

# Crime Mapping Based on Experts' and Residents' Assessments of Neighborhood Environment

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## Abstract

This study examines the limitations of existing crime mapping that relies mainly on reported crime data, suggests a crime mapping method based on experts' and users' assessments of a neighborhood environment as an alternative approach, and conducts a case study on a real-world site by applying the suggested approach. According to the results of the case analysis, while the areas adjoining arterial roads with heavy pedestrian traffic were shown as high crime risk areas in the crime map based on actual reported crime data, the areas adjoining local roads with low pedestrian traffic were high-risk areas in the crime risk area map based on experts' and residents' evaluations. This study makes a contribution to the field in that it demonstrates the detailed application process of crime risk area mapping according experts' and residents' evaluations, compares the results with those of an existing crime map, and finally shows that the former can function as a complement to the latter.

Keywords : Crime Safety, Fear of Crime, Crime Mapping, CPTED

## 1. Introduction

Along with the development of information/communication technology such as big data and the Internet, and the increase in social demand for public information disclosure, the demand for crime map for visualizing crime information is also increasing (Weisburd and McEwen, 2015). GeoPros developed for police purposes such as crime investigation and security, and the Korea Safety Map for sharing crime information with citizens are representative examples in Korea.

However, there are still many technological issues to be solved, including the inaccuracy issues of the criminal data used for crime mapping and the incorrect match issues in the geocoding process. Many of such technological problems are caused by the inherent nature of the reported crime data which are a main resource for current crime mapping practices (Kim, 2015).

Focusing on the problems caused by relying on a specific type of resource (crime reports) for crime mapping, this study suggested an alternative approach that utilizes a different type of data resources, that is, crime risk area mapping based on people's direct assessments of physical environments. CPTED (Crime Prevention Through Environmental Design) theory has suggested that the physical environment is a major influencing factor for crime (Cozens and Love, 2015). The study compares the alternative crime mapping based on CPTED theory with the existing crime mapping practice and offers suggestions for improvement. This study consists of 1) literature reviews on the limitations of the existing crime mapping practice and the applicability of CPTED on crime mapping, 2) the development of an alternative crime mapping method based on CPTED: crime mapping using experts' and users' assessments of neighborhood environments, and 3) a case study on a real world site to test the usability of the alternative crime mapping method.

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## 2. Literature Review

### 2.1 Existing crime mapping method based on reported crime-related statistics

The author reviewed literatures related to the limitations of the crime mapping practice relying on reported crime data, which is actively used in Korea. GeoPros and Korea Safety Map service are representative examples.

GeoPros, which is used by the police, provides various functions such as analyzing crime area, identifying suspects, and predicting the location of serial criminals by linking crime information (Lee, 2015), while the Korea Safety Map provides information on crime-stricken areas to the public at a level that protects the privacy of the individual by changing crime locations into gradation patterns and making it impossible to specify the locations (Lee and Choi, 2014) (Fig. 1).

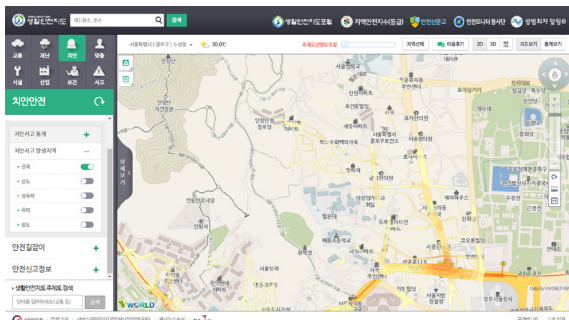


Fig. 1. Korea Safety Map webpage (NDMRI, 2017)

These two exemplary crime maps rely on reported crime statistics, and crime maps relying on such crime statistics have the following limitations. First, there are “dark figures” such as crimes that are unreported or omitted from the record deliberately or unintentionally. Although actual numbers of crimes are hardly possible to know accurately, previous studies have estimated that it could be several times to tens of times more than the reported numbers (Hwang, 2010; Lee, 2014; Kim, 2015).

