A Geographic Intelligence Model of Criminal Groups: A study of cargo theft on Mexican Highways

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I, José Luis Hernández-Ramírez, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.
Abstract
Organised criminal groups (OCGs) are responsible for a large amount of criminal activity that is experienced in countries across the world. Although many studies have examined the structure of OCGs and the influence they have, very few studies have examined their geographic activity. In particular, geographic activity that can provide intelligence that can be used to counter the criminal activities of these groups. Using the example of cargo theft on highways in Mexico, this research aims to develop a geographic intelligence model (GIM) of criminal group activity.

Between 2015 to 2020, cargo theft on Mexican highways increased by 40% and on average accounted for almost $USD 4 million in losses per day. Most of these crimes were associated with OCGs. To better understand the activities of these criminal groups a hybrid analytical quantitative and qualitative model of geographic intelligence is proposed. The first part of this model involves a spatial analysis of the criminal activity to identify the extent to which this activity is spatially and temporally concentrated. In this case, the spatial and temporal concentration of cargo theft across highway segments in Mexico. The second part of the model involves using crime script analysis to examine the sequencing of the activities associated with the criminal act to identify patterns of offender decision-making, the roles that ‘actors’ (e.g., members of the criminal group, non-members and businesses) perform, and the associations between those involved in the criminal activities. The information gathered through this second process is used for presenting a crime commission process (CCP) of the criminal activity, from its planning to its execution. The information gathered in the CPP is then examined to extract geographic locations of interest that relate to the activities of the actors involved. The third
part involves the creation of a geographic profile that considers the environmental characteristics of where offences take place and the geographic activities of the actors involved in the CCP to determine locations where a criminal group locates their strategic places of action.

In this manner, the GIM is an intelligence product for better understanding the criminal activities of criminal groups, with specific attention to where their activities are located. With this better understanding of criminal groups, interventions to counter their activities can be better targeted and tailored.
Impact statement

This thesis offers a profound contribution to both academic understanding and practical application in the field of Crime Science. This research introduces the "Geographic Intelligence Model (GIM)", a pioneering approach that significantly advances our comprehension of organised criminal groups (OCGs). This innovative model melds qualitative and quantitative methods to produce intelligence products, equipping law enforcement with enhanced analytical capabilities in countering such groups. The GIM comprises three distinct yet interconnected studies:

- Temporal and Spatial Analysis: This facet identifies specific locations and timeframes with the highest concentrations of criminal activity. By studying these patterns, it elucidates the geographic hubs of OCG operations.

- Crime Script Analysis: The GIM unravels the entire crime commission process, meticulously detailing the roles of various 'actors' and co-offenders within the group and their interactions. This analysis offers a comprehensive understanding of how criminal activities unfold, providing invaluable insights for law enforcement.

- Geographic Profiling with the CAL Method: This aspect extends geographic profiling to OCGs, uncovering the likely operational bases of these criminal groups. By considering the environmental characteristics of crime locations and the geographic movements of the individuals involved, the GIM discerns crucial strategic anchor points for the criminal groups.
The GIM is a methodological and theoretical framework that empowers law enforcement with a nuanced perspective on organised crime. It caters to both the macro and micro aspects of criminal activities, contributing a complete understanding of OCG operations.

Through a comprehensive analysis of cargo theft on Mexican highways, this research has practically demonstrated the GIM’s effectiveness. By scrutinising the geographic distribution of cargo theft, this study discerns the pivotal anchor locations essential for OCGs engaged in this criminal activity.

The GIM on criminal groups offers a profound influence of geographic conditions on OCG activities. This novel approach precisely maps out cargo theft patterns in Mexico. It considers offender decision-making processes, the situational environment, social and economic factors, access to co-offenders, and proximity to storage facilities and markets.

By integrating these multifaceted elements, law enforcement agencies can improve their crime prevention, detection, and intervention strategies. The detailed insights into the roles and relationships of co-offenders empower practitioners with the knowledge needed to disrupt criminal networks effectively. It allows for the development of tailored security measures and enhances operational effectiveness. Ultimately, the GIM can help to develop intelligence-led countermeasures against organised criminal activities, enhancing safety and security for society at large.

