통계적 품질관리도를 활용한 차별적 경찰대응전략의 평가
Evaluating the Quality of the Differential Police Response Strategy:
Applications of Statistical Quality Control Charts

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요약

　본 연구의 목적은 차별적 경찰대응전략의 품질을 평가하는 것이다. 새로운 경찰대응시스템이 도입된 지약 3년이 지났지만, 이를 실증적으로 평가한 연구는 미비한 실정이다. 2가지 종류의 통계적 품질관리 기법을 활용하여, 2012년 한해동안 익산경찰서에 신고된 약 3,000건의 경찰데이터를 분석하였다. "Xbar-R 관리도"의 분석결과, 경찰은 긴급출동신고전화 (Code 1)에 지속적으로 신속히(3분 이내) 대응하지 못하는 것으로 나타났다. 더불어 "P 관리도"의 분석결과, 경찰은 비긴급출동신고전화 (Code 2)에 5분이내로 대응하지 못한 출동건수의 월별 상이성이 큰 것으로 나타났다. 본 연구에서 알 수 있듯이 경찰이 추구하는 "신속한" 수준의 대응전략에 있어 코드별 목표대응시간에 대하여 재검토 할 필요성이 제기된다.

■ 중심어 : | 차별적 경찰대응전략 | 통계적 품질관리도 | 프로그램 평가 | 112 통합신고센터 | 경찰전략의 과학적 평가 |

Abstract

　The purpose of this research is to evaluate the quality of Differential Police Response strategy. Although it has been approximately three years since these new police response systems were introduced, there is no research to evaluate them empirically. Using two types of statistical quality control techniques, Xbar-R control charts for variables data and P charts for attributes data, this study analyzes approximately 3,000 calls reported throughout the year 2012 to the 112 Integrated Dispatch Center in Ik-san police station. The Xbar-R control charts revealed that the police did not consistently respond to an emergency call for service (i.e., code one case) within 3 minutes. The P control chart also identified that there was a significant variation in the portion/number of defective calls where police failed to respond to non-emergency calls for service within 5 minutes. The results from this study suggest the police may need to review the target response time for code 1 and code 2 respectively.

■ keyword : | Differential Police Response Strategy | Statistical Quality Control Charts | Program Evaluation | 112 Integrated Dispatch Centers | Scientific Evaluation of the Police Strategy |

1. Introduction

Quality control is important in many occupational fields because it reflects the demands and requirements of customers[1]. When operating properly, it detects and corrects the cause of the problem, which is impeding efficiency or having negative impact on quality in its early stages. In the field of production management, the purpose of the quality control is to minimize the economic costs and ensure the quality of product or service. In this regard, quality control of police service is more important than that of virtually any other field because factors that lower the quality of police service can contribute not only to economic damage, but also to significant personal injury or loss of life. There are a variety of factors to consider when evaluating the service quality police provide[2]. Among them, police response time has been considered as one of the most important factors. Rapid response to calls for police service is closely related to citizens' satisfaction. According to research on police response, rapid response time is not associated with the possibility of arrest, but has a positive impact on citizens' trust in police and decrease in fear of crime[3-6]. Therefore, it is very important for police to consistently arrive within the expected response time established by police policy for citizens' satisfaction on the police.

Korean national police introduced the 112 Integrated Dispatch Centers System and Differential Police Response (DPR) system in 2010, and has implemented them in all police stations across the country. DPR classifies every call for police service into three levels of codes according to emergency, importance and necessity of reported incidents[7]. Based on this, dispatchers direct more police resources to urgent calls than where it is not an emergency, or police response is not appropriate or necessary. The objective is to increase the likelihood of making an arrest or otherwise resolving the emergency, and to improve citizen satisfaction. The desired end result is to improve efficiency while operating more effectively. Although it has been approximately three years since the new police response systems were introduced, almost no research has been conducted to evaluate the quality and efficiency of the system. In fact, there has been only one research project to systematically evaluate the effectiveness of the system, which was conducted by Kang for his doctoral dissertation in 2011. Further, a significant problem exists in the methodology used by agencies in self-evaluating the effectiveness or the quality of the system. Agencies have conducted non-scientific evaluations by simply comparing the average response time to call for service from one year to the past year without categorizing the level of call classification.

The purpose of this study is to evaluate the quality of 112 Integrated Dispatch Centers (IDC) and Differential Police Response by using two types of statistical quality control techniques, which have long been used in many other fields of research. This strategy emphasizes the necessity of introducing a variety of scientific quality control techniques. Based on the results of the study, policy implications for improving the quality of 112 IDC and DPR are suggested.