Second, there is the problem of incorrect matching that could occur in the geocoding process of matching crime data on digital maps. That is, geocoding could be inaccurate because of problems with a criminal record itself such as

missed or incorrectly recorded location information or problems with digital maps such as overly large matching segments or maps that are not updated (Kim, 2015).

Third, a crime map relying on reported crime data has limitations in that it is based on the results rather than the causes of crimes. It shows spatial patterns of crimes but it does not reflect the characteristics of the physical environment that cause crime. Lynch and Hack (1984) pointed out that it is difficult to precisely identify the causes from the information obtained from such past patterns

Finally, in the case of crime maps that rely on crime statistics, the actual crime incidence is reflected, but the fear of crime may not be reflected properly. Previous studies have pointed out that locations where actual crimes occur frequently do not coincide with those where people feel the fear of crime (Huh and Moon, 2011; Park, 2015). Fear of crime, by itself, affects the quality of life of citizens, so crime maps need to reflect fear of crime (Jang *et al.*, 2014; Hong and Jang, 2015; Ku, 2016).

### 2.2 CPTED as an alternative approach

The concept of CPTED, considering the physical environment as one of the factors influencing crime occurrence, can help to complement the limitations of crime maps relying on crime statistics. Newman (1972) suggested three factors that could affect crime occurrence: 1) natural surveillance by residents or passers-by, 2) the territoriality that people have, and 3) the ‘milieu’ that a public space is well managed. That is, crime is more likely to occur in places where natural surveillance is poor because of low pedestrian traffic or low visibility with insufficient street lights, places where strangers’ access is difficult to control due to unclear boundaries between private and public realms, or dirty, abandoned places that no one takes care (Lee and Kim, 2014). Such environmental factors can affect not only actual crime potential but also fear of crime (Choi and Lee, 2016; Kim and Kim, 2015; Park and Yun, 2014; Lee and Lee, 2014).

### 2.3 Previous studies on crime mapping and CPTED

Although there have been attempts to apply CPTED to crime mapping, they hardly incorporated the characteristics of the environment that people actually perceive because their

spatial unit of analysis was too large (Cheong and Park, 2015), or they used secondary data collected for other purposes such as digital map (Shin and Kim, 2014; Kim, 2014; Park and Kim, 2015) and demographic statistics (Park and Kim, 2015), or focused on specific facilities such as CCTV and street lights (Park *et al.*, 2015; Kwon *et al.*, 2016). In addition, the Children Safety Map projects pursued by the Ministry of Gender Equality and Family made attempts to find crime risk areas through direct observation of the neighborhood environment, but they mainly aimed at child safety education rather than systematic crime mapping (Kang *et al.*, 2013).

This study aims to compensate for the shortcomings of the existing crime maps discussed above through an alternative approach that introduces the concept of CPTED more actively. Details of the process are described in the next section.

### 3. Development of an Alternative Crime Map Based on CPTED

First, based on the review of previous research conducted above, the author suggested the following preconditions for the alternative crime mapping to be developed in this study: 1) it should be based on a direct assessment of the neighborhood environment, 2) it should reflect various perspectives such as those of experts and users, and 3) it should reflect the concept of CPTED actively.

Reflecting on these conditions, the author proposed a crime-mapping process based on the experts' and users' evaluations of neighborhoods. The following are the basic procedures for crime mapping based on experts' and residents' assessments. More details are determined during actual application, depending on the site.

#### 3.1 Crime mapping based on investigators' field observations

The evaluation by experts is conducted through field observation, which provides detailed information on the various elements of the physical environment while enabling an integrated assessment (Lynch and Hack 1984). Of the three elements of CPTED discussed above, it focuses on natural surveillance and management of the neighborhood

environment, except territoriality, which is difficult to study through direct observation.

