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SPACE & ENVIRONMENT

ISSUES & TRENDS 01

Measures to Utilize Mobile Big Data for Spatial Policy

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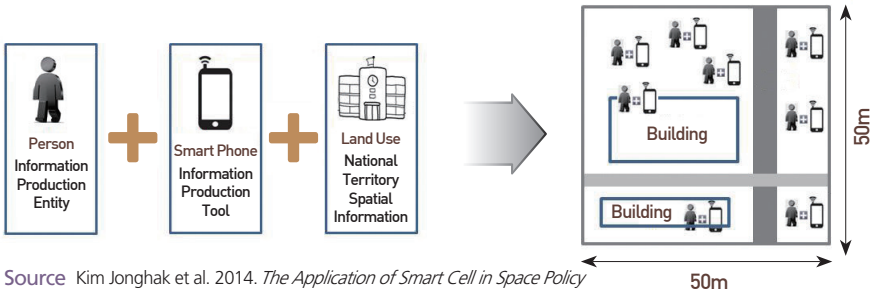
1. Concept of mobile big data

As mobile phones have become a ubiquitous commodity, the production of mobile big data to identify people's living patterns has kept pace. Currently, every person in Korea owns 1.07 mobile phones of which smart phones account for 69 percent, a number more than twice as high as that of 31 percent of regular cell phones. Indeed, people have signed up for 35.56 million smart phones compared to signups for regular cell phones which have doubled in the same year, and the volume of mobile traffic increased 210 percent to 73,000 terabytes[1] per day compared to a year ago.

Mobile phone-based big data is made through active population's information produced per certain space unit via mobile service provider, which is available to identify people's mobile phone use (such as calls and data transfer) per cell unit of 50 meters x 50 meters. (Figure 1) This data can be translated into mobile phone users at the specific time of the cell, which is the active population of that cell.[2] Using data from the Statistics Korea, this research found that the co-relation coefficient is 0.94 between mobile big data and Seoul's active population, which means mobile big data can be regarded as representing an active population.

Figure 1. Mobile phone-based big data per cell unit (50 meters x 50 meters)



Source Kim Jonghak et al. 2014. *The Application of Smart Cell in Space Policy*

1) Terabyte (TB) is a unit for digital information. 1TB is equivalent to about 1,000 gigabytes (GB).
2) Multiple uses of a mobile phone In the same amount of time in a cell is calculated as active population.

KRIHS Gazette

KRIHS (Korea Research Institute for Human Settlements) was established in 1978 with a mission of creating a beautiful and pleasant living environment. To achieve the mission, KRIHS has been committed to enhancing the quality of life and well-being of the people in the nation with its spatial planning studies and policy suggestions.

Since its foundation, KRIHS has carried out a variety of studies on the efficient use, development, and conservation of territorial resources. Its research areas range from sustainable and balanced territorial development and conservation of the territory to the provision of housing and infrastructure.

A nation's land is a space where various entities' activities occur in various kinds of facilities and places. Spatial policy in Korea has been designed on the basis of a static data set established by month and year. On the other hand, mobile big data, regardless of spatial hierarchy, can be a starting point of providing an active population's data by days of the week and by hour. Mobile big data, of course, cannot respond to all spatial phenomena and issues, but can provide a momentum to trigger small changes in spatial policy planning and implementation. Mobile big data can be built up in a consistent data set format whether the data is from as small a place as a parking lot or from as large a space as a metropolitan city, as well as in a format of dynamic data by days of the week and hour.

2. Dynamic distribution of active population

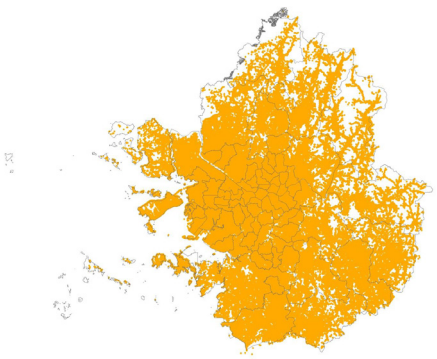
This study indexed active population information in Seoul and its surrounding metropolitan areas and analyzed the indexed data for spatial policy application. First, the active population information of mobile big data from 890,000 cells in the metropolitan areas[3] was analyzed by day and by hour. The result showed that 3 p.m. on Friday recorded the largest active population and this trend continued until 5 a.m. on Saturday, which means that the so-called "Thank God, It's Friday" effect was proven true. Setting Friday's activity level at 100, the average activity level on weekdays was 97 and the same on weekends, 70, which is 39 percent lower than the figure of weekdays.

