Using Intelligence Led Policing to Fight Bank Robberies in Rio Grande do Norte, Brazil

Usando Policiamento Liderado por Inteligência para Combater Assaltos a Bancos no Rio Grande do Norte, Brasil

Uso de Servicios Policiales Dirigidos por Inteligencia para Luchar Contra los Robos a Bancos en Rio Grande do Norte, Brasil

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ABSTRACT

Bank Robberies is one of the greatest challenges faced by police in Brazil, especially its most violent type, known as "Novo Cangaço". This type of crime occurs when a gang of many criminals heavily armed attacks a small town, using violence and intimidation as weapons to assault all banks that there are in that town. This problem is even bigger in Northeast Region of Brazil. During this paper we are going to show how Intelligence Led Policing, one of the most modern police management techniques was employed by federal and state polices to reduce bank robberies in Rio Grande do Norte, one of the states located in Northeast Region in Brazil. We are also going to present how we could use a Machine Learning technique to help police decisions makers to select the best options to maximize impact.

Keywords: intelligence led policing; bank robberies; police management; machine learning.

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RESUMO

Os Roubos a Bancos são um dos maiores desafios enfrentados pela polícia no Brasil, principalmente seu tipo mais violento, conhecido como "Novo Cangaço". Esse tipo de crime ocorre quando uma quadrilha de muitos criminosos fortemente armados ataca uma pequena cidade, usando violência e intimidação como armas para assaltar todos os bancos que existem naquele local. Esse problema é ainda maior na Região Nordeste do Brasil. Durante este trabalho vamos mostrar como o *Intelligence Led Policing*, uma das mais modernas técnicas de gestão policial foi empregada pelas polícias federal e estadual para reduzir os assaltos a bancos no Rio Grande do Norte, um dos estados localizados na Região Nordeste do Brasil. Também apresentaremos como podemos usar uma técnica de *Machine Learning* para ajudar os tomadores de decisão da polícia a selecionar as melhores opções para maximizar o impacto.

Palavras-chave: policiamento liderado por inteligência; assaltos a bancos; gestão policial; aprendizado de máquina.

RESUMEN

Los atracos a bancos son uno de los mayores desafíos que enfrenta la policía en Brasil, especialmente su tipo más violento, conocido como "Novo Cangaço". Este tipo de delito se da cuando una banda de muchos delincuentes fuertemente armados asalta un pequeño pueblo, usando la violencia y la intimidación como armas para asaltar todos los bancos que hay en ese pueblo. Este problema es aún mayor en la Región Nordeste de Brasil. Durante este artículo vamos a mostrar cómo el *Intelligence Led Policing*, una de las más modernas técnicas de gestión policial, fue empleado por las policías federales y estatales para reducir los robos a bancos en Rio Grande do Norte, uno de los estados ubicados en la Región Nordeste de Brasil. También vamos a presentar cómo podríamos usar una técnica de aprendizaje automático para ayudar a los encargados de tomar decisiones policiales a seleccionar las mejores opciones para maximizar el impacto.

Palabras clave: vigilancia dirigida por inteligencia; atracos a bancos; gestión policial; aprendizaje automático.

1. Introduction

In this paper we are going to present results from a project that takes place in Rio Grande do Norte, a state in Northeast of Brazil, during the year of 2017, when Brazilian Federal Police and Rio Grande do Norte's Civil Police worked together in a Task Force to fight Bank

Robberies, a huge problem in that state.

So, we are going to demonstrate how Intelligence-Led Policing (ILP) methods were employed during the planning and execution of this Task Force. We will also evaluate the results achieved employing the Maryland Scale of Scientific Methods (SHERMAN, *et al*. 1998).

Using this evaluation methodology, we will be able to determine if ILP is promising as a policing framework to fight bank robberies in Brazil.

We will also demonstrate how we can use a Predictive Policing technique, K-Means Clustering, to support decision makers in how to use their police officers in a more effective way, also evaluating the results we can achieve this technology.

2. Problem Statement

Bank robberies are a huge problem in most of states in Northeast Brazil.

According to a report from Brazilian Northeast Bank (BARROSO, 2019), in 2015, only 16% of bank branches in Brazil are in the mentioned region (3.300 in Northeast and 20.100 in Brazil), as we can see in table 1.

Table 1 Number of Bank Branches. Source: Barroso, 2019

Canais Tradicionais	Nº Agências	
(em 1.000 unds.)	Brasil	Nordeste
2011	17,8	2,8
2012	18,7	3,0
2013	19,5	3,2
2014	19,9	3,2
2015	20,1	3,3

However, according to Brazilian Ministry of Justice and Public

Safety[1] (MJSP), during the year of 2015, 42% of all 1,3311 bank robberies in Brazil occur in the Northeast Region (566 crimes), clearly not proportional to the number of branches.

During the year of 2015, this kind of crime was a huge problem in Rio Grande do Norte, especially when we compare the number of occurrences in Paraíba, a nearby state, with very similar conditions to Rio Grande do Norte. While in Rio Grande do Norte, we had 55 bank robberies, in Paraíba in the same period we had only 35 of this crime.

But beside the violence of this kind of crime, what makes bank robberies even more problematic to population, it is its consequences on the number of bank branches, especially in small towns. According to data from Federal Police, one of the biggest banks in Brazil, Banco do Brasil, just in 2017, closed 8 of its 78 branches in Rio Grande do Norte. When we consider Banco Postal a type of Banco do Brasil branch that operates in the premises of Post Office, this impact is even bigger, because from August to October in 2017, Banco Postal closed 88 of its 181 branches in Rio Grande do Norte.

This impacts population of these towns where branches have been closed because people doesn't have any more a bank branch where they can get cash and make some financial operations that can't be done without physical presence.

This change has several impacts in economic life in small towns, because with less money in circulation, small shops may face great difficulties to survive.

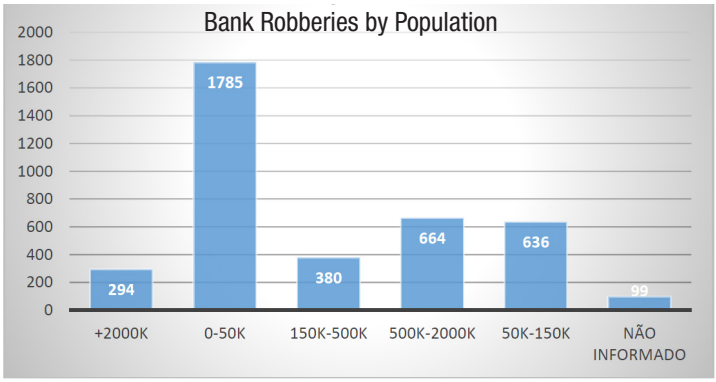
So, as we have established in this topic, bank robberies are a huge problem in Northeast Brazil, and particularly in Rio Grande do Norte, not only because of the violence associated to these crimes but also due to it is impact in economic life in small towns.