Investigative items for natural surveillance include pedestrian traffic volume and the presence of security facilities such as CCTV and street lights, and those for environmental management include garbage and the cleanliness status of public spaces.

In order to increase the reliability of field observation, a systematic investigation plan and a pre-training program for investigators should be prepared (Yin, 2014). The investigation plan should include investigation routes, investigative items, and investigation and evaluation processes for each item.

#### 3.2 Crime mapping by user survey interview

The users' assessment is conducted through a survey interview method. Direct communication with users like a survey interview is an important source of internal information such as the behavior, feelings, perceptions, or values of the people (Lynch and Hack, 1984).

In order to grasp the image of the neighborhood environment formed through daily experience, investigators ask respondents to point out the places vulnerable to crimes on the neighborhood map and to explain the reasons for their selections.

#### 3.3 Comparison and integration

More implications can be derived by comparing the crime map based on experts' assessment with that based on users' assessment. For example, places assessed as vulnerable to crime in both assessments could be interpreted as areas of high crime risk. For the places where the two assessments do not coincide with each other, investigators can reinterpret the discrepancies considering the characteristics of each assessment or conduct reinvestigations of the places. In the next chapter, the author described the specific process and results of applying the proposed crime mapping method to a real case, and demonstrated the difference between the proposed alternative and existing crime mapping practice.

## 4. Case Study

### 4.1 Design of site evaluation process

### 4.1.1 Site synopsis

The site for the case study is the Seocheon area of Jongro-gu in Seoul, which has diverse urban environments that are required for this case study. In terms of land use, the site is mainly residential area in which non residential uses such as retails, offices and public facilities are appropriately mixed. In terms of the transportation system, the site includes various types of streets from arterial roads to narrow pedestrian paths, and it is easy to access the public transportation system including buses and the subway (Fig. 2). The boundary of the study area was set to a range that is naturally recognized as a neighborhood by wide arterial roads and parks rather than following administrative boundaries. Inwang Mt. Park bounds the north and the west side, and arterial roads bound the east side (Jahamun-ro, 6 lanes) and the south side (Sajik-ro, 9 lanes).



Fig. 2. Case study area boundary (Daum, 2017)

### 4.1.2 Field observation process

Field observation was conducted in the order of establishment of the investigation plan including the investigation route and items, pre-training of investigators, and field observation. First, the investigation route was determined after conducting a preliminary site analysis using an online map service. Considering important spatial elements of the site, the author set up an investigation route that included 23 types of streets, two public spaces (parks) and two main intersections that represented all the streets and public spaces in the site (Table 1, Figs. 3 and 4). In particular, the hierarchy of streets and the uses of buildings facing the streets were considered in classifying street types because they are major factors influencing the activities on the streets. The results for each street segment included in the investigation route are assumed as representative values of the streets classified as belong to the same type in the analysis.



Fig. 3. Field observation routes Fig. 4. Photos of street segments

Table 1. Classification of street segments according to street types and land uses

Street types & uses		Classification and investigation street segments
Street	Arterial road & commercial	Street-front retail & street trees: ①, ②③
	Arterial road & residential	Low-rise residential with neighborhood facilities: ⑤
		Low-rise residential, on-street parking, street trees & public facilities: ⑥
	Collector road & mixed uses	Low-rise residential, offices & trees: ⑧
		Low-rise residential & street-front retail: ③
	Local road & commercial	Low-rise residential, street-front retail, street trees & on-street parking: ⑰
Traditional market (Tong-in Market): ④		
Local road & residential	Street-front retail: ⑳, ㉑	
	Low-rise residential: ⑦, ⑨, ⑬, ⑭, ⑮	
	Low-rise residential & neighbor park: ⑩	
	Low-rise residential & public parking: ⑫	
	Low-rise residential & on-street parking: ㉒	
Local road & mixed uses	Low-rise residential with neighborhood facilities+ neighborhood park: ⑪	
	Low-rise residential & street-front retail: ②, ⑯, ⑱	
Major public spaces	Low-rise residential, street-front retail, neighborhood park & street trees: ⑲	
Major intersections	Pavilion & pocket park: ㉔	
	Suseong-dong Valley Park: ㉕	
Major intersections	Local road & local road: ㉖	
	Arterial road & local road: ㉗	

