building's life time, the total cost ratios of underground scenarios to surface scenario becomes much lower. If underground construction is on a good geological condition, the ratio is approaching equal, meaning only a slight difference with surface building.

This comprehensive life-cycle cost estimation is an important input to adjust UUS investment. According to engineering experts, construction cost is more or less stable in the world market, while energy cost varies a lot along time, which should be considered in advance for project evaluation.

2.4 Institutional Feasibility for Developing UUS

In order to succeed in implementing underground construction project, no matter for large scale government-invested ones or small private-invested

[6] Analysis was performed in the scheme of "Deep City" project, supported by Swiss National Fund.

ones, different components as "hardware" and "software" have to be integrated. The "hardware" includes land purchase, engineering feasibility, capital, labour and operating bodies, while the "software" here includes regulatory guidelines, legal permission and management tools. Government as the city administrator, should play a leading role in steering all major urban projects. Intra-governmental interests of different hierarchies should be coordinated to provide necessary regulatory system and stand ready to guide. Structure of the institutional network and related objectives and regulations are showed on Table 7.

Similar to conventional surface construction projects, UUS development should go through all related management bodies within municipal institutional structure, to avoid conflicts with existing infrastructures and buildings, as well as to avoid incompatibility with the natural environment. Since the last decades, many countries have been trying to establish planning laws and related regulatory framework for development of underground space. Harmonizing the intra-governmental interests within the framework could help to facilitate construction projects and promote sustainable subsurface utilization. Interviews were conducted with officials and professionals from Geneva Canton in Switzerland and from Jiangsu Province in China[7] to examine politico-economic constraints in implementing UUS development. Both administration regions playing leading role at national level indicated that, they face different issues to manage UUS as shown in Table 8.

The urban areas of these two regions are facing strong land supply pressure, due to increasing housing demand, as well as redevelopment restrictions due to heritage preservation in city centers.

3. Integrated Governance of Urban Underground Resources (UUR) to Attain the Goal of Sustainability

This section emphasizes environmental protection planning and energy planning in the process of developing urban subsurface. Since UUS development have not been given much attention in the past decades, it is necessary to take this opportunity to include it into the whole sustainable city transformation practice [BOBYLEV, 2009].

As presented at the beginning, there is a natural environmental system beneath our urban land. Each of these natural resources in the system contribute significant role to support our urban life. Placing infrastructure and developments underground challenges the natural state of these resources. To have a comprehensive understanding of the development impacts on individual components and the

Stakeholder parties	Main objectives	Related regulations
Economic Planning Commission	• Promotion of urban economic growth by delivering approval for potential projects to qualified developers.	Macro-economic plan, National Economic agenda, Public finance plan, Investment regulations, etc.
Land Management Department	• Allocation of land resources, emphasizing on farmland protection. • Management of property rights under land transaction and registration system.	Law of Land Administration, Civil Code on property rights, Regulation on Land property market, etc.
Urban Planning Department	• Promotion of spatial growth by allocating urban functions (commercial, industrial, residential, public space) on designated area. • Establishment of detail planning and design guidelines for construction projects to ensure quality.	Law on spatial planning, Urban Planning standards and guidelines, etc.
Urban Construction Department	• Management of construction works by establishing operational guidelines for civil engineering. • Standardization of urban construction project management for contractors and owners.	Law on urban construction, Building standards, Building energy consumption standards, Law on Fire Protection and Security, etc.
Real Estate and Housing Department	• Management of real properties by establishing obligations and rights.	Real Estate Law, etc.
Urban Infrastructure Department	• Provision of public facilities, including transport system, water and sewage system, energy utility, and communication networks. • Standardization of public infrastructure project design to ensure social benefits.	Law on urban infrastructure, Regulations on concessions for public infrastructures, etc.
Environmental Protection Department	• Control environmental impact assessment for construction projects. • Promotion of natural resources protection by imposing related standards according to natural carrying capacities.	Law on Environmental Protection, Law on Waste Management, Regulations on Environmental Impact Assessment, etc.
Civil Defense Department	• Provision of basic shelters and evacuations during disaster and emergency.	Law on civil defense, etc.

Table 7 Public Stakeholder Structure and Regulations

Geneva Canton (CH)	Jiangsu Province (CN)
Construction costs and related remediation costs for field cleaning-up	Construction costs and related compensation costs for nearby infrastructures
Social resistance for excessive constructions	Property rights of land ownership
Low public attraction of using UUS	Lack of knowledge and useful information

Table 8 Politico-economic Constraints for UUS Sse

[7] Interviews in China were performed in June 2011; Interviews in Switzerland were performed during 2010.

interrelationship of the impacts enables city administrators and project owners to work jointly for synergy effect in developing UUS (such as combining basement and foundation construction with energy geostructures [8]), as well as to avoid engaging in conflicting and incompatible utilization (such as damaging drinkable groundwater during tunnel excavation). The concept of "Deep City" was put forward in the framework of Swiss national research program NRP54 "Sustainable development in the built environment". This project named "Underground resources and sustainable development in urban areas" developed a management methodology to optimize multiple exploitation of these underground resources in city perimeters, with detailed case study for the city of Geneva for methodological validations. Methodological scheme with multi-use approach to manage urban underground resources is showed in Figure11.

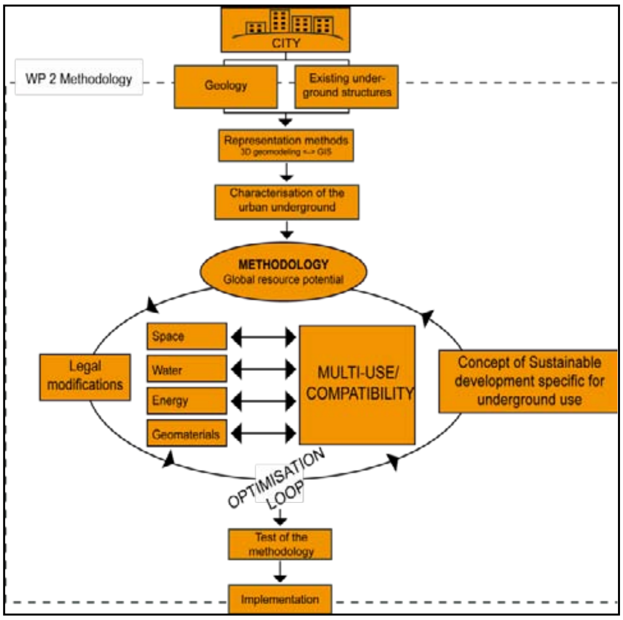


Fig. 11 Multi-uses Evaluation Methodology

In order to widen the applicability of this concept to much larger cities around the world, an ongoing project named "Deep City China" was launched with Nanjing Institute of Underground Space and Geo-environment (whose contributions are presented in section 2.2). This comparative research between Swiss and Chinese contexts in terms of urban underground resources (UUR) management will have a complementary focus on economic assessment of subsurface development. It will also explore the feasibility of UUS development under a coordinated administrative and regulatory system. In order to guide national application of the concept, territorial underground typology will be classified to suit the needs of various urban governance and resources management.

4. Conclusion

Research significance of this paper is to show a comprehensive methodology on the evaluation of demand-supply potential of Urban Underground Space (UUS) and resources (UUR). Potentials illustrated in the framework are then translated into economic terms as cost and benefits in order to justify project investments. Further work will be to complete the evaluation of benefits based on a real project scheme. Institutional feasibility investigation plays an essential role to facilitate future implementation of UUS planning and management. Finally, the holistic approach of UUR exploitation, "Deep City" concept, is presented with the aim to raise political awareness for optimal use of natural resources.

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