2. Differential Police Response

Research on the effectiveness of police response to calls for service has been conducted since the mid-1970s. In particular, research has focused on the effectiveness of rapid response to citizen calls for

service. One of the first studies on rapid response time was conducted in Kansas City, Missouri, in 1977. The results of the study reveal that rapid response to calls for police service is not related to the likelihood of arrest or availability of witnesses. Further, citizens' satisfaction with police response is more likely to be associated with their individual expectations and perceptions of response time than with actual response time. A subsequent study conducted by Spelman and Brown (1981) confirmed the results that rapid police response does not increase the probability of arrest; rather, the reporting habits of citizens matter. Also, a rapid response is not necessary for every call for service because most crimes are discovered after they were already committed. They found a rapid response was unnecessary in 75% of serious crime calls and that an arrest is made in less than 3% of these calls. Their results suggested efficiencies could be gained by redirecting cold calls away from uniformed patrol officers, and allowing reports to be made over the phone, or by sending civilian employees to certain cold property crime scenes. Alternatives to traditional police responses began to gain attraction in the early 1980s in the United States. Cohen & McEwen (1984) described a new remedy for improving the handling calls for service. The concept of Differential Police Response (DPR) is not primarily focused on improving response times. DPR strategies are designed to optimize the balance between increasing requests (calls) for police service from citizens and limited police resources. The desired end result is an increase in efficiency, improved effectiveness, all while either maintaining or improving levels of citizen satisfaction. Established by department policy, the priority system is designed to systematically differentiate the requests for police service[7]. The DPR system incorporates two basic strategies coded as "Delay" and "Relief." For any

types of calls to which a rapid response is not necessary, dispatchers can delay police response from a few minutes to several hours, or use a variety of relief responses including taking telephone reports, making online reports, asking a complainant to come to the police station, transferring a call to the appropriate internal or external department/agency, or dispatching non-sworn officers (civilians) rather than dispatching sworn patrol officers. Research on evaluating the performance of DPR, has found it can improve both the efficiency and effectiveness of police resources. Cohen & McEwen (1984) found the use of alternative responses almost doubled on experimental days. Overall, over 46% of calls were eligible for a DPR response and this resulted in large savings in patrol resources. With additional time made available to officers, self-initiated arrest increased by 40% and field interrogations increased by 15%. Besides improving the use of agency resources, it was also found about 90% of citizens were satisfied with alternative responses. This research was confirmed by Worden (1993) who again found 90% of citizens were satisfied with alternative responses for low priority calls. Only 3% of those who were dissatisfied cited response time as their reason. Worden found it was what officers did when they responded and not the delay that mattered when it came to citizen satisfaction. The factors that had the most significant impact were if officers lacked empathy, were not courteous, or could not solve the problem. Ultimately, Worden suggested DPR was an essential prerequisite to the implementation of proactive police technologies, such as directed patrol, community policing, or problem-oriented policing. Without DPR officers lack the uninterrupted time needed to foster partnerships in the community and engage in problem solving[8]. More recent assessments concur that DPR strategies are an important piece in allocating police staff and

managing their workload[9].

3. DPR in South Korea

The concept of DPR is now being used internationally and has been implemented in Korea. These strategies were introduced to the Korean national police in 2010 after a two-year test operation conducted in four metropolitan police agencies. It is important to understand why DPR strategies were introduced in Korea as an alternative to traditional police response strategies before conducting any research. The introduction and use of automobile patrol, two-way radio and 112/911 system provided better service, but simultaneously increased demands for police service. Also, reactive police patrol strategies were implemented, which resulted in an increase in dispatched calls for service for both emergency and non-emergency calls. This increase occurs because as police become more active they create more calls for service through self-initiated activity. The number of police calls for service has been constantly increasing every year. According to Korean Annual Police Reports published from 1999 to 2009, for example, the number of calls for service has increased by 300% for the past 10 years; by comparison the number of police officers has increased by 10% during the same time period. The numbers suggest that handling the increasing demands for police service has become a heavy burden on the police department. Furthermore, approximately half of all calls to police departments in 2011 were non-emergency calls related to social services. Responding to these non-emergency calls could result in a situation where police cannot respond to emergent crime incidents quickly and effectively.

4. Data / Analysis

A case study on the quality of Differential Police Response was conducted using data obtained from the 112 Integrated Dispatch Center in Iksan Police Station. The data includes approximately 45,000 calls reported throughout the year 2012 to the 112 Integrated Dispatch Center in the Iksan police station. Calls received by the dispatch center were assigned one of the three possible differentiated codes and appropriate resources were dispatched to the scene, or the call was rerouted to the appropriate agency.