Bank robberies investigations are also a challenge to Brazilian Policies, because they occur mostly in small towns. As example, we will use Ceará, Rio Grande do Norte, Paraíba e Pernambuco where 46%

1 https://www.justica.gov.br/sua-seguranca/seguranca-publica/sinesp-1/bi/dados-seguranca-publicac

of bank robberies in 2014 and 2015 take place in towns with less than 50,000 inhabitants, according to Federal Police data. We can see this data in the figure 1.

Figure 1 Bank Robberies by total of inhabitants. Source: Federal Police



In this kind of town, we usually don't have police stations (SILVA, 2019) with the resources needed to investigate this kind of complex crime which is committed by dangerous criminal organizations.

So, police decision makers have a though defy: how to fight criminal organization specialized in bank robberies when they attack mostly small towns with little policing?

They must search for answers in HIPE Policing models (RATCLIFFE, 2015). These models are:

a) Harm focused.

b) Intelligence Led.

c) Problem Oriented.

d) Evidence based.

These are police models that must be included in any police commander toolbox because they have an evidential basis that stands for its efficiency. So, we are going to demonstrate how Rio Grande do Norte's Civil Police and Federal Police's Office in this state used an Intelligence Led Policing model to face bank robberies during the year of 2017 and how they obtained great results in their actions.

3. Objectives

Our principal objective in this paper is to evaluate the results obtained by Rio Grande do Norte Investigative Police Task Force in fighting bank Robberies, in 2017, employing Intelligence Led Policing (ILP) as management model.

As partial goals we are going to, first, explain theoretical concepts which are important to understand criminal analysis and ILP. Also, we will demonstrate how Rio Grande do Norte Task Force was constituted.

Then we will demonstrate how ILP was employed by Rio Grande do Norte Task Force, using 3i cycle steps to understand the methodology.

Finally, we are going to evaluate the results obtained, comparing criminal statistics from Rio Grande do Norte to Paraiba using this state as control group.

4. Theoretical Concepts

Before we explore details about Rio Grande do Norte's Investigative Police Task Force, it is important to stablish some theoretical concepts which orientate decision makers while planning its employment.

We are going to show a few basics concepts on Environmental Criminology, Criminal Patterns Theory and Intelligence Led Policing (ILP).

4.1 Environmental Criminology and Routine Activities Theory

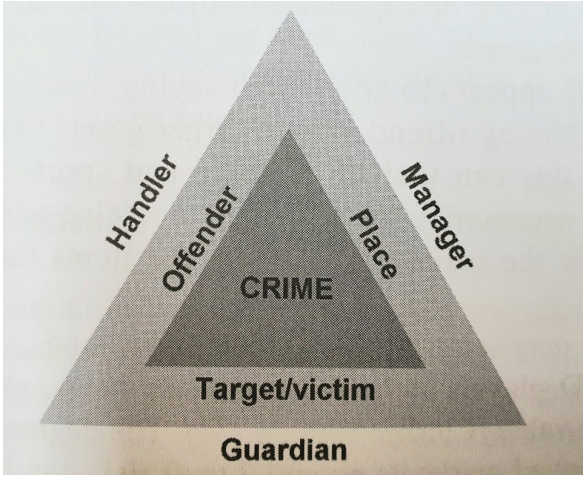
Crime and security strategies always have inherent spatial components. A crime always occurs somewhere, and the perpetrator will have always moved from somewhere to the place where the crime

was committed. Thus, it appears that this spatial component is vital in understanding a specific criminal event (CHAINEY; RATTCLIFFE, 2005).

According to Environmental Criminology, the aspects under crime should be studied are (DANTAS, PERSIJN; SILVA JUNIOR, 2006): a) space; b) time; c) law; d) author (criminal) and; e) victim (that can be a person or an object).

Knowing that, Cohen and Felson (1979) developed Routine Activity theory, which states that a crime occurs when we have in same place and time, a likely offender, a suitable target or victim. These three components, offender, target/victim and place together without a capable guardian provides the chemistry for crime (FELSON, 1998). We can represent these conditions using the Crime Triangle (figure 3).

Figure 2 Crime Triangle. Source (CHAINEY; RATTCLIFFE, 2005)



In figure 2, we can see also some enhancements in crime triangle. When we think about offenders, they are more likely to commit crimes without a proper handler, a third party who can influence his behavior, as parents, teacher.

Guardians, as told before, protect victims, as police officers, while managers are able to control a place. Using crime triangle, it is possible "to focus analysis and problem-solving towards the cause of crime, from a routine activity perspective" and mechanism we can use to prevent crime (CHAINEY; RATTCLIFFE, 2005, p. 89)

So, to understand why, where and when crime occurs is extremely important to understand the place, the geographical space, which is a hybrid between system of actions and system of objects, as appointed by Milton Santos (2006). Crime as a human action can be explained by the study of the geographic configuration of territory (fixes) and others actin (flows).

4.2 Criminal Pattern Theory

We all have many routine activities, including criminals. We go to school, work, to shop and we spend a lot of time in home. These routine activities create within us a "cognitive map" (BRANTIGHAM; BRANTINGHAM, 1984) of places and routes, a list of well-known areas, composed not only by physical things, like buildings but also social and economic infrastructure. So, these "cognitive map" is our awareness space (CHAINEY; RATTCLIFFE, 2005).

Offenders also have awareness spaces. They commit search for criminal opportunities in these areas. Then, for each offender we can generate a model of awareness space and criminal opportunity space (*ibidem*).

So, as crime occurs in patterns, we can model them using interactions of criminals and their physical e social environment (BRANTIGHAM; BRANTINGHAM, 1984).

We can state the same using Milton Santos' Space Theory. According this Brazilian Geographer, Geography has as its study object the geographic space, defined, according to Milton Santos, as an inseparable hybrid of the systems of objects and systems of actions

To understand the reason behind any human action, legal or illegal, criminal or not, one must study the spatial aspect, because actions and its interaction with other existing actions and objects are incorporated into the concept of space. As noted by Milton Santos, where determines how to be, because being means presence (*ibidem*), a presence that can be understood as similar to Heidegger's concept of "ser-ai"[2]. According this concept, one only can be when it materializes

2 As in the original in Portuguese. In English "Being-there"

himself, and it always must take place in somewhere. We put ourselves in the world through our actions (DANTAS, 2014)

Therefore, we can only explain the world we live if we consider the geographical space as being formed, in an inseparable way, by human actions and by the natural and technical objects that form the territorial configuration.