This thesis aims to serve as a bridge between academia and practical law enforcement capabilities. It has the potential to transform how we understand the impact of the geographic conditions on organised criminal groups, making our communities safer and more secure.
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What were you doing in 2016? In my case, that was the first time that I dreamed of a PhD. That year, I attended a conference in Louisville (I know, what a random place to begin this journey!). There, I met Professor Jerry Ratcliffe and other marvellous crime scientist for the first time, and since then, I have been engaged with the possibility of becoming a crime scientist. After a couple of years, I became one of them.

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Chapter 1

A Geographic Intelligence Model of Criminal Groups

1.1. Introduction

Criminal groups have evolved to become professional organisations that identify specific opportunities of where and when to act (Bouchard & Morselli, 2014; Coughlin, 2012; Mainas, 2012; Warr, 1996). This professionalisation is exemplified by their improved capacity to adapt their actions (Ekblom, 1999, 2001; Lacoste & Tremblay, 2003; Morselli & Roy, 2008) and the increasing flexibility in their group composition (Andresen & Felson, 2012; Cornish & Clarke, 2001; Malm & Bichler, 2011). Concurrently, criminal groups have identified opportunities to commit crimes in more sophisticated ways (Beauregard et al., 2007; Wood et al., 1996) while also reducing their risk of being captured and prosecuted (Malm et al., 2011; Malm & Bichler, 2011; McGloin, 2005; Natarajan, 2000), and evading attempts to disrupt and dismantle their group structures (Morselli, 2009a; Natarajan & Hough, 2000; Waring & Weisburd, 2000). Therefore, law enforcement agencies could be said to be losing the battle against organised crime.

The actions and strategies of law enforcement agencies to reduce the impact of organised criminal groups’ activities have prompted these groups to become more professional. These groups have evolved from small groups of offenders to larger, more institutionalised entities with standardised procedures and regional networks (Morselli, 2009b; Pearson & Hobbs, 2001; van Koppen et al., 2010). This professionalisation has led to members of these groups taking on specific roles and functions, sometimes forming
sub-networks within the larger organisation (Kleemans & Van de Bunt, 2008; Natarajan, 2006; Sierra-Arévalo & Papachristos, 2017; Varese, 2006).

Furthermore, these criminal groups have expanded their illegal activities to include more complex crimes for more financial revenue (Felson, 2006b; Palmer & Richardson, 2009; Zoutendijk, 2010). They have expanded their illegal activities to other markets where they can trade on different types of goods. To facilitate this, criminal groups have established business relationships with other criminal organisations (Bruinsma & Bernasco, 2004; Hancock & Laycock, 2013; Naylor, 2003) and individuals operating in both illegal and legal markets (Margaret, 2017; Papachristos, 2014; Williams, 2001).

Hitherto, substantial research attention has been focused on the organisation (and structure) of organised crime groups to support disruption activities by law enforcement agencies (Bruns, 2015; Klima, 2011; Sampson et al., 2010). However, a noticeable research gap exists concerning the geographic distribution of activities conducted by criminal group members and the connections between those locations. These activities must occur at specific places and times, implying that a geographic dimension to organised crime groups exists, which in turn shapes their decision-making process to commit crimes (Ekwall & Lantz, 2015a; Telep et al., 2014; Weisburd et al., 2012). Therefore, there is a pressing need to investigate how the geography of criminal groups and their activities are interrelated. This is the focus of this doctoral dissertation.

The current research aims to establish the basis of a theoretical and methodological framework that identifies specific locations essential to the functioning of criminal groups. This includes understanding the processes involved in their activities, characterising relationships within the group, and identifying the geographic distribution of the activities
of a criminal group’s members and their activities with partners and other associates. By doing so, the research aims to determine the relevance of geographic locations associated with the group’s criminal activities and identify if certain geographic anchors are associated with a criminal group’s activities. I refer to this as a “Geographic Intelligence Model on Criminal Groups”.

In this research, I use cargo theft on highways in Mexico to examine and test the theoretical and methodological framework that specific locations are essential to the functioning of criminal groups. Cargo theft on highways is a complex activity that requires the identification of suitable places for the commission of a crime (i.e., the act of cargo theft) and convenient locations to dispose of stolen items. Cargo theft on highways also requires the involvement of more than one person in the crime commission process; it is fundamentally a criminal group activity (Burges, 2013; Coughlin, 2012; Ekwall & Lantz, 2017; 2016). Therefore, there are likely to be multiple activities performed by these individuals that are geographically concentrated, and some of these activities may occur at common locations.