3) Information on the average active population by the day of the week and by hour in November 2013. (Source: SK Telecom)

Figure 2. Hourly change of the density center of the active population in the metropolitan areas

Source
Kim Jonghak et al. 2014.
The Application of Smart Cell in Space Policy

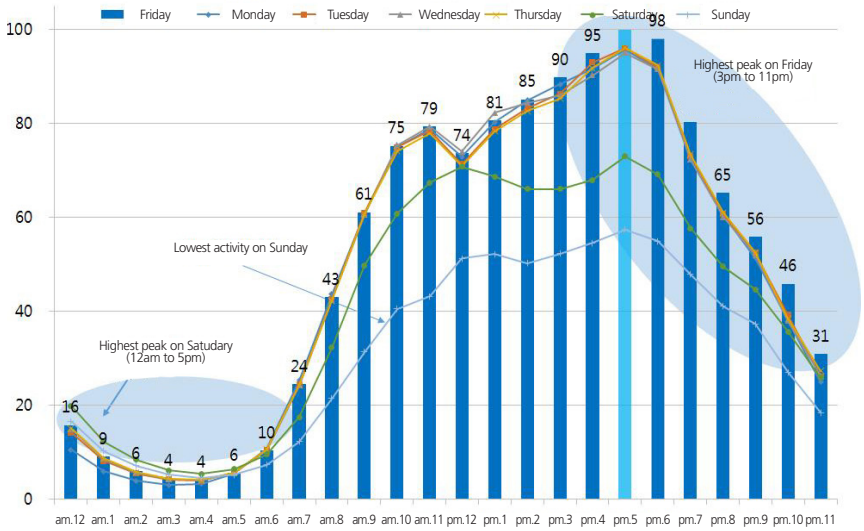
Figure 3. Changing patterns of the active population in the metropolitan areas using mobile big data



The units of mobile big data in the metropolitan area: 887,323

Source
Kim Jonghak et al. 2014.
The Application of Smart Cell in Space Policy

Figure 4. Changing patterns of the active population in the metropolitan areas using mobile big data



Source
Kim Jonghak et al. 2014.
The Application of Smart Cell in Space Policy

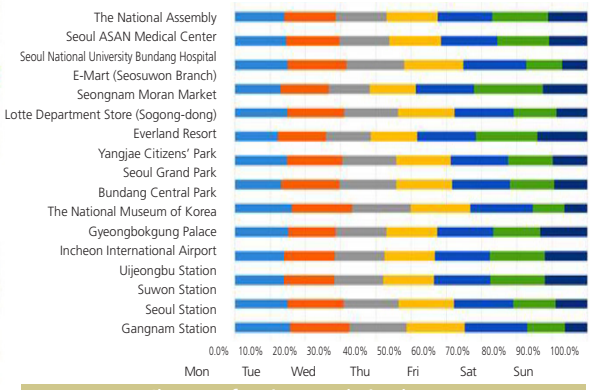
The next step was to analyze the change of the density center of the active population in the metropolitan areas by using the location of big data and the information of the active population. The result showed that the central point of the active population in the metropolitan areas was centered in the Sadang-dong area in Seoul, which shows changing patterns by hour mainly in north-south directions. The central points moved from the south at 7 a.m. to the north at 9 a.m., the starting time of work. These patterns are due to the metropolitan area's spatial structure—residential areas in south Seoul and companies in central Seoul—and movement patterns toward north-south directions.

Active populations at transportation and shopping centers as well as leisure facilities in the metropolitan areas were also analyzed. The active population by day peaks on Friday, followed by Tuesday, and the Gangnam subway station has the highest share (17.7 percent) of the active population on Friday. By day, the highest active population at certain locations were as follows: Tuesday and Wednesday had the highest number at large-scale hospitals; Tuesday and Friday at the National Assembly; and Saturday at amusement parks, such as Seoul Grand Park and Everland Resort.