Also, it is important to note the similarity between the concept of crime event in Environmental Criminology and event, as understood by Milton Santos (2006). According to this author, an event is an instant in time and a point in space (*ibidem*), where place is its final repository. Thus, the criminal fact studied - bank robbery in Rio Grande do Norte - can be interpreted as an event, as space and time gathered in just one category (SANTOS, 1999), representing the realization of the countless possibilities (SILVEIRA, 2006), as already mentioned above.

Therefore, a bank robbery, a criminal action done by a gang represents the empiricization of one of the countless possibilities. So, Crime Triangle can be understood using Milton Santos' Space Theory framework, as a representation of the concept of geographic space, since its sides are nothing more than systems of objects and actions which affect one specific criminal occurrence.

4.3 Intelligence Led Policing (ILP)

Intelligence Led Policing is a model conceived from data and observations developed by the police of the English county of Kent, where it was identified that a considerable number of infractions were committed by a relatively small number of individuals. Thus, police work would be more efficient if it focused on serious, repeat offenders (SILVA JUNIOR, 2014).

Based on the assumption mentioned above, a policing model was developed, characterized by the intense use of available information to recognize who are the key criminals or groups responsible for a significant part of criminal activity in each area. After carrying out this initial task, police forces should focus their efforts on these groups, in

order to maximize results (RATCLIFFE, 2011)

However, it turns out that there is a central problem in Intelligence Led Policing: how to identify key criminals? The answer lies in police intelligence activities, mainly based in the analysis of all information available from criminal investigations not only closed but also in progress.

Using these data, it is possible to identify who are those individuals or organizations that contribute most significantly to increase criminal rates. These procedures are also effective when in a certain type of crime, such as the one studied here, bank robbery. This type of crime requires high specialization and, as a rule, it is only practiced by criminals already experienced, due to the violence and the risk involved in this type of action (SILVA, 2019).

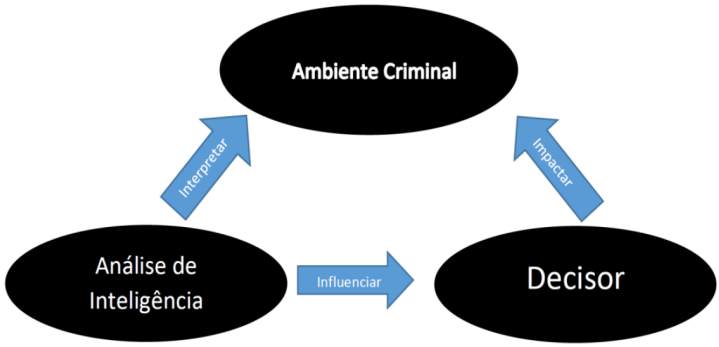
So, Intelligence-Led policing presents itself as an adequate management model for tackling bank robberies, especially only criminal organizations are specialized in this type of crime is committed, what makes it a very complex one to investigate.

How, then, police decision makers should establish their priorities when adopting this model? These are the principal points they should take care: focus on the most relevant criminals; monitoring crime hotspots; identifying and investigating jointly related offenses; decision-making based on data provided by police intelligence; prioritizing repressive actions targeting the most repeat offenders, as well as against the most serious crimes (RATCLIFFE, 2011).

Another characteristic that can be pointed out about ILP is the great centralization of means, in an organizational approach top-to-bottom. In such manner, we can have the greatest impact possible with using minimum means (*ibidem*).

To achieve these impacts, Ratcliffe (2003) points out that police decision makers should use the 3-I Cycle, described in figure 2. Cycle 3-i shows the results and the expected functioning of ILP, in a conceptual way, as can be seen below.

Figure 2 3-I Cycle Source: RATCLIFFE 2011



Thus, according to this model, police intelligence interprets the criminal environment using the techniques of criminal analysis and intelligence in order to identify key individuals or criminal organizations. Using this knowledge, the police intelligence agency should support police managers in the decision-making process. So, based in this information, police decision makers employ theirs means, concentrating them on high level criminals, who were identified by the Intelligence.

Then, it is expected, according to the model now presented, that this decision directly impacts the criminal environment, reducing criminal statistics, the goal of this police action.

In an organization managed based on this model, it is essential to identify the presence of the three "i" s mentioned in the model: a correct environmental interpretation, decisions influenced by the activity of Intelligence and criminal analysis and that really impacts the criminal environment, through the reduction of criminal statistics (RATCLIFFE, 2003).

As described above, bank robberies were a great problem to police forces in Rio Grande do Norte, because even when compared with another state, with similar characteristics, in the same region, which already has problems in protecting bank branches, the number of this type of crime was huge.

Then, police decision maker, in state level, decide to employ Intelligence Led Policing (ILP) to face this problem. As mentioned

above, ILP has as principal characteristics (RATCLIFFE, 2011):

a) Focus on the most relevant criminals.

b) Monitoring crime hotspots

c) Identifying and investigating jointly related offenses.

d) Decision-making based on data provided by police intelligence service.

e) Prioritizing repressive actions targeting the most repeat offenders, as well as against the most serious crimes.

First, according this methodology, police intelligence analists should, as in 3-i Cycle, understand criminal environment to identify criminal organizations which are specialized in bank robberies in Rio Grande do Norte.

After presenting some theorical concepts, we are going to demonstrate, in next topics, how this policing model was applied by Federal and Civil Police in Rio Grande do Norte to face bank robberies and, we will evaluate this action.

5. Investigative Police Task Force in Rio Grande do Norte

Rio Grande do Norte's Investigative Police Task Force was composed by three police units, which two from Federal Police (Rio Grande do Norte's Federal Police Unit for Repression of Crimes Against Property - DELEPAT/SR/PF/RN) and Federal Police Unit in Mossoró - DPF/MOS/SR/PF/RN) and one from Rio Grande do Norte's Civil Police (Police Unit for Investigation against Organized Crime – DEICOR/PC/RN).

It was created by as Agreement (*Acordo de Cooperação Técnica 01/2017-SR/PF/RN*) signed by Federal Police Superintendence in Rio Grande do Norte (SR/PF/RN) and Rio Grande do Norte's Public Safety Secretary (SESED-RN) and stablished the headlines to its operation. These lines were:

a) Cooperation in all investigation on bank robberies.

b) Possibility of special Logistical Support in investigations on bank robberies.

c) Sharing all and any information related to bank robberies investigations.