Mexico experiences some of the highest levels of cargo theft on highways in the world (Analytica, 2017; Bleszynska, 2021; BSI et al., 2022; SENSITECH, 2022), and increased by 40% between 2015 and 2020¹. To date, there has been limited research on the geographic patterning of cargo theft worldwide, and no published research has examined the geographic patterning and criminal offending behaviour associated with cargo theft committed on Mexican highways.

Cargo theft occurs under various circumstances, often involving distinct modus operandi tailored to exploit different vulnerabilities in the transportation and logistics process (Burges, 2013; Coughlin, 2012; Ekwall & Lantz, 2016). One common scenario involves thefts during transit, where criminals intercept moving vehicles on highways or remote roads (BSI et al., 2022; SENSITECH, 2022). In these cases, offenders may use tactics such as roadblocks, hijackings, or forced stops to gain access to the cargo. Additionally, thefts frequently occur when vehicles are parked overnight or at rest stops, presenting criminals with opportunities to target unattended trucks and trailers. Another prevalent scenario involves thefts occurring during the loading and unloading of cargo at warehouses, distribution centres, or ports. Criminals may infiltrate these facilities or pose as legitimate workers to gain access to valuable goods (BSI et al., 2022; FBI, 2019; EUROPOL, 2009; SENSITECH, 2022a).

Moreover, the rise of cybercrime has introduced a new dimension to cargo theft, with organised criminal groups orchestrating virtual attacks to obtain sensitive information about shipments, routes, and security protocols (Filho et al., 2021; Pizzi, 2020). These new trends often involve cyber tactics such as hacking into logistics systems, manipulating GPS tracking devices, or impersonating legitimate stakeholders to facilitate physical thefts (Cremer et al., 2022, Masip-Bruin et al., 2021). Then, cargo theft encompasses a range of modus operandi and circumstances which highlights the need for better understanding potential risk factors related to this crime.

To develop the Geographic Intelligence Model on criminal groups (GIM), the current research focuses on identifying and examining the geographic spaces that cargo thieves occupy. First, this involves identifying the places where cargo thefts cluster. Second, the
specific segments of the Mexican highway network where cargo thefts concentrate are identified. This is then used to inform the type of geographic conditions associated with cargo theft. Third, an attempt is made to identify the roles that members of a criminal group perform, the associations these members have with other relevant actors (e.g., individuals engaged in illegal markets) and how these relationships are influenced by geography (e.g., if illegal markets are located close to where cargo thefts occur). Fourth, I present a technique that aims to identify strategic locations that are important to the activities of criminal group, evaluating the offenders’ spatial and criminal hunting behaviours in the identified areas with more cargo theft.

The research combines an examination of the locations where crime events occur with the geographical characteristics of the locations that experience more crimes, the sequence of activities that occur across a criminal activity (i.e., the crime commission process), and an assessment of a criminal group’s spatial behaviours. In turn, it is anticipated that this examination of places, procedures, activities and behaviours exhibited by criminal group members will produce a Geographic Intelligence Model on criminal groups. Figure 1.1 presents an illustrative representation of the proposed model and the analyses that are part of the research framework.
Each component of Figure 1.1 represents an empirical study that is part of the GIM. The first component, “Spatial & Temporal Analysis”, uses methods to identify the specific places and the temporal intervals with a higher concentration of cargo theft. This component includes two geospatial approaches to identify places with more crime concentration at two different geographical levels. The first approach identifies the macro-level spatial distribution of cargo theft by identifying municipalities that form statistically significant spatial clusters of cargo theft. The second approach involves the use of spatial methods to identify micro-places where crime concentrates. That is the specific segments of the Mexican highway network where most cargo thefts occur. Both approaches include descriptive temporal analyses that mirror the unit of analysis (i.e., macro—micro). The first part of this temporal analysis presents the temporal evolution of cargo thefts during the study period and the months when more thefts occur. The second part of the temporal analysis focuses on identifying the hours of the day when cargo thefts concentrate.
The second component of the GIM in Figure 1.1 involves the use of a qualitative method—Crime Script Analysis—to synthesise information about the crime commission process. The objective here is to identify and describe the main elements of the cargo theft commission process, from planning the theft and the robbery itself to the disposal of the stolen merchandise. This second component incorporates a detailed description of the offenders’ roles in the criminal group, the equipment they require to perform activities, and the links that the offenders have with potential co-offenders in legal and illegal markets.