From this data, code three cases were excluded from the analysis because these calls do not require a police response to the scene. Only code one and two cases will be used in the analysis as they result in police services being dispatched to a scene. Code one calls require the most urgent response, while code two calls receive a less urgent response. The calls will be analyzed according to response code, as a measurement error would occur if they were considered together when calculating the average police response time. A sample of 38,198 cases (Code 1 and Code 2) was used for the analysis of this study. The two types of statistical quality control techniques that were used to evaluate the quality of the DPR system were Xbar-R quality control charts and n-p quality control charts. For more accurate analysis of the differentiated each code, samples were divided into Code 1 and Code 2; and they were analyzed. The Korean National Police announced an expectation for calls responses according to the codes. The expected maximum police response time for code one calls is three minutes and five minutes for code two calls. These maximum response times were used for both the upper control limit for the Xbar-R control charts and a defect selection standard for n-p control charts. For the Xbar-R control charts, 20 cases were

randomly selected for each month throughout the year 2012. However, January and May were excluded in the analysis for Code 1 due to lack of cases. For the p control chart, all cases over the expected response time the police suggested (Code 1: 3 minutes, Code 2: 5 minutes) were considered as defectives.

5. Results and Discussion

Statistical process control (SPC) analyses were used to monitor and control the differential police response process. The Xbar-R control chart, the first set of analyses, was used to examine whether the process was statistically in control over time. The np control chart, the second set of analyses, was used to measure the extent to which the police do not arrive on the scene within the targeted time.

5.1 Xbar-R Control Chart

[Figure 1] shows the Xbar-R control chart for the code one cases provided by the dispatchers at Iksan police station throughout the year 2012. The top half of the [Figure 1] presents the result of the Xbar chart, and the bottom half provides the result of the R chart. First, the mean score of the Xbar control chart for the code one cases is 250 seconds, and the upper control limit and the lower control limit respectively are 358 seconds and 142 seconds. All samples of measurements fall within the control limits, indicating that variation in the monthly mean score is in statistical control regardless of season. However, one thing to notice in interpreting [Figure 1] is the expected response time suggested by the police for the code one cases was three minutes (180 seconds). All the monthly points, except February, fall above the expected upper limit. It demonstrates that the target response time set by the police is not being met as they consistently do not meet their set goals.

The R control chart shows that three points fall above the upper limit or below the lower limit, indicating that the variance in the police response time is out of statistical control over time and a particular causal issue is present in the process for these months. The points below the lower control limit, however, argue that the police are consistently responding to code one incidents within the goals that were set. Considering the results of Xbar-R control chart for the code one cases, Febuary is a good example of the police meeting the goals set for this process.
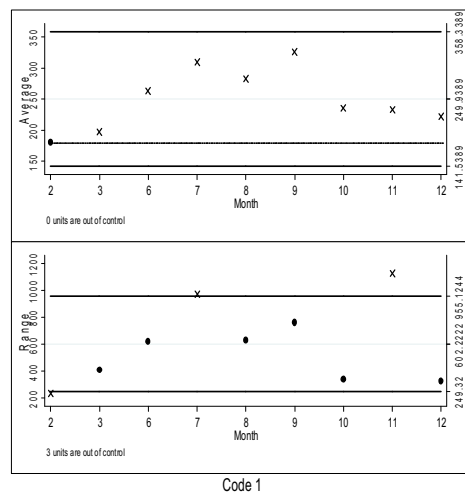

Fig. 1. Xbar-R control chart for Code 1 cases

[Figure 2] is the Xbar-R control chart for the code two cases. The mean score is 284 seconds, and falls below the expected upper limit of 300 seconds (5 minutes). Although the process seems to be statistically stable given that all the points fall under the control limits from 157 to 412 seconds, three points are above the expected upper limit. It means that the police do not respond to the code two incidents within the desired five minute average during these three months. Considering that the number of calls increases during these periods, however, the extent to which they exceed the limit is

not a significant difference (i.e., within 6 minutes). Therefore, it can be considered that the police response for the code two cases is in statistical control. The R control chart supports the result of Xbar control chart by demonstrating the stable process.
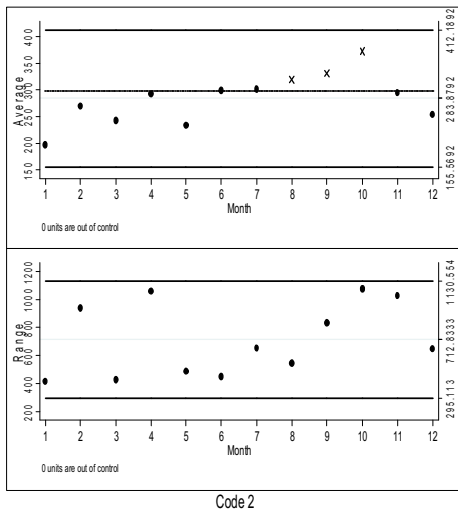