To guarantee respect to these headlines, decision makers in highest levels (Federal Police Superintendent and Public Safety Secretary) decided to set a weekly meeting with heads of units involved in the task force, when they could present results, discuss any difficulty and share information.

It had an executive group composed by the chiefs of each unit and a strategic committee, composed by the Federal Police Superintendent, Chief of Civil Police and Public Safety Secretary, who was responsible to evaluate the results.

This agreement was signed to make possible employment of ILP as a policing model to fight criminal organizations specialized in bank robberies in Rio Grande do Norte.

Intelligence Led Policing, as already said, is a policing management model focused in the most relevant criminals or criminal organizations and characterized by, among other things, identifying and investigating correlated crimes together and by decisions based in police intelligence analysis.

This kind of analysis supports decision makers and are based in an understanding the criminal environment, to identify which are most dangerous criminals or criminal organizations, their *modus operandi*, their awareness space and which crimes are connected, so police can investigate them together.

To achieve this goal, intelligence analysts must interpret criminal environment, including the area where crimes occur, because as demonstrate, spatial conditions are very important factor in criminal's decision process.

In our study case, immediately after Task Force had initiated its

operations, criminal analyst studied Rio Grande do Norte's geography to understand spatial characteristics which impacted in bank robberies. This is a fundamental step in crime intelligence analysis which allows criminal analysts to interpret criminal environment and to influence decision makers job, so their decision can reflect in action that impact criminal environment, reducing bank robberies statistics.

6. Cycle in Investigative Police Task Force

We are going to present how 3i cycle was employed in Rio Grande do Norte's Investigative Police Task Force. First, it will be shown how criminal analysts have done their analysis to interpret criminal environment, then how they influence decision makers and finally how these stake holders' decisions impact criminal environment.

To evaluate this impact, we are going to use criminal statistics and compare results with another state in same region, with similar population and area, Paraiba, where ILP was not employed.

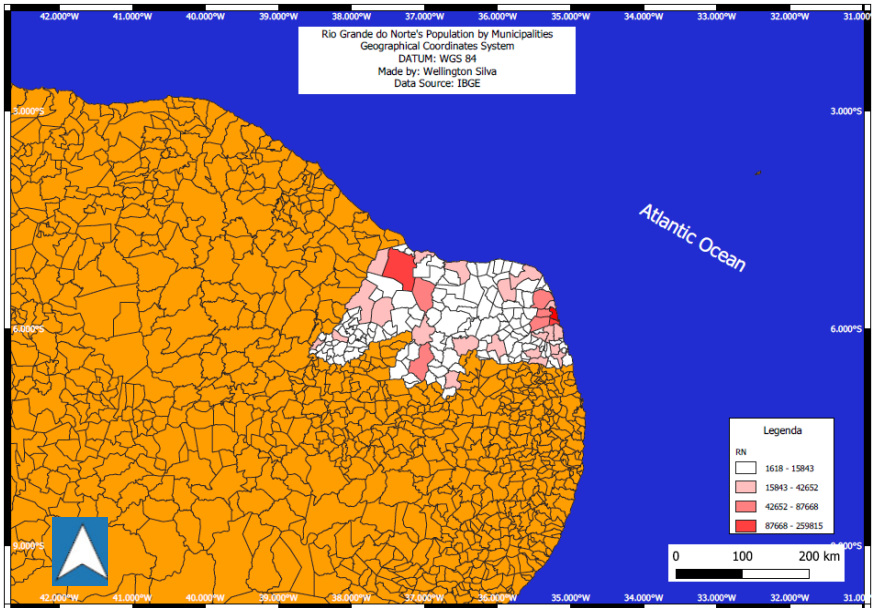
6.1 Interpreting Criminal Environment by Intelligence Analysis

Rio Grande do Norte is a Brazilian state located in northeast coast with 167 municipalities and 58,811 km^2 with a population of 3,479 million, according to IBGE, as shown in figure 3.

As appointed by Silva (2019), bank robberies are influenced specially by spatial factors, specially population (which impacts directly in the number of police officers available in each town), roads and communications networks.

We can see in figure 4, how is population distributed in this state.

Figure 4 - Rio Grande do Norte's Population Data Source: IBGE



As we can see we have two major towns, the capital, Natal, in the shore, and Mossoró, in western region, a few medium size towns, especially in Southern Center area and many small villages, with very few inhabitants.

Communications network are fundamental in such crimes, as said before, because criminal organizations need information to flown through its members. As they only get together to commit the crimes, they must use specially cell phones network, as we could observe analyzing Criminal Investigation (Inquérito Policial 208/2016-4-DPF/MOS/SR/PF/RB) (BRASIL, 2016).

Cell Phones Network are widespread in Rio Grande do Norte, as we can see in figures 5 e 6, below.

Figure 5 3G Network in RN Source: ANATEL & IBGE

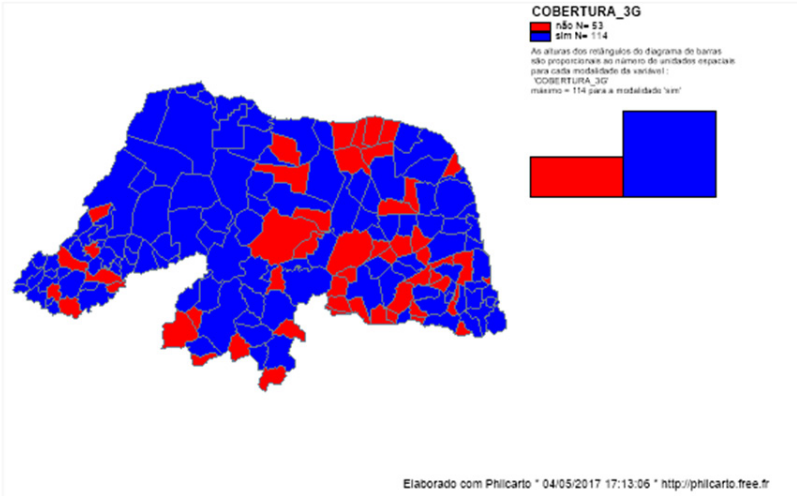
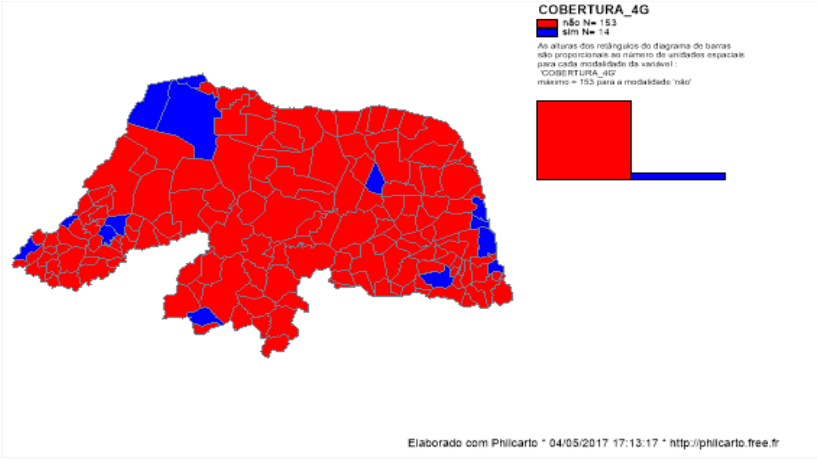