Regarding investigation items, reflecting on the concept of CPTED, the author set up three items: pedestrian traffic (natural surveillance), level of management and cleanliness (management), and investigators' overall assessment (natural surveillance and management). Territoriality, which was difficult to grasp in a short observation, was excluded from the investigation items. Regarding pedestrian traffic, investigators counted the number of pedestrians for five minutes per street segment. Regarding the level of management and cleanliness, they rated each segment in a five-point Likert scale considering the existence of garbages and cleanliness status. Regarding the overall assessment, they rated each section in five point scale considering pedestrian traffic, safety facilities (such as street lights and CCTV), and level of management together. In order to increase the objectivity of the assessment, three investigators conducted the investigation together twice (12:00 pm to 4:00 pm and 9:00 pm to 11:00 pm), and each section was photographed for further analysis.

#### 4.1.3 User survey interview process

The user survey interview was conducted to gather information on the safety of the physical environment recognized by residents who are the main users of the neighborhood environment (The investigators asked the respondents whether they resided in the case site and whether they recognized the site as their neighborhood, and they included only respondents who answered "yes" in the analysis). The respondents were selected so that their sex and aged distribution were similar to that of those in the site. For this purpose, a total of 50 people were interviewed on a weekend (September 28th, 2014, Sunday) when the various generations of residents were expected to be at the site. The investigators explained the purpose of the study and questions to the respondents first and recorded their answers. As key questions, the investigators asked where crime risk was high and why they thought certain areas were dangerous.

### 4.2 Analysis of site evaluation results

#### 4.2.1 Field observation results

Regarding pedestrian traffic, it was the highest (more than 100 people per five minutes) in the arterial roads (Jahamun-

ro and Sajik-ro), and decreased in the order of collector road (Pirundae-ro) and local roads. Therefore, natural surveillance was expected not to work well on local roads (Fig. 5). Regarding the level of management and cleanliness, arterial roads and collecting roads were relatively well managed and clean but the local roads were not (Fig. 6).

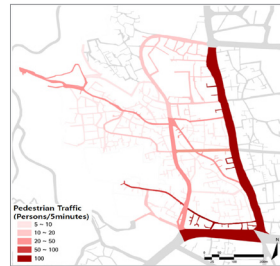


Fig. 5. Pedestrian traffic volume

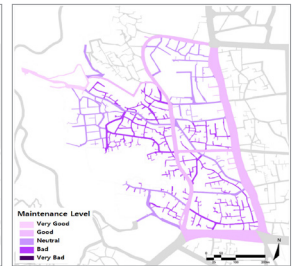


Fig. 6. Level of maintenance

Finally, regarding the investigators' overall assessment, narrow alleys and dead ends in densely populated multi-family housing areas were rated as vulnerable to crime (Fig. 7), which coincided with the analyses of the pedestrian traffic and the level of management and cleanliness. In other words, the investigators rated local roads, with poor natural surveillance due to low pedestrian traffic and low levels of management and cleanliness, as being more dangerous.

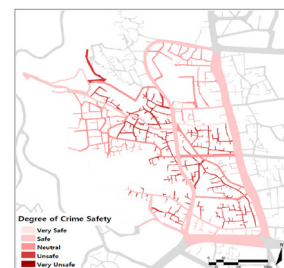


Fig. 7. Overall evaluation for crime safety

#### 4.2.2 User survey interview results

In the user survey interview, the places (10 or more) that the greatest number of respondents selected as places vulnerable to crime were the street in front of Baehwa Women's University (A) and the intersection of Sajik-ro and Pirundae-ro (B), and the major reasons for selection were lack of street lights and existence of many dark blind spots. In addition,

many respondents (6 or more) pointed out the narrow alleys near Suseong-dong Valley (D) and Sajik Park (C) as places vulnerable to crime due to low pedestrian traffic and lack of CCTV (Fig. 8).