Figure 5. Changes of active population by day-to-day facility

Everland Resort

Seoul ASAN Medical Center

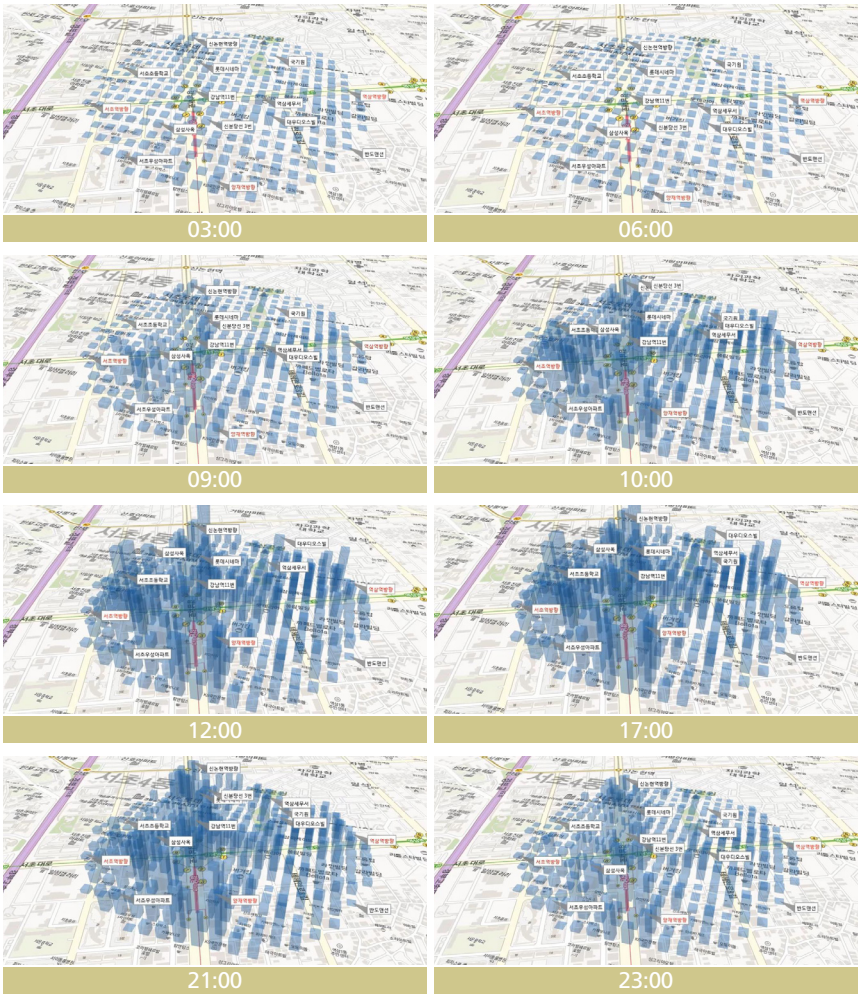


Change of Active Population by Day

Source
Kim Jonghak et al. 2014.
The Application of Smart Cell in Space Policy

This study also analyzed mobile big data collected from the Gangnam station neighborhood with the largest population volume in the metropolitan areas and pictured the analysis results. The active population near the head offices of big companies, public agencies, and the subway station was relatively bigger than the population near apartments and elementary schools. The population near the Gangnam station, of course, recorded the highest active level.

Figure 6. Changes of active population by hour within the 500 meter-range of the Gangnam station



Source
Kim Jonghak et al. 2014.
The Application of Smart Cell in Space Policy

3. Case study for applying mobile big data in transportation

This study analyzed the residential location distribution of the active population in the Gangnam-gu district with payment mailing addresses of mobile phone service. The location recorded the highest ratio of active population to mobile phone service in the near-metropolitan areas of Gyeonggi Province and Incheon, while Busan was the top location among local regions. The residential location distribution of the active population in the Gangnam-gu district active population was as follows: Seoul recorded 57.2 percent, Gyeonggi Province 25.5 percent, Incheon 3.1 percent, and other local regions recorded 14.2 percent. It was found that 8.6 out of 10 among