Figure 6 4G Network in RN Source: ANATEL & IBGE



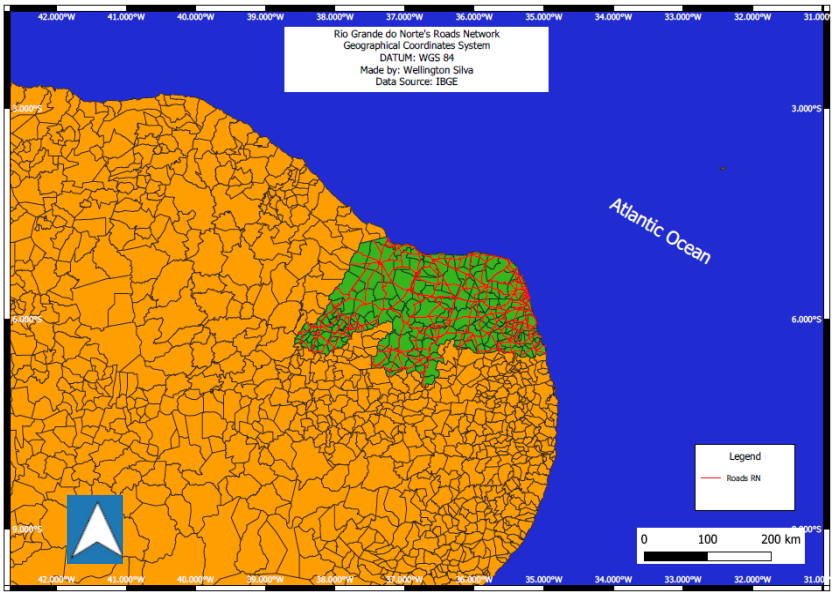
So, criminals can use their cell phones all over the state easily to plan robberies until they must get together to action.

Another very important network in bank robberies is roads network. In Rio Grande do Norte, we have a good roads network, making possible to go from one place to another fast.

We decide to explore these networks because, as shown by Silva (2019), communications and transport are fundamental to criminal organizations, reflecting in the number of bank robberies in

each region. Place without good cell phones and roads networks have less probability of this kind of crime (*ibidem*).

Figure 6 Roads Network in RN Source: Federal Police & IBGE



From these characteristics, we can say that criminal organizations are able to use roads and cell phones networks to communicate an to move between safe houses, residences and targets, in an easy way. This analysis was confirmed by intelligence reports, that indicates criminal just get together in safe houses a few days before attacks and uses cell phone to plan and to get information on targets.

Knowing this, our Task Force can use some techniques to exploit this usage, as monitoring roads and wiretapping, showing how important is to understand geographical condition which impacts in specific crime.

A second step to understand criminal environment is to analyze data on bank robberies. For that we used a dataset provided by SESED-RN. In figure 7, we can see the first five rows of the data.

https://doi.org.br/10.31412/rbcp.v13i8.929

Figure 7 RN 2016 Bank Robberies dataset Source: SESED-RN

	DATA DA OCORRÊNCIA	HORA DO FATO	NATUREZA	SITUAÇÃO	BANCO/INSTITUIÇÃO	MUNICÍPIO DO FATO	LATITUDE DO FATO	LONGITUDE DO FATO	FORMA DE ENTRADA E AÇÃC
0	2016-01-08	15:00:00	ROUBO	CONSUMADO	BRADESCO	BARAUNA	-5.080325	-37.615702	ARMADOS
1	2016-01-11	NI	FURTO	CONSUMADO	CAIXA ECONOMICA FEDERAL	NATAL	-5.792545	-35.199183	MAÇARICO
2	2016-01-14	NI	ROUBO	CONSUMADO	BANCO DO BRASIL	NATAL	-5.792545	-35.199183	ARMADOS
3	2016-01-27	04:00:00	FURTO	CONSUMADO	BRADESCO	RAFAEL FERNANDES	-6.196453	-38.225062	USO DE EXPLOSIVO
4	2016-01-28	NI	FURTO	CONSUMADO	CAIXA ECONOMICA FEDERAL	PARNAMIRIM	-5.879223	-35.201327	NI
5	2016-01-30	02:40:00	FURTO	CONSUMADO	BRADESCO	TANGARA	-6.201934	-35.802268	USO DE EXPLOSIVO
6	2016-02-04	02:30:00	FURTO	CONSUMADO	BANCO DO BRASIL	UPANEMA	-5.642205	-37.258160	USO DE EXPLOSIVO
7	2016-02-17	03:00:00	FURTO	CONSUMADO	BRADESCO	AREZ	-6.194051	-35.160451	USO DE EXPLOSIVO
8	2016-02-21	NI	FURTO	CONSUMADO	BRADESCO	PARAU	-5.777955	-37.104896	USO DE EXPLOSIVO
9	2016-02-23	02:00:00	FURTO	CONSUMADO	BRADESCO	MONTANHAS	-6.486398	-35.287295	USO DE EXPLOSIVO

Then, criminal analysts have analyzed distribution of crimes in time, as we can see in figures 8 and 9.

Figure 8 Distribution of Bank Robberies by Month Source: SESED-RN

In figure 8, we can see that banks robberies occurred during the whole year in 2016, with peak in April and got stable in high level from July to October, reducing in December.