The third component of the GIM is a descriptive Geographic Profiling Analysis. It describes how the offenders select their anchor locations (places that offenders frequent and play a significant role in their criminal activities) based on geographic and sociodemographic conditions familiar to them. This study uses a theoretical framework based on crime pattern theory, rational choice, and journey to crime (among other theoretical approaches), alongside the main findings of the spatial and temporal analyses and the results from the crime script to identify spatial activity nodes.

The results from the three empirical studies form the three components of the Geographic Intelligence Model. In combination, these three components are designed to better identify how geographic context influences offender decision-making in their selection of location to commit a crime, how geographic context influences how offenders plan and perform activities associated with the commission of crime and if certain locations are strategically important to the operation of organised crime activity.
1.2. Research Framework

This section presents the research framework that guides the development of the Geographic Intelligence Model. This research framework provides a structured approach to investigating the relationship between geographical, sociodemographic and economic variables and the offenders’ decision-making process. In this thesis, I propose a mixed-methods approach to collect both quantitative and qualitative data, which is analysed using both spatial and aspatial techniques to achieve the objectives of the proposed GIM. Using this comprehensive research framework, I aim to generate geographic intelligence that provides new insights and a novel perspective to how individuals in a criminal group operate, from which strategies can be developed to counter the criminal activities of organised groups.

I next outline the objective and structure of this thesis, summarising how this research was designed and conducted. This includes the research questions, the hypotheses, and a brief description of the methods and techniques applied. Each respective chapter contains a complete description of each of the methods used.

1.2.1. The aim of the research

The current research aims to introduce a Geographic Intelligence Model to understand how the geographic conditions of specific areas influence the commission of a crime by organised criminal groups. A sequential mixed-methods design was used to achieve the aim of this research; this involved analysing quantitative data first and then expanding the results with in-depth qualitative data. The quantitative approach used data from Mexican institutions to identify the spatial concentration of cargo theft across the country. The
A qualitative approach required gathering open-source information to determine the crime commission process and infer the offenders’ decision-making for committing cargo theft.

The model takes into consideration that the geographic conditions include the situational environment where cargo theft is committed, the social and economic conditions relating to the areas where cargo theft occurs, access to labour (in the form of co-offenders) to support crime commission, and geographic proximity to potential storage places and markets for the sale of stolen items. The primary question the current research aims to answer is:

**Do the geographic conditions where organised criminal groups choose to commit their illegal activities influence offender decision-making?**

To answer the primary research question, a series of additional research questions were developed. For each research question, at least one hypothesis is tested to examine the geographic distribution of criminal activities, identify their concentration, and determine how the geographic conditions of specific areas influence the crime commission process and the offenders’ criminal behaviour.

### 1.2.2. Research questions & hypotheses

Scholars describe cargo theft as a crime that is committed by a group of offenders at specific places that involves the illegal extraction of merchandise from a cargo transport that could be moving or parked⁴ (Burges, 2013; Coughlin, 2012; Ekwall & Lantz, 2015b; Sebyan-Black & Fennelly, 2021). The primary question of this thesis aims to include how

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⁴ Section 2.5 expands the definition and analyses the literature on cargo theft.
geographical conditions influence offender decision-making when committing cargo theft. The first empirical study in the thesis uses the following research question to examine the geographic distribution of cargo theft in Mexico.

**Research question 1: Is cargo theft unevenly distributed across Mexico in space and time?**

**Hypothesis 1:** cargo theft is spatially clustered at the municipal level across Mexico.

Substantial evidence has shown that crime concentrates geographically (Brantingham et al., 2009; Davies & Johnson, 2015; Steenbeek & Weisburd, 2016). Several studies have indicated that cargo theft exhibits this geographic patterning (BSI et al., 2022; Burges, 2013; Coughlin, 2012; EUROPOL, 2009). However, the spatial analyses of cargo theft that have been completed to date have only considered regional or metropolitan concentration (Coughlin, 2012; Guerin et al., 2021; Haelterman, 2009; Justus et al., 2018) rather than clusters and micro-places. To add to the existing research, the first empirical study examines whether cargo theft is unevenly distributed across Mexico. This tests for evidence of spatial clustering of cargo theft using data that are aggregated to the 2,471 municipalities of Mexico.