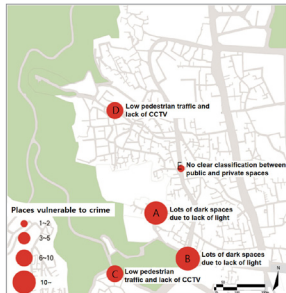


Fig. 8. User survey interview results

#### 4.2.3 Comparison and integration

In this section, the author first overlapped and compared the two crime mappings based on field observation and user survey interview (Fig. 9) and then compared these two crime mappings with the Korea Safety Map based on reported crime data (Fig. 10).

First, in the comparison of the crime mapping based on field observation and user survey interviews, only the narrow alleys near Suseong-dong Valley (D) were shown as places vulnerable to crime in both crime mappings, and the rest places were not matched with each other. Generally, in the crime mapping based on field observation, a specific type of streets were evaluated as places vulnerable to crime, which were narrow alleys or dead ends in the densely populated multi-family housing areas where pedestrian traffic was low and environmental management was not good.

However, in the crime mapping based on user survey interviews, except for the vicinity of the parks (C and D), the places rated as dangerous were the intersections (A and E) and the streets near schools (B) where pedestrian traffic was over a certain level.

Residents' assessments are based on their experiences in everyday life, so they might have selected the places vulnerable to crime from the areas that they visited frequently, and such selections might be influenced more by other factors (such as street lights, CCTV, or access of strangers) rather than pedestrian traffic. Second, in the comparison of

the Korea Safety Map with the two crime mappings of this study, the spatial pattern of reported crimes shown in Korea Safety Map was similar to that of pedestrian traffic (Fig. 10). That is, more crimes were reported where pedestrian traffic was high, which is in contrast to the results of the two crime mappings of this study. This discrepancy in the results can be interpreted as follows. In cases where pedestrian traffic is high, people feel relatively safe because of natural surveillance, but the chance of encountering criminals and victims also increases, which can lead to more actual crimes.

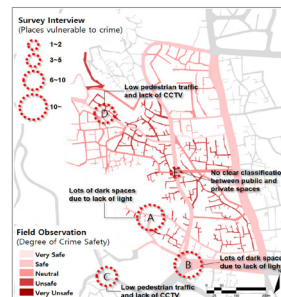


Fig. 9. Comparison of field observation and user survey interview results

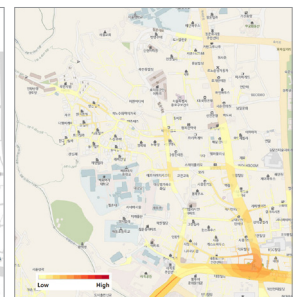


Fig. 10. Spatial patterns of reported crimes (<http://www.safemap.go.kr/>)

#### 4.2.4 Implications of the case study

It was found that the results of the crime mappings based on field observation and user survey interview were not necessarily consistent with the reported crime patterns in the existing crime mapping method.

The matched places should be improved first because they were evaluated as problematic in terms of the physical environment as well as the the occurrence of crime. On the other hand, the places assessed to be vulnerable to crime in the crime mappings by field observations or user survey interview also should be improved because they might cause fear of crime even though the number of reported crimes is not large.

## 5. Conclusions

In order to compensate for the disadvantages of the existing crime map relying on reported crime records, this study proposed crime mapping methods based on the evaluation

of the physical environment by experts and citizens, applied them to a real world case and reviewed the application process and results. The case study results showed that the results of the proposed crime mappings based on field observation and user survey interview did not necessarily coincide with reported crime patterns.