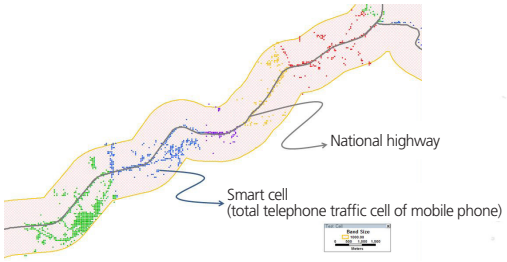
the active population are living in the metropolitan areas and 1.4 live in other local regions. In case of Gyeonggi Provice, Sungnam in Bundang-gu district and Namyangju had a high ratio of active population, and of local regions, the highest to lowest ratios were recorded in Busan Metropolitan City, Gangwon Province, and Gyeongbuk Province, respectively.

The correlation of mobile big data and the volume of traffic was rather higher on the outskirts of than in the central city. This study first identified central city areas and outskirts of the city center and matched the annual average daily traffic (AADT) data to mobile big data. According to the results, the outskirts of the city center in metropolitan areas showed a higher correlation than in central city areas; 111 spots on the 18 national highways in peripheral areas with a low population density had a relatively high correlation of 0.745.

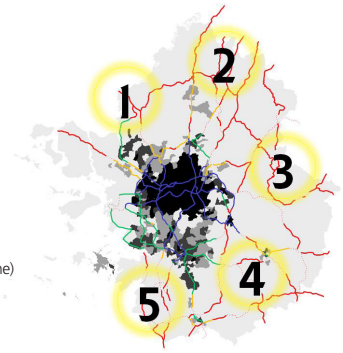
Note Residential ratio in Gyeonggi Province: Bundang-gu district, Sungnam (9.7%) > Namyangju (5.6%) > Suji-gu district, Yongin (4.9%)

Note Residential ratio in local regions: Busan Metropolican City (12.9%) > Gangwon Provice (9.3%) > Gyeongbuk Province (9.1%)

Figure 7. Correlation between the active population and the volume of traffic in metropolitan areas



Cell data established nearby national highway



Analysis area in the metropolitan area

Classification	National highway lane	Observation spot for the volume of traffic	Correlation coeffiency (r:95%)
1	1, 37, 39, 48, 77	13	0.6496
2	3, 37, 43, 47, 87	28	0.8787
3	6, 37, 44, 45, 46, 75	23	0.8181
4	3, 17, 37, 38, 42, 43, 45	28	0.8264
5	38, 39, 43, 45, 77, 82	19	0.7887
Total	18 lanes	111	0.7449

Source
Kim Jonghak et al. 2014.
The Application of Smart Cell in Space Policy

4. Mobile big data application

Application to spatial planning and policy

First of all, mobile big data can be used to identify dynamic administrative needs by hierarchical space. Active population information from mobile big data can provide optimal public service by recognizing its needs in real time in various spaces. When planning for the equipment of park facilities, for instance, a customized facility planning based on the real demands is possible.

Mobile big data can also provide the groundwork in policy making by taking into account individuals' activities. Mobile big data based on these activities can be used as novel policy materials that through an automated date collection system, enable planners to listen to citizens' voices without extra expense or research. For instance, using mobile big data to identify the locational density of the active senior population can help develop plans for customized senior care centers.

Application to transportation

Mobile big data can also be used in several transportation fields. First, mobile big data can help identify real-time travel patterns by hierarchical space and establish transportation plans. Identification of travel patterns at every level from town and county up to district and city is available with the active population's travel patterns, and the patterns identified can be used in transportation policy making.

Mobile big data can provide and substitute for supplementary data on traffic volume on the outskirts of cities not often calculated. It can also help outline traffic volume without additional investigation when establishing road plans or designing road construction.

In addition, mobile big data can enhance reliability models for traffic of origin-destinations (O/D). Hourly in-and-out data of cells that are the units of mobile big data can enable a count of O/D traffic only with the population, and consequently enhance the reliability of O/D traffic data in the national transport database.

This article is a summary of the research paper of *The Application of Smart Cell in Space Policy,* which can be found at KRIHS English Website (http://eng.krihs.re.kr).

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