**Hypothesis 2:** cargo thefts across Mexico are concentrated in a small proportion of highway segments.

Assuming that cargo theft is unevenly distributed across the municipalities of Mexico, the second part of this examination of geographic patterning uses a bespoke highway network to examine if cargo theft is concentrated at the highway segment level. To date, no known study has examined the geographic patterning of cargo theft (or any other type
of crime) at the highway segment level. The motivation for examining cargo theft in this manner is to replicate the micro-place street segment analysis of “The law of crime concentration” introduced by Weisburd (2015). This research aims to identify the extent of crime concentration when using highway segments as the geographic unit of analysis and identify the specific segments of highways that account for a large proportion of cargo thefts.

**Hypothesis 3:** cargo thefts across Mexico are concentrated in specific months and specific hours of the day.

Places where crime concentrates only tend to experience high crime levels at certain times (Nakaya & Yano, 2010; Rengert & Wasilchick, 1985, 1989; van Sleeuwen et al., 2021). However, scant cargo theft studies analyse temporal patterns. Therefore, the analysis presented in this thesis will examine if there are certain months and specific hours of the day when cargo theft is most common.

The third empirical study involves a qualitative approach which describes the cargo theft commission process and analyses the impact of the geographic conditions on this process. Qualitative research can involve a multimethod system and a set of complex and interpretative practices to carry out the research (Denzin & Lincoln, 2017; Grossberg et al., 1992). Several scholars have noted that qualitative research approaches do not tend to test hypotheses per se, but the development of hypotheses is part of the process itself (Barroga & Matanguihan, 2022; Gelo et al., 2008; Lareau, 2012; Malterud, 2001). Creswell (2014, p. 185) suggests “a central question and associated subquestions” when performing this type of study. Thus, I propose three research subquestions to investigate
whether the geographic conditions where offenders plan to commit cargo thefts influences their decision-making process.

1. **What geographic conditions do offenders consider when involved in the commission of cargo theft on highways?**

2. **What specific skills are required to commit cargo theft?**

3. **How does the environmental background of the locations where offenders intend to act influence the design of the cargo theft commission process?**

Several scholars have shown that the geographic and sociodemographic conditions of the places where offenders plan to commit crimes influence their behaviour and choices (Alonso Berbotto & Chainey, 2021; Rossmo, 1995b; Vilacheva & Yashkova, 2019). For example, offenders may consider the characteristics of a place when selecting a specific location to act and determine the equipment required to commit a crime. To better understand the cargo theft commission process, a combination of qualitative techniques was used to gather sufficient quality information about the offenders’ actions to commit cargo theft and model them. I emphasise the influence of the geographical conditions on the identified activities that are part of the cargo theft commission process.

The theoretical framework of this thesis suggests that places where offenders perform their illegal activities are not randomly selected. Geographic, sociodemographic, and economic characteristics of those places can impact the offenders’ decision-making process. This impact is not just in choosing those specific locations to commit crimes but also in the scope of the area where they accomplish their illegal activities, the identification of potential partners that would benefit from the criminal activity and other co-offenders that are part of the crime commission process.
This thesis's fourth and last empirical study uses a mixed-method approach to infer the most probable geographical area of the offender’s strategic locations (Chainey, 2021; Rossmo, 2000; Tonkin et al., 2009). Like the locations where crime is committed, the strategic locations associated with organised crime activity are also unlikely to be selected at random. The selection of these locations likely responds to a spatial pattern that is associated with an offender’s spatial decision-making behaviour. I propose the following research questions to investigate the impact of the geographical and sociodemographic conditions on an offenders likely area of operation, and in turn how this provides insights into the strategic locations from which members of criminal groups operate.