Fig. 2. Xbar−R control chart for Code 2 cases

5.2 P Control Charts

[Figure 3] presents the results of the p control charts, which consider the monthly portion of calls that would represent a sample of defective calls. The target response time set by the police for code one calls is 180 seconds, and 300 seconds for code two calls and any calls exceeding these limits would be the standard for a defective call response. Considering that subgroup sample sizes are unequal, researchers use the stabilized function in STATA ver. 13 to stabilize the p chart. The results, as shown in [Figure 3], indicate that the average portion of defective calls for code one and code two calls respectively is .6681 and .3707. Approximately 67% of the code 1 cases and 37% of the code 2 cases do not arrive on the scene within the expected time. Upon initial examination, the p control chart for Code 1 samples appears to be

statistically in control over time, but a closer assessment finds this is not necessarily the case. [Figure 3] shows the variation in the defective portion over time, and less variation, considering the high levels of defective portion, demonstrates that the police do not consistently respond to emergency calls for service within 180 seconds. In addition, the p chart for code two samples shows that 11 points fall above or below the control limits indicating that they are statistically out of control over time. There is a significant variation among the defective calls over time. It demonstrates that the police do not provide the consistent response service toward citizen calls that was intended in the DPR system. If this continues to be the case over time, citizen levels of satisfaction in police service will likely decline.
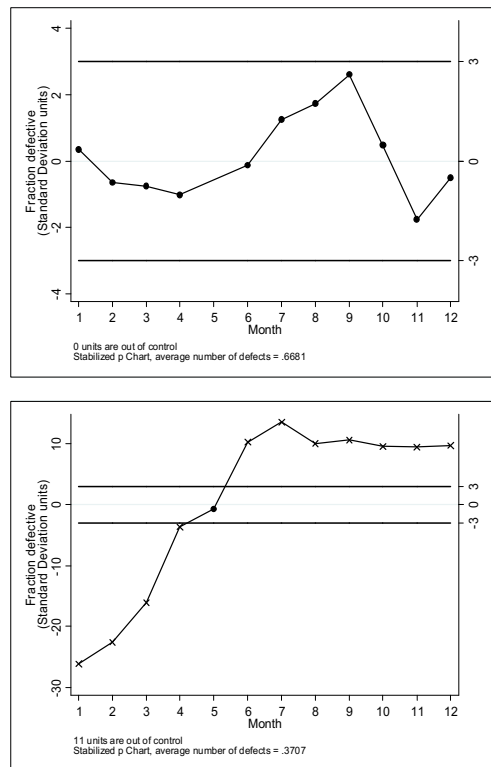

Fig. 3. P control charts for Code 1 & 2 cases

6. Conclusion

This study set out to provide the first systematic, empirical examination of the differential police response strategy. The main goal of the current study was to evaluate the quality of the differential police response strategy by using two types of statistical process control analyses: the Xbar-R control chart for variables data and P control chart for attributes data. The Xbar-R control charts revealed that the police do not consistently respond to an emergency call for service (i.e., code one case) within 3 minutes. The P control chart supported this result, and further identified that there is a significant variation in the portion/number of defective calls where police fail to respond to non-emergency calls for service within 5 minutes. The results from this study suggest the police may need to review the target response time for the code one calls. The setting of unrealistic goals can lead not only to the failure of the new police strategy, but also to the dissatisfaction of citizens. These findings provide empirical evidence allowing for a better assessment and understanding of differential police response strategies. This study also demonstrates, the statistical process control methods, usually used for the quality management in industrial manufacturing, may be applied to social science research.

Several limitations need to be acknowledged. First, the case study research design makes these findings less generalizable to other Korean national police agencies. The data for this study was obtained from the 112 Integrated Dispatch Center at Iksan Police Station throughout the year 2012. It is recommended that future research use a nationally representative and longitudinal sample to increase the reliability and validity. Second, this study did not include some data due to a lack of information; for example, the code one samples of January, April, and May was excluded for analysis of Xbar-R chart. The data also highlights the importance of a dispatcher's ability because there was a much smaller number of code one cases during these months (e.g., 4 cases in January, 18 cases in April, and zero case in May) than other months (e.g., 165 cases in September, 134 cases in August, and 123 cases in November.)

This study will serve as a basis for future research. The issues raised by this study question the ideal target response time for code one and code two calls. The results provide the evidence to solve a possible problem with the system and avoid potential citizen dissatisfaction in police response. Additional research using similar statistical methodology is needed to improve the quality of the differential police response strategy by focusing on cases that are not meeting the goals set by police. Further research will allow the Korean National Police to establish response goals with a greater degree of accuracy.

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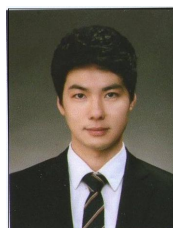
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