Figure 9 Distribution of Bank Robberies by day of the Month Source: SESED-RN

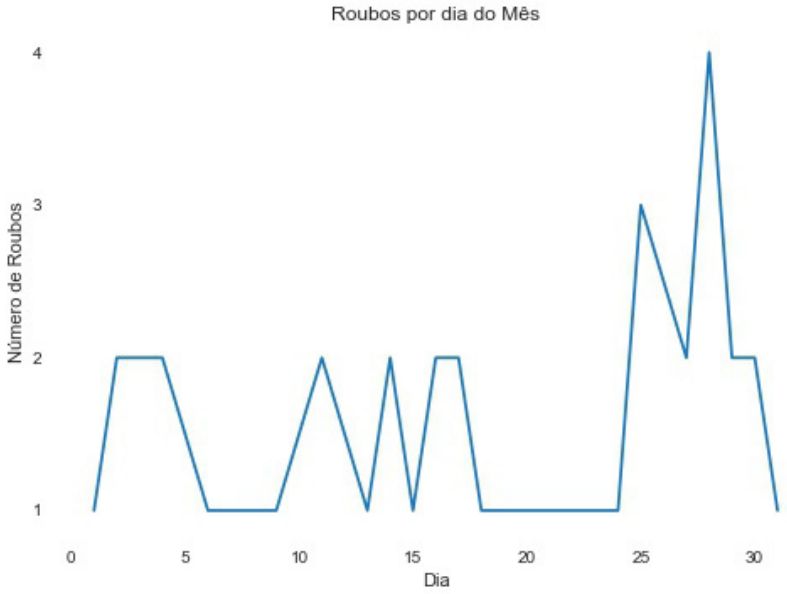


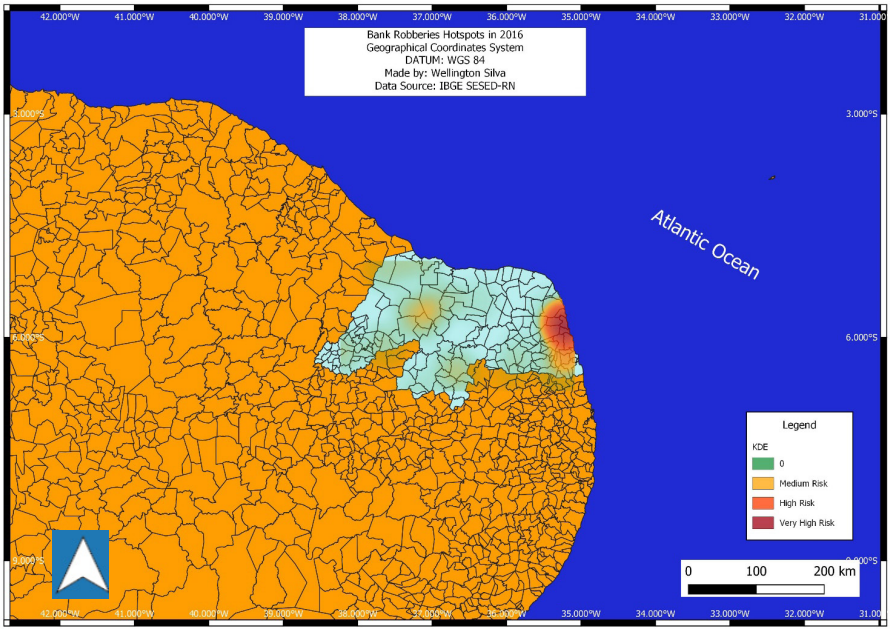
Figure 9 show us that we can notice a concentration of this occurrences in the end of each month.

As already said, geographical space has a huge importance in determining when, where and how a crime occurs. So, it is an essential aspect in every criminal analysis. To this analysis, we have utilized a hot spot technique, using Kernel Density Estimation (KDE) to stablish which areas are more exposed to the risk of a bank robbery.

This is most employed technique in criminal analysis because it can evaluated with a good precision the risk of crime to happen in a place (CHAINEY; RATTCLIFFE, 2005). So, in figure 10, we can see a Hot Spot map of bank robberies in Rio Grande do Norte in 2016. We have used a quadratic kernel function, as it is the most employed (QUEIROZ NETO, 2020), and the ArcGIS default bandwidth, which is calculated using a spatial variant of Sherman's rule of thumb, that is robust to outliers and calculated specifically to the input dataset.

https://doi.org.br/10.31412/rbcp.v13i8.929

Figure 10 Bank Robberies Hotspots Source: SESED-RN IBGE



We can see in figure 10 that it is possible to identify three most important regions to bank robberies in Rio Grande do Norte. One near Natal, in east shore of the state, another near Mossoro, in west, and another in south center.

This conclusion is compatible with intelligence reports which shows that we have three criminal organizations acting in Rio Grande do Norte, one in each of the regions mentioned above, and by Criminal Pattern Theory which states that an offender has an awareness space in which he acts (CHAINEY; RATTCLIFFE, 2005).

As one of the principles of ILP is to investigate jointly related offenses, it was an important step in criminal analysis to identify which crimes were committed by the same criminal organizations. To solve this problem criminal analyst employed an unsupervised machine learning technique named clustering.

"The goal of clustering is to find a natural group of data so that items in same cluster are more similar to each other than those from different clusters" (RASCHA; MIRJALILI, 2017, p.347). So, to solve

this problem, find which occurrences are related, clustering is a viable technique. Clustering was used before with good results (SILVA, 2016). In that case, it was used to identify which cars robberies were committed by the same criminal organization in an area in Rio de Janeiro. To evaluate that model was used the technique proposed by Mena (MENA, 2003), which is to submit results to a expert (criminal analyst or police officer) who would analyze clusters and check their coherence. It was done because of the difficulties in evaluating the model when you are dealing with criminal investigations, which deal with little information and secrecy.

In our study case, we had intelligence information suggesting that there were three criminal organizations acting each one in a region of the state. This conclusion is coherent with theoretical concepts, as awareness space. According to this theory, we expect that a criminal organization acts in a specific region.

So, we could use this characteristic to identify which crimes were committed by each criminal organization. To detect crimes that were connected had another advantage. It made possible to attribute related offense to a specific police unit. So, we could guarantee that linked crimes are investigated together, as ILP states.

In our Task Force, we had three police units as mentioned before, Rio Grande do Norte's Federal Police Unit for Repression of Crimes Against Property - DELEPAT/SR/PF/RN) and Federal Police Unit in Mossoró - DPF/MOS/SR/PF/RN and Civil Police Unit for Investigation against Organized Crime – DEICOR/PC/RN. As we want to distribute bank robberies investigations between these three police units, we have created three clusters, each for one of the police units above.

