



A typology of network city in a socio-economically disadvantaged region



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ABSTRACT

This paper examines a typology of network cities by linking a range of mobility environments to small and medium-size cities in a socioeconomically disadvantaged region. Despite the considerable volume of international studies focused on a global network of major cities and functional network linkage, little studies examine the local impact of passenger, cargo and migration flows on forming a network city within a disadvantaged region. In particular the evolution of disadvantaged low rank-size cities into a network city within a socio-economically disadvantaged region remains uncertain. This paper found that some socio-economically disadvantaged small cities in the Dongnam region, Korea where mobility environments are relatively weak were excluded in forming urban networks. Functional linkage to the major cities and the expansion of passenger and cargo based links have a significant impact on a typology of network cities with various nodality and polycentrality structure within the region.

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1. Introduction

Connectivity between cities and regions leads to globalization in World Cities and more vigorously expanded regional and urban networks enhance national economic growth and hence a nation's competitiveness. Early studies on the urban networks focused on the development of physical infrastructure such as the connectivity of transport in urban areas. The frontier work of [Christaller's central place theory \(1933\)](#), for example, explains the hierarchical structure of central cities and neighboring municipalities by a distance prepared to travel along road networks. The central place theory has been expended in various ways to create the terms 'urban networks' ([Albrechts & Mandelbaum, 2005](#)), 'network city' ([Bertolini and Dijst, 2003](#)), and 'social network' ([Newman, 2010](#)). In particular [Batten \(1995\)](#) first introduced the concept of network city, which was influenced by the study of 'New Cities' by [Fishman \(1990\)](#) who used the basic unit of urban sprawl as a 'growth corridor'. [Batten \(1995\)](#) used the term network cities, which focused on the polycentrality of the city along with the growth corridor, and argued that the polycentric urban form is the most socially, economically and environmentally sustainable urban

structure. In a methodological perspective of network cities the graph theory has been often adopted to provide a graphical representation and related mathematical structure to model pairwise relations between nodes in the region ([Borgatti et al., 2009](#); [Caschili & De Montis, 2013](#); [Green, 2007](#)). In this approach the concept of centrality or nodality is often used to describe the structure of real-world systems as networks. The centrality of a node (link) determines the relative structural importance of that node (link) within the graph ([Taylor, Hoyler, & Verbruggen, 2010](#); [Zadeh & Rajabi, 2013](#)).

However, most studies on network cities tend to focus on major cities or growth corridors but the extent to which the socio-economically disadvantaged small size cities within a region will affect a typology of urban networks with a range of nodality and polycentrality is currently little understood.

In the Republic of Korea (hereafter Korea), a socioeconomically disadvantaged region has a distinctly different structure of urban form and industry with respect to transport network and modality or centrality than the major metropolitan area. Korea is one of the most highly urbanized nations in the OECD, 91.6% of the population in urban areas ([MOLIT, 2014](#)). The spatial disparity between the Seoul Metropolitan Area (SMA) and outer regions is apparent. Within the national urban hierarchy of Korea, the SMA accounts for a significant proportion of the national population, approximately

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51.2%, reflected in its importance in the economic, social, political and cultural life of Korea and over 50.9% of employment is concentrated in the SMA (MOLIT, 2014). The regional balanced development between the SMA and non-SMA has been an important government policy in Korea. Balanced distribution of economic activities, industries and population across cities and towns depends on building up strong urban networks to empower socioeconomically disadvantaged areas within the non-SMA. The Korean planners, economists and policy decision makers believe that the development of urban networks within the socioeconomically disadvantaged region could help to enhance the performance of local economies where the regional population as a whole has decreased.

Despite the current regional planning for promoting balanced regional development that promotes more efficient and effective transport networks and economic growth within the region, uncertainties remain as to whether disadvantaged cities and towns in the region will become a network city and which network structure would be the most effective for those cities and town to form a network city. This paper first identifies the characteristics of network cities and examines if socioeconomically disadvantaged areas meet the needs of network cities. Finally the study simulates a typology of network cities if those disadvantaged cities meet the requirements. It outlines the planning implications of network city development, including the strengthening of competitiveness of small and medium-size cities in the disadvantaged region.