This study has contributed to research field in that it has suggested a practical method to complement the limits of the current crime mapping practice which mainly relies on reported crime data. The author does not argue that the crime mapping methods proposed in this study are better than the existing ones but that they can be used complementarily depending on the purpose of use. For example, in the case of urgent crime investigations or policing activities, existing crime maps that update crime information in real time might be more useful, while in the case of applying crime mapping to a specific neighborhood such as a urban regeneration project area or a CPTED pilot project area to use as a plan support tool to detect the crime risk areas and influencing factors, the crime mapping methods of this study based on the microscopic evaluation of the physical environment might be more effective.

This study is an exploratory study for complementing existing crime mapping methods and has the following limitations. First, the case study examined only one neighborhood in Seoul. Thus, there is a limit to the generalization of the process and results of the case study. Subsequent studies can verify the generalizability of the results by applying the proposed crime mapping methods to other cases with different spatial and geographical contexts. Second, the classification of street segments in field observation does not reflect difference according to geographical location. For example, although other physical characteristics may be the same, the street near the subway station and the street inside the neighborhood may differ in terms of vulnerability to crime. Third, this study used a limited number of investigation items for field observation and user survey interviews due to time and financial constraints. In the follow-up study, it is expected that a more detailed investigation will be possible by adding investigation items. Finally, considering the time and economic costs, frequent updating of crime mapping by experts' and residents'

assessments at national or city level might not be easy with current technology. However, if the use of AI become full-scale, it might be possible that AI analyze street view images provided by current online map services in a similar manner to this study and regularly update crime mapping for wide-scale spaces.

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## References

- Cheong, J. and Park, J. (2015), Test of the scale effect of MAUP in crime study: Analyses of sex crime using nationwide data of eup-myon-dong and si-gun-gu, *Journal of Korea Contents Association*, Vol. 15, No. 10, pp. 150-159. (in Korean with English abstract)
- Choi, Y. and Lee, J. (2016), A study on the impact of the safe village residents' awareness of CPTED on their fear of crime, *The Korean Association of Police Science Review*, Vol. 60, pp. 305-328. (in Korean)
- Cozens, P. and Love, T. (2015). A review and current status of crime prevention through environmental design (CPTED), *Journal of Planning Literature*, Vol. 30, No. 4, pp. 393-412.
- Daum (2017), Daum map service, <http://map.daum.net/> (last date accessed: 7 May 2017).
- Hong, M. and Jang, H. (2015), Comparative analysis on the fear of crime between South Korea and the United States, *Journal of Public Policy Studies*, Vol. 32, No. 1, pp. 1-28. (in Korean)
- Huh, S. and Moon T. (2011), Spatial analysis of the difference between real crime and fear of crime, *Journal of the Korean Association of Geographic Information Studies*, Vol. 14, No. 4, pp. 194-207. (in Korean with English abstract)
- Hwang, J. (2010), Estimating the amounts of some major hidden crime 2008 in Korea, *Korean Criminological Review*, Vol. 21, No. 3, pp. 7-51. (in Korean)
- Jang, Y., Kim, S., and Jung, J. (2014), The effect of crime victimization and fear of crime on quality of life, *Journal*

