



An integrated planning concept for the emerging underground urbanism: Deep City Method Part 1 concept, process and application



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ARTICLE INFO

Article history:

Available online 23 May 2013

Keywords:

Underground urbanism
Deep City Method
Integrated planning
Management process
Geneva city

ABSTRACT

Four underground resources have been seen as having a long-term potential to support sustainable urban development: underground space, groundwater, geomaterials and geothermal energy. Utilization of these resources proposes a new paradigm of economic development: underground urbanism. The new management approach named “Deep City Method” is put forward to aid decision-makers to integrate global potential of the urban underground into city-scale strategic planning. The research output will be presented in form of two papers each with a different focus. Part 1 aims to introduce the concept, process and initial application in Switzerland; Part 2 is devoted to show methodological insight for a new zoning policy in China and investment scenarios for project cost viability.

This Part 1 paper will begin by presenting the fundamental concept of the Deep City Method, followed by a proposition for a trans-institutional planning process. The application is firstly based on a rating system to identify cities having a potential for underground development. The city of Geneva is selected for conceptual application and strategic level study. Further operational steps are required in order to generalize the concept to other cities around the world.

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1. Context of the emerging underground urbanism and purpose of the research

In 2007, the urban population around the world surpassed 50% of total habitants, among which nearly 20% live in metropolitan areas (urban areas with more than one million people).¹ This emerging trend of rapid urbanization and concentration requires smarter solutions for adapting to growing needs of living space, construction land, water access, energy production and material provision. While decision makers are facing challenges to seek additional resources to meet urban demand, some emerging resources are becoming more and more attractive.

Land, as the main production factor of cities, is limited, nonrenewable and scarce. Cities are transforming from agricultural traders to industrial manufacturers to service providers. Their land use planning agenda is changing from industrial land oriented planning to commercial land oriented planning to residential land oriented planning, even to mixed use planning (Kivell, 1993; O’Sullivan, 2009). In a context of sustainable urban development, innovative spatial planning attempts to maximize land use value

by mixing urban activities, linking urban mobilities, and compacting the urban fabric. While more space is needed but more land leasing is frozen, space hunting is going to a three-dimensional trend. Density generates space, but over-densification is always restricted by planning regulations. Another dimension is being stated by civil engineers, claiming that by going underground we can acquire more possibilities for construction. Emerging uses became attractive such as subway tunnels, road tunnels, buried utility lines, subterranean parking, deep storage, pedestrian pass, and large basement buildings (Magnus Bergman, 1986). Technological advancement makes these uses even more competitive (Goel et al., 2012), because going underground can mitigate surface constraints on land acquisition, from building height limits and from landscape control (Carmody and Sterling, 1993; Golany and Ojima, 1996). Relocating space volume underground helps to equilibrate densification and revitalization. This is the first resource being used to shape underground urbanism: *underground space*.

Water, is another critical production factor for agriculture, industry and urbanization. The use of groundwater exceeds 70% of the total water consumption in most European countries, especially for domestic drinking water use (Zektser and Everett, 2004). In the post-industrial era, quality of life dominates our residential location choice. An abundant source of drinking water has a competitive advantage for sustaining urban growth. This is the second resource offered by underground urbanism: *groundwater*.

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¹ Data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS.

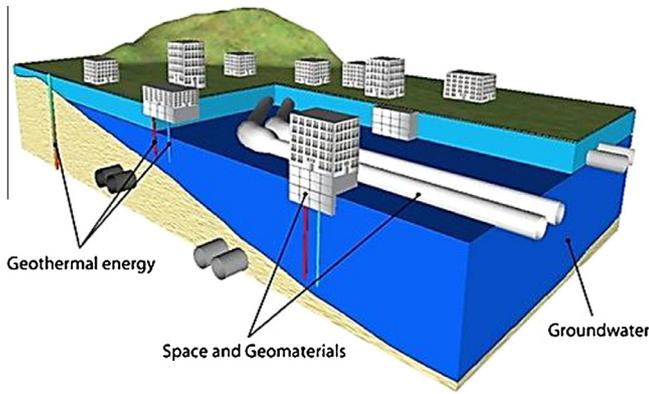


Fig. 1. Deep City Method: a holistic management concept for underground resources.

Energy provisioning is a challenge to modern societies. Transport and building count for more than half of the total energy demand, which is being intensified by rapid urbanization. Energy efficiency can be gained from technological innovation in transport systems and building structures. A subway, as a transport system of high efficiency, speeds up urban mobility and shortens travel time. The building sector is also undergoing continuous progress to save energy use. The ground source heat pump (GSHP) market is expanding around the world (Navigant Consulting, 2009; IEA, 2010), making this hidden resource the third element in underground urbanism: *geothermal energy* (Parriaux et al., 2004).