1. **How do geographical conditions influence the offenders’ spatial behaviour and their offending activities in their area of operation?**

2. **Can Geographic Profiling Analysis be used to infer the anchor points of criminal groups?**

Considering geographic and sociodemographic conditions, offenders select specific locations for conducting activities related to cargo theft, such as meeting potential business partners. These conditions can also influence the selection of the areas where offenders anchor their activities, establish their operational bases, and commence their search for suitable targets. To infer likely locations of offenders’ operational bases, I used a mixed-method approach combining geographic and temporal analyses, alongside the theoretical principles relating to the journey to crime, crime pattern theory and geographic profiling. This analysis examines the influence of geographic and sociodemographic conditions on offenders’ spatial behaviours, including their criminal hunting behaviour, spatial mobility, and locations from where offenders are likely to act.
1.3. Thesis structure

So far, I have outlined the three empirical studies that constitute this thesis. This section describes the structure of the eight chapters in this thesis. The empirical chapters present the approaches to answering the research questions. For each study, within its respective chapter, a description of the methods and data used is provided, including an explanation of the methodological approaches used to understand the geographic features of cargo theft on highways. Each empirical study is a component of the Geographic Intelligence Model (GIM) on criminal groups.

The second chapter describes the theoretical framework for the current research in more depth, drawing from relevant crime theories and empirical findings. There, I outline the gaps in the current literature that this thesis aims to, in part, address. Chapter three contains details about the data sources and the process used to prepare these data to be suitable for the analyses conducted in the empirical studies.

The first empirical study in Chapter 4 uses spatial and temporal analyses to provide initial insight into the distribution of cargo theft across Mexico. This involves testing the suitability of available data on cargo thefts and justifies why other forms of cargo theft data were utilised for later analyses. As part of this study, exploratory spatial and temporal analyses are developed to identify municipality-level spatial clusters with a higher incidence of cargo theft. Chapter Four also presents a temporal analysis identifying the months with more thefts.

Chapter Five advances this work by presenting a second spatial study using bespoke network data that was created for the purposes of this research. This analysis identifies
the specific micro-places – highway segments – where more thefts were committed and subjects the highly concentrated patterning of cargo thefts across Mexico to statistical testing. Echoing the smaller unit of analysis used in this chapter, a complementary temporal analysis of the hours of the day with more cargo theft concentration is presented alongside the spatial analysis. Reasons why certain places experience high levels of cargo theft are then examined to identify if certain geographic features about these locations stand out. This includes considering the choice of these locations from the offender’s perspective. Hence, this study contributes to the GIM on criminal groups by identifying the highly concentrated nature of cargo thefts on highways and why offenders may choose these locations over others to commit cargo thefts.

The third empirical study is presented in Chapter Six. This contributes to identifying offender preferences in spatial decision-making behaviour by developing a crime script of cargo theft on Mexican highways. Document analysis is applied to open-source intelligence to structure the data collection and to quality assure the data that is populated into the crime script. The resulting crime script considers the activities involved in the process of committing cargo theft, with a particular focus towards identifying where the activities take place. The crime script also reveals associations between individuals involved in the activities associated with cargo theft and any geographic features about these associations. In doing so, the crime script reveals further insights into a criminal group’s crime commission and provides additional inputs for the geographic intelligence model of criminal groups.

Chapter Seven introduces a geographic profiling approach as the fourth empirical study of the GIM. This is a mixed-method approach because it uses theoretical principles from
environmental criminology alongside quantitative techniques to analyse offender spatial behaviour (Rossmo, 2000, p. 213). The aim is to infer the likely anchor locations of offenders that are members of criminal groups (i.e., strategic locations that are associated with the activities of a criminal group), drawing from the findings of the three previous empirical studies. The insights gained from Chapters 3-6, which identify specific segments and their impact on the crime commission process, are used to create a geographic profile. This profile provides an understanding of the offenders’ spatial behaviour, target selection, attack and hunting types, and the activity nodes associated with their criminal activities.