- of Police Science*, Vol. 14, No. 3, pp. 33-65. (in Korean with English abstract)
- Kang, S., Park, J., Lee, S., and Lee, K. (2013), A study on the production and utilization of children safety map for crime-free urban spaces, *Seoul Studies*, Vol. 14, No. 1, pp. 153-167. (in Korean with English abstract)
- Kim, E. (2014), Methodology of identifying crime vulnerable road and intersection using Digital Map version 2.0, *Journal of the Korean Society for Geo-spatial Information Science*, Vol. 22, No. 4, pp. 135-142. (in Korean with English abstract)
- Kim, S. (2015), A study on the police use and public disclosure of crime maps in Korea, *Journal of Korean Academy of Public Safety and Criminal Justice*, Vol. 24, No. 1, pp. 44-72. (in Korean)
- Kim, Y. and Kim, J. (2015), The influences of CPTED on fear of crime: Case of Namdong-gu, Incheon, *The Korean Association of Police Science Review*, Vol. 50, pp. 3-33. (in Korean with English abstract)
- Ku, G. (2016), A study of crime fear factors : Focused on direct and indirect experience, *Discourse and Policy in Social Science*, Vol. 9, No. 1, pp. 113-126. (in Korean with English abstract)
- Kwon, H., Song, K., Seok, S., Jang, H., and Hwang, J. (2016), Development of social map prototype for intelligent crime prevention based on geospatial information, *Journal of The Korea Society of Computer and Information*, Vol. 21, No. 8, pp. 49-55. (in Korean with English abstract)
- Lee, C. (2014), Estimating dark figure: Mathematical model utilizing crime-unreporting rate, *Korean Journal of Criminology*, Vol. 26, No. 1, pp. 109-136. (in Korean with English abstract)
- Lee, G. (2015), Recent scientific investigation policy and task of police, *Soongsil Law Review*, Vol. 34, pp. 321-339. (in Korean)
- Lee, S. and Choi, J. (2014), A study on domestic life safety guidance through international crime mapping service case analysis, *Proceedings of Korea Computer Congress 2014*, KIISE, 25-27 June, Busan, Korea, pp. 948-950. (in Korean)
- Lee, S. and Lee, C. (2014), A study on the relations between apartment residents' perception and fear of crime on CPTED elements, *The Korean Association of Police Science Review*, Vol. 48, pp. 169-195. (in Korean with English abstract)
- Lee, S. and Kim, J. (2014), Effects of streets lined by multi-family houses with pilotis on fear of crime and car accident, *Journal of Korea Planning Association*, Vol. 49, No. 1, pp. 33-49. (in Korean with English abstract)
- Lynch, K. and Hack, G. (1984), *Site Planning*, MIT Press, Cambridge, MA.
- NDMRI (2017), Korea safety map, *Ministry of the Interior and Safety*, Korea, <http://www.safemap.go.kr/main/smmap.do#> (last date accessed: 7 May 2017).
- Newman, O. (1972), *Defensible space*, Macmillan, New York, NY.
- Park, H. (2015), Spatial Comparison of crime occurrence and fear of crime, and factors affecting fear of crime, *Journal of Community Safety and Security by Environmental Design*, Vol. 6, No. 2, pp. 40-62. (in Korean with English abstract)
- Park, D., Kang, I., Choi, H., and Kim, S. (2015), Crime mapping using GIS and crime prevention through environmental design, *Journal of the Korea Society for Geospatial Information Science*, Vol. 23, No. 1, pp. 31-37. (in Korean with English abstract)
- Park, J. and Kim, E. (2015), Methodology of extraction of crime vulnerable areas through grid-based analysis. *Journal of the Korean Society of Surveying, Geodesy, Photogrammetry and Cartography*, Vol. 33, No. 4, pp. 221-229. (in Korean with English abstract)
- Park, Y. and Yun, W. (2014), Analyzing the effects of CPTED on females risk of victimization and fear of crime: Focusing on female residents in Daegu City, *Korean Academy of Public Safety and Criminal Justice*, Vol. 23, No. 3, pp. 80-109. (in Korean with English abstract)
- Shin, M. and Kim, E. (2014), Personalized safety map service using GIS and CPTED, *Proceedings of the KSGIS Conference*, KSGIS, 14-15 November, Incheon, Korea, pp. 75-76. (in Korean)
- Weisburd, D.L. and McEwen, T. (2015), Introduction: Crime mapping and crime prevention, *SSRN*, Rochester, NY, <https://ssrn.com/abstract=2629850> (last date accessed: 7 May 2017).
- Yin, R.K. (2014), *Case Study Research: Design and Methods 5<sup>th</sup> Edition*, Sage Publications, Los Angeles, CA.