To evaluate the result of this model, we have used a similar process to the one employed by Silva (2016) and Mena (2003). It is especially adequate because we have good intelligence information indicating that we have three different criminal organizations acting each one in an area, so we could compare our results with intelligence information.

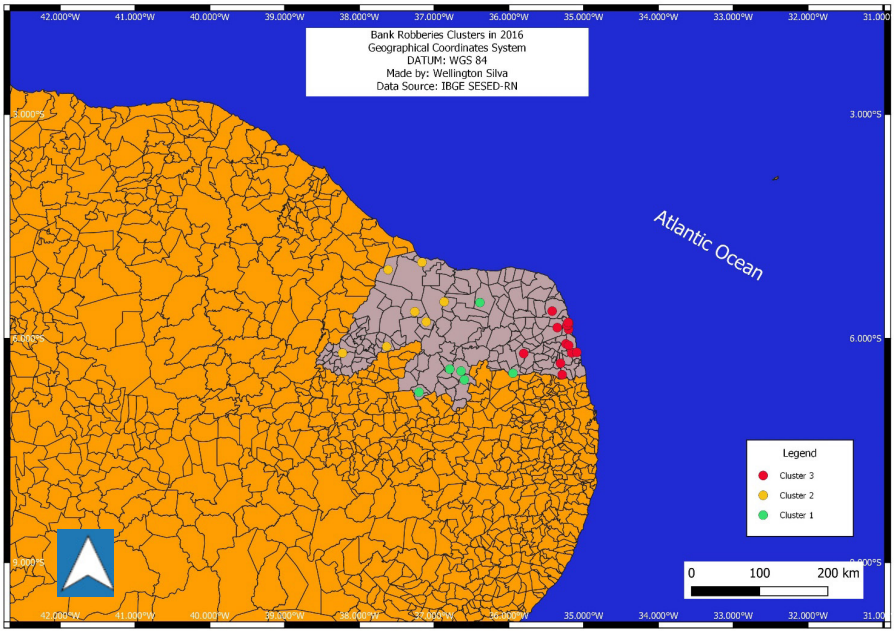
As our goal was to obtain three clusters, we have decided to employ K-means algorithm, with k equal to three. This algorithm is Prototype-based clustering, which means that each cluster is represented by a centroid (in our case, because we have used continuous features) (RASCHA; MIRJALILI, 2017).

During Exploratory Data Analysis, we noticed feature "FORMA DE ENTRADA E AÇÃO DA ABORDAGEM", related to criminals *modus operandi*, is unbalanced, with a unique value representing 64.1% of total. When we use K-mean clustering this kind of feature can cause extreme large clusters, what will make our analysis useless for decision makers. In "NATUREZA", we can also identify the same question, when "FURTO" represents 89.7% of all events. These features also have a high correlation, as indicated when we use *ProfileReport* function form *Pandas Profiling* library. So, we decided to drop these features to avoid useless clusters for our goal.

We also decide to drop the following features "HORA DO FATO", "SITUAÇÃO", "BANCO/INSTITUIÇÃO", "MUNICÍPIO DO FATO" because according to our intelligence analysis these features have a little impact on our goal, identifying which crimes are correlated. We also decide to drop the columns "DATA DA OCORRÊNCIA", because as we identified a huge concentration in last five days of each month, it did not collaborate in tell apart crimes.

We ended up with "LATITUDE DO FATO" and "LONGITUDE DO FATO", which are the geographical coordinates of the crimes. As we had geographical positions of robberies, and we had theoretical concepts, as awareness space, previous publication (SILVA, 2016) and intelligence information indicating that we can use these features to create clusters identifying related crimes, we decide to create clusters with these variables. As we were working with relative positions in space between offenses, we decided to use as distance function in our algorithm Euclidian distance.

Figure 11 Bank Robberies Clusters Data Source: SESED-RN IBGE



We could visualize the result in figure 11. We obtained three clusters, one near Natal, capital in east shore, other in middle of state, and another in west.

To evaluate our model, we used a similar technique as employed by Mena (2003) and Silva (2016), which is to use intelligence information to certify accuracy of our clusters. In this case, our results were exactly as expected, i.e., a perfect match with intelligence information.

The capital findings from this criminal analysis process are criminals can use cell phones and roads network to communicate and to drive all of the state, which gives them a great mobility, presence of three criminal organizations, acting in different areas of the state, as we can see in figure 11.

After these findings, intelligence officers, continuing 3i cycle, would influence decision maker, so their plan could impact criminal environment.

6.2 Influencing Decision Makers

Using intelligence reports, produced by criminal analysts from criminal environment's interpretation, intelligence officer could help decision makers to better plan police actions, so they could get better results.

Intelligence analysis showed three criminal organizations acting in great areas in the state, each one with a specific awareness space. These criminal organizations had a great mobility, as they could use a good roads network. They also could communicate all over the state, what permitted that they only gathered to prepare for action, what made police work more difficult.

These findings pointed that police forces had the need for a qualified approach, a different kind of information that could not be obtained by using ordinary means of investigation. It was seen that it was necessary to carry out investigative police special operations in order to guarantee the necessary use of special means of investigation, such as telephone interceptions, searches and seizures etc.

Now, it is important to concept investigative police special operations. These are, in short, police investigations which conduct would take place as an investigation project, counting on the allocation of different resources (human, technological and financial), in a limited period, being, therefore, recognized as a priority by the Judiciary Police institution itself (SILVA, 2017).

So, according to intelligence analysis, the best action plan was to execute three investigative police special operations, having as target each of the criminal organizations.

To identify correlated crimes, and to investigate them together, strategic committee decided to attribute each cluster of crime to a unique police unit, as suggested by criminal analysis. So, cluster 1 was attributed to Rio Grande do Norte's Federal Police Unit for Repression of Crimes Against Property - DELEPAT/SR/PF/RN), cluster 2 to Federal Police Unit in Mossoró - DPF/MOS/SR/PF/RN and cluster 3 to Civil Police Unit for Investigation against Organized Crime – DEICOR/PC/RN.

Units also had a weekly at Federal Police Office, so they can share information, especially because it was possible that information from one investigation could help other. As we can see, there are one crime in cluster 2 that is near to cluster 1 and another near cluster 3. Awareness space in such a case is not precisely defined because area is too big, so it is important that information flows perfectly.

Therefore, all planning was done, it was time to execute it and to assess how criminal environment was impacted by these actions.

6.3 Impacting Criminal Environment

During these three investigations, Investigative Police Task Force executed seven police operations, to arrest criminal organizations' members and to prevent them to commit crimes. These operations are listed in table 2.