Chapter Eight summarises the findings and discusses these findings in relation to the theoretical principles introduced in Chapter Two. In this chapter, I also discuss the implications of using the GIM to generate geographic intelligence for informing strategies to disrupt and prevent criminal activities in specific places. Limitations and opportunities for further research are also described in this chapter. At the end of Chapter Eight, a concise overview of the entire thesis, conclusions of the current research and its contribution to the existing knowledge in the field is provided. Supplementary figures are provided in annexes.
Chapter 2

Towards a Theoretical Framework for a Geographic Intelligence Model

2.1. Introduction

Most offenders make decisions to commit crimes based on their motivation to achieve some goal or gain, from their observations of potential victims to target, and some knowledge of the location where they believe an opportunity for crime is present (Braga & Weisburd, 2010; Brantingham & Brantingham, 1981; Clarke & Eck, 2005). The spatial distribution of crime is not random (Bottoms & Wiles, 2002; Chalfin et al., 2021; Curtis-Ham et al., 2020), meaning that criminal activity tends to show patterns of geographic concentration. These patterns of geographic concentration are influenced by the type of crime and the surrounding conditions that facilitate or inhibit these crimes from occurring. This description of criminal behaviour is captured by Brantingham and Brantingham (1981), who state four dimensions are associated with the commission of crime:

- Legal: a law is broken
- Victims: someone or something has been affected
- Offender: someone committed it
- Spatial: occurs at a specific location.

The current research focuses on the last two dimensions: the offender and the spatial. This chapter reviews criminological approaches to analysing those two dimensions. The first part of the chapter reviews the offender dimension; presenting theoretical principles
about how offenders decide to act, the rationality behind this decision-making, the identification of opportunities to maximise their gains, the design of a crime commission process and the recruitment of co-offenders to support their activities to improve their offending abilities.

The second part of the chapter reviews the spatial dimension, considering concepts from environmental criminology (Bottoms & Wiles, 2002; Brantingham & Brantingham, 1981; Brantingham & Brantingham, 1993; Bruinsma & Johnson, 2018; Wortley & Mazerolle, 2008). Collectively, this theoretical perspective is used to explain why crime occurs at certain locations, how offenders identify opportunities to commit a crime in these locations, and the potential characteristics of these places that are criminogenic. The last part of the chapter reviews the research literature on cargo theft – the crime type under study in this research. This latter section aims to explain the scale of this crime problem and the existing empirical evidence on its crime commission.

2.2. Offenders’ decision-making framework

Offending is generally a goal-driven behaviour. The offender must make decisions that determine their actions to achieve this goal. This suggests that offenders operate rationally, which involves weighing up the benefits of committing a crime against the risks involved, which is described under the precepts of the Rational Choice Perspective. Furthermore, the Routine Activity Approach helps to identify behaviour patterns that increase the risk of a target being a victim of crime. The first part of this chapter considers these approaches to understand offenders’ decision-making and the rationality of this decision-making process.
2.2.1. Rational Choice Perspective

2.2.1.1. Origins of RCP

The Rational Choice Perspective (RCP) was first introduced by Cornish & Clarke (1986). RCP is a theoretical framework that describes the cognitive decision-making process of the offender to achieve their (illegal) goals. This approach incorporates the concept of rationality in decision-making by considering how offenders seek to maximise economic profits and other non-monetary benefits (such as criminal status or sexual gratification) while decreasing the impact of negative externalities.

Cornish and Clarke proposed their novel approach to the reasoning of offenders in making decisions in response to the lack of conclusive evidence of the traditional medico-psychological perspective for explaining offender decision-making. Their logic for this perspective originated from their previous research about how offenders’ decision-making and their crime commission is affected by the situational environment (Clarke, 1980; Cornish, 1978; Oliver et al., 1985). Cornish and Clarke also considered how decision-making can evolve over time as offenders learn more about the environment in which they operate (Clarke & Martin, 1975; Cornish & Clarke, 1987).

As many scholars have suggested, committing a crime tends to be based on the logical and structured analysis of the context and the offender's capabilities (Clarke, 1997; Newburn, 2017; Wortley, 2012). This process seeks to take advantage of opportunities that offer potential benefits while also considering the costs of these criminal activities (Carroll, 1978; Cook, 2017). According to Cornish and Clarke (1986, p.17), offenders use

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3 The medico-psychological perspective assumed that the propensity for an offender to commit a crime was related to criminal predisposition and psychopathologies (Morgan, 1975; Palmer, 2003; Wortley, 1997).
"the same sorts of cognitive strategies when contemplating offending as they and the rest of us use when making other decisions". Therefore, offenders’ decision-making processes can be comparable to the decision-making processes used in everyday reasoning.