Availability of materials is one of the main factors influencing construction industry, a mainstay sector in the urban economy. As mining areas become limited, provision of material is becoming

more difficult. A recyclable material source from construction excavation sites could relieve material provision deficiency (Rochat et al., 2006). Excavation provides raw materials that may be able to aid in meeting higher demand. This is the fourth emerging resource: *geomaterial*.

This article will present an appraisal system of these four underground resources (Fig. 1) as a starting point for investigating a deeper dimension of urban sustainability. Underground Urbanism can be defined as an innovative concept for urban restructuring and transformational construction practice (Utudjian, 1972; Barles and Guillerme, 1995; Bélanger, 2007), aiming to increase mixed uses in urban centers by relocating space underground in order to release surface land, while safeguarding valuable groundwater, geothermal energy and geomaterial resources. This new concept is named “Deep City method” (Fig. 1), an interdisciplinary project based in Switzerland since 2009 (Parriaux et al., 2010).

After a holistic investigation of supply capacity of these four emerging resources, the main research contribution of the study will be founded on economic and institutional feasibility of underground space development, proving that the underground will become a strategic resource for urban growth. An integrated management process is created for strategic thinking and operational planning practices, combining understandings on supply and demand schemes of underground resources. A new economic index is introduced (in the Part 2 paper) in order to comprehensively assess underground projects, taking into account divergences of land quality, project scope, land price and building configuration.

Section 2 will present the integrated planning process, followed by the first-step critical success factor framing in Section 3. Two groups of cities are evaluated in Section 4 to select applicable cities, which are further studied through remaining steps based on the integrated management process.

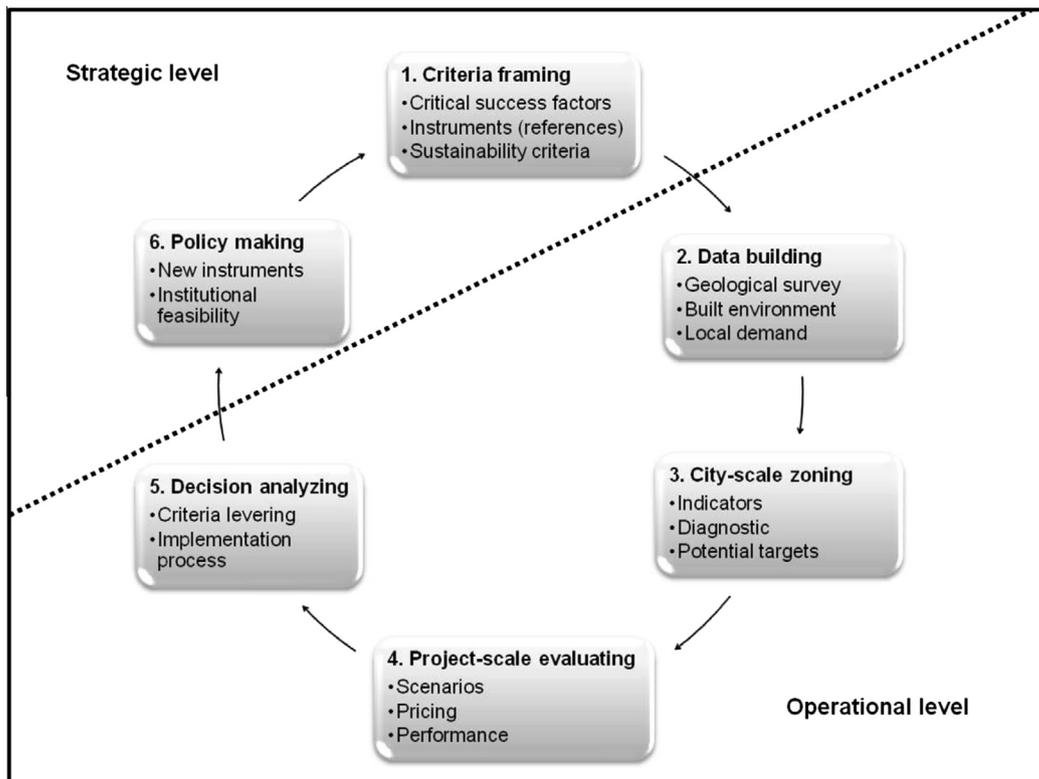


Fig. 2. Integrated planning process of Deep City Method (by the authors).

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