Table 2 IPTF Operations Source Federal Police

DATA DE DEFLAGRAÇÃO	CIDADE	NOME DA OPERAÇÃO	DELEGACIA RESPONSÁVEL
31/3/2017	Jaguaruana/CE	Andarilho	DPF/MOS/SR/PF/RN
6/5/2017	Afonso Bezerra/RN	Lajedo	DELEPAT/SR/PF/RN
28/6/2017	São Gonçalo do Amarante/RN	Lajedo 2	DELEPAT/SR/PF/RN
29/7/2017	São José do Mipibu/RN	Deicor-Polícia Civil	DEICOR/PC/RN
1/9/2017	Macaíba/RN	Deicor-Polícia Civil	DEICOR/PC/RN
3/9/2017	Brejo da Cruz/PB e Campo Grande/RN	Deicor-Polícia Civil, PM/RN e PM/PB	DEICOR/PC/RN
27/9/2017	Mossoró/RN	Andarilho 2	DPF/MOS/SR/PF/RN

As we can see, in a short period of time, only 7 months, 7 Police operations were carried out with the specific objective of breaking the cycle of planning the investigated crimes, through the monitoring and neutralization of criminal organizations, which were involved in bank robberies in Rio Grande do Norte.

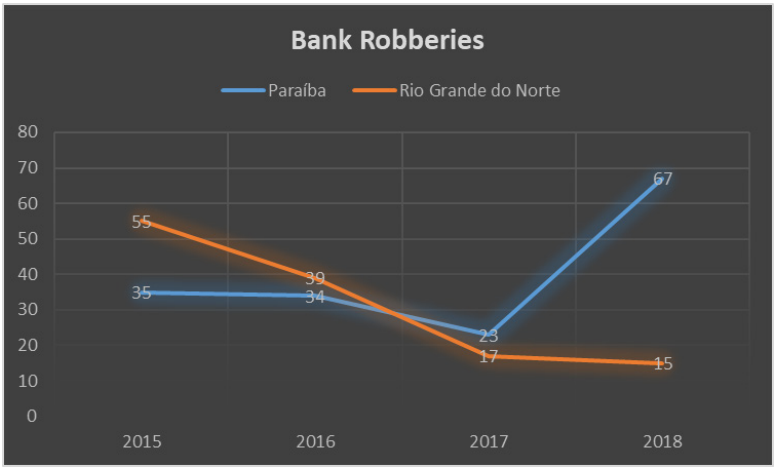
At this moment, it is possible to measure the efficiency and effectiveness of the task force on screen, as its investigations have allowed to identify, monitor and neutralize, in a short time, criminal organizations responsible for bank robberies in the state of Rio Grande do Norte.

To evaluate the results obtained by IPTF, we are going to use

Maryland Scale of Scientific Methods as described by Sherman, *et al.* (1998). To verify if we had good results, we are going to make a level 3 evaluation. This level requires a comparable unit of analysis to serve as control group, and temporal sequence between the program and the crime clearly observed.

As comparable unit of analysis, we are going to use Paraíba, a state also in Northeast Region, bordering Rio Grande do Norte and with a similar area and population[3] to it, and where this program was not implemented in 2017.

Figure 12 Comparison between Bank Robberies in PB and RN Sources:SESEDE/ RN, Federal Police and Sinesp.4



From the analysis of the data above, we can see that there were, in 2017, actions that persistently impacted the criminal statistics of bank robberies in Rio Grande do Norte.

In the years 2015 and 2016, the number of occurrences in Paraíba was lower than those recorded in Rio Grande do Norte. However, in 2017, when the Investigative Police Task Force was employed, the reduction in Rio Grande do Norte was so remarkable that there were fewer bank robberies in that state than in Paraíba.

3 Paraíba: Area: 56,469.778 Km2 Population: 3,996,496 - Rio Grande do Norte: Area: 52,811.126 Km2 Population: 3,479,010. Source: IBGE

4 Sistema Nacional de Informações de Segurança Pública: Brazilian Ministry of Justice System which consolidates crime statistics in Brazil.

In 2017 there was a 60% reduction in the number of these kind of occurrences in Rio Grande do Norte, while in Paraíba this reduction was only 32%, about half of the results obtained in Rio Grande do Norte.

Furthermore, in relation to 2018, when the impacts of the plan implemented in Rio Grande do Norte persisted at a historically low level, in Paraíba we cannot detect this impact.

Instead, in Paraíba, there was an explosion of bank robberies in 2018, as shown in the data studied. There was an increase of 44 occurrences. Meanwhile, the variation in Rio Grande do Norte was minus one occurrence.

Thus, using the statistics from Paraíba as a control point, it can be seen that the results obtained by the plan implemented, both in an absolute and relative way, are encouraging and expressive, in order to prove the effectiveness of Intelligence Led Policing as a model to fight bank robberies.

7. Conclusion

During this report we demonstrate how Intelligence Led Police was employed as methodology during the work of Rio Grande do Norte Investigative Police Task Force.

As bank robberies are great problem in Rio Grande do Norte, the constitution of a Task Force to fight this kind of crime was a reasonable decision, and use of ILP as methodology a good choice, because as this offense is usually committed by a small numbers of criminal organizations, it is suitable the focus in the most relevant criminals, stated by ILP.

And results show that the impact in criminal environmental was huge, with sensible reductions in criminal statistics, especially when we compare with Paraíba, state we used as control group.

As conclusion, we can state that Rio Grande do Norte Investigative Police Task Force and ILP obtained good results, with

significant reduction in Bank Robberies statistics. This result is even better when we analyzed results in Paraíba, which in 2018 presented a huge growing.

Author´s Biography.

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He holds a PhD in Geography from the Federal University of Rio Grande do Norte and a Master's in Science and Geographic Information Systems from the Nova University of Lisbon and in Military Sciences from the School for the Improvement of Army Officers. He held a Post-Doctoral internship in Computer Science at the Federal University of Ceará. He is a Federal Police Chief. He has experience in the areas of Public Management, Data Science and Artificial Intelligence, Formulation of Public Security Policies, Intelligence and Law, with an emphasis on the use of Data Science in the Management of the Judiciary Police. He is a professor responsible for the disciplines of Judicial Police Management and criminal analysis at the Graduate Program in Police Science at the National Police Academy and an external professor at the Graduate Program in Geography at UFRN. He held several management positions during his professional life, including Regional Superintendent of the Federal Police in Roraima and Rio Grande do Norte and Director of the National Secretariat of Public Security. He currently holds the position of Strategic Management Coordinator for the Federal Police.

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