2. Literature review: network cities

Network cities aim to improve regional competitiveness by sharing a specific function of low rank-size cities where it is difficult to provide an extensive service due to the scale of economy of each city and its relative disadvantage in physical and social connectivity to neighboring cities. The concept of network cities focuses on regional development by networking small and medium size cities and enhances regional competitiveness through effective interactions and cooperation between the cities. The development of network cities is therefore regarded as a strategic planning initiative to improve regional economy (Frenken & Hoekman, 2006). The research of Frenken and Hoekman (2006) analyzed regional economic performance in an enlarged Europe (EU25) by using the economic growth data of 1088 regions. The result of the regression analysis in this study showed network cities are positively correlated to higher economic growth than other cities. The urban networks contributed to increasing initial salary and population density comparison with non-network cities.

Studies on network cities focused on not only physical proximity to other cities but also the impact of local connectivity on national economic development in relation to the link of transport nodes, communication networks, and increasing human interaction (Batten, 1995; Frenken & Hoekman, 2006; Van Eck & Daalhuizen, 2005). Cheng, Bertolini, Clercq, and Kapoen (2013) pointed out the functional interactions within the urban network replaces the physical proximity. An example of network cities is the Randstad region in Netherlands, which consists of four central cities where each city has different economic and social characteristics. The gross regional product (GRP) of Randstad in 2008 was the fifth highest and the labor participation rate of the four cities in this region was the highest in Europe. In particular the level of education and skilled labor are higher than the average in the EU (TNO, 2010). The Kansai region in Japan is another example of network cities where the region recently gained greater confidence in building regional productivity for the national economic growth. The Kansai region developed the network cities as a hub of Japan's economic growth over many years of competition with the rival

city of Tokyo (Batten, 1995; Kwon, 2009). Many studies found that network cities generate a synergy effect to regional economic development as well as a spill-over effect to other regions (Meijers, 2005; Van Eck & Daalhuizen, 2005; Van Oort, Burger, & Raspe, 2010).

Batten (1995) suggested that a network city should have at least three central cities within the region and that horizontal networks link them. However, for the network between other cities of different sizes it does not show a hierarchical order of the cities (Batten, 1995; Hall & Ward, 1998). The study identified the major characteristics of network cities as centrality, size neutrality, tendency towards flexibility and complementary relationships, heterogeneous goods and services, horizontal accessibility, two-way flows, information costs and imperfect competition with price discrimination. Similarly Kwon and Shin (2005) conducted a case study in Randstad and found that the success of network cities depend on functional cooperation and connection of surrounding cities, and thereby, the spatial connection with transport infrastructure and industry cluster helps reduce travel time and costs and creates synergy effects in the region. Kwon (2009) also found several factors such as transport network, independency between cities, and functional division play a significant role in a high population growth rate in the city especially in the case of small and medium-sized cities.

Meijers (2005) distinguished network cities into a 'club' type or a 'web' type. In club networks, actors share a common objective, activity and service, while web networks are characterized by different activities of the actors. The club networks focus on their mutual interests and similar size economy in the network cities, while web networks aim to obtain a vertical synergy in pursuit of complementarities with a hierarchical economic structure and are specialized for a synergy effect of heterogeneity in the network cities. Capello (2000) underpinned that cities have a scale economy in complementary relationships and create synergies in cooperative activities by participating in the network. Recently Sohn (2011) asserted that Network City is new urban system that creates a synergy of web networks, and the factor of complementary relationship among cities is one of the key characteristics of the Network City. Van Oort et al. (2010) also supported this view that the degrees of spatial and functional integration and urban complementarities in economic networks are important, and the Randstad is a good example of the economically sound polycentric urban form. Hence complementary relationships lead to the spatial and functional integration, which can be a key to the network cities.

Based on the literature review Table 1 shows a summary of the main characteristics of the Network City. The past studies suggested the lineament of the Network City by three indicators; polycentrality, nodality, and the links with at least three cities. The links between cities are divided into physical links and functional links. Physical links mean the direct connection of cities through the traffic network, while functional links refer to the sharing of other's resources through the functional division of cities. Cheng et al. (2013) suggested that a commuter's accessibility-based approach can provide a successful platform for the analysis of the functioning of urban network. In this paper we define the Network City as an urban system that holds at least three central cities (central places) connected by physical and functional links (refer to Fig. 1).

3. Data and methods

The Republic of Korea has seven mega city regions including the Seoul Metropolitan Area (SMA), which is the most socioeconomically advantaged region in Korea, and six relatively disadvantaged regions: Chungcheong, Honam, Dongnam, Daegyeong, Gangwon

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