2.2.1.2. Critics of RCP

RCP assumes offenders make decisions based on a rational analysis of potential benefits and associated costs. Although this theoretical approach helps to understand offenders’ decision-making processes, it has been criticised for its narrow assumptions and limitations. Much of the criticism that RCP has attracted relates to the concept of “rationality” (Jacobs & Wright, 2010; Laycock & Pease, 2012; Leclerc & Wortley, 2013; van Gelder et al., 2013). Such critics centre their questioning on how an offender can act rationally in their decision-making when the information available to them and, in particular, the lack of information, could constrain their ability (and rationality) to maximise their utility (Farmer, 1992; Hudik, 2019; Lovett, 2006). Similarly, potential offenders can ignore or are not capable of accurately assessing the inherent risks of criminal activities (Copes & Vieraitis, 2009; Leclerc et al., 2011; Opp, 1997a; Simon et al., 1979); hence both sides of the cost-benefit calculus can be flawed.

Other criticisms involve the presence of emotions and intoxicants that can significantly alter an individual’s ability to make rational decisions (Rossmo & Summers, 2021). Emotions can profoundly impact decision-making, leading individuals to make choices that may not be advantageous for them. For example, scholars have documented that the impact of emotional changes, especially on young people, can motivate them to get
involved in gangs or become delinquents (Lindegaard et al., 2013; Paes-Machado & Levenstein, 2004).

Similarly, consuming intoxicants, such as alcohol or other drugs, has an impact on cognitive functions and critical judgment, affecting the ability to make rational decisions. For example, Exum (2002) found that intoxicated individuals (from alcohol consumption) are 26% more likely to engage in physical assaults. Countless scholars have written about the effect of drugs and violence, especially in how drug abuse leads people to become offenders in their pursuit of drugs (Brownstein et al., 2000; Brunelle et al., 2000; Goldstein, 1989; Kuhns & Clodfelter, 2009). The impact of intoxicants on decision-making is, therefore, another factor that needs to be considered when analysing the rationality of criminal behaviour.

Rossmo and Summers (2022) recently examined offenders’ decision-making using prospect theory and behavioural economics perspectives. They found that offenders, especially those who abuse drugs and/or alcohol, often exhibit distorted perceptions of effort, risk, and rewards. These perceptions are heavily influenced by cognitive biases and heuristics, resulting in decisions that are often intuitive and, on occasion, even superstitious. Those results emphasise the insufficiency of rational choice and expected utility theories in explaining offender’s decision-making, particularly in drug addiction situations.

The assumption of perfect rationality and complete information may then not be realistic. Instead, a lack of knowledge, sometimes combined with the presence of emotions and/or intoxicants, can result in significantly compromised decision-making processes. Although these are enduring criticisms of RCP, this has nonetheless become a widely used
theoretical framework that is founded on the assumption that offenders undertake some sort of rational decision-making in the criminal activities they perform (Clarke & Cornish, 2017; Clarke & Martin, 1975; Cornish & Clarke, 1989, 2003; Nee & Meenaghan, 2006), even if that results in imperfect decisions.

RCP suggests that these individuals will act in ways that advance these goals. Countless studies have used RCP to explain the rationality behind the decision to commit property crimes such as auto theft (Copes & Cherbonneau, 2006), e-commerce and identity theft (McNally & Newman, 2008; Newman & Clarke, 2013), organised crimes (Bullock et al., 2010; Cornish & Clarke, 2003), and interpersonal crimes such as serial sex offences (Beauregard et al., 2007; Leclerc et al., 2011). Other environmental criminologists have further developed RCP to incorporate space considerations into decision-making (Johnson et al., 2009; Rossmo & Summers, 2021; Smith et al., 2009). The rational choice perspective focuses on how offenders select targets based on their perceived benefits and risks, but how do those potential offenders locate suitable targets to commit a crime? That is the territory of the routine activity approach.

### 2.2.2. Routine Activity Approach

For a crime to occur, it requires a potential offender to find the opportunity to commit it. The *Routine Activity Approach* (RAA) is a theoretical framework used to understand and explain criminal activity by considering the opportunities to commit crimes at specific times. Introduced by Marcus Felson and Lawrence E. Cohen in 1979, it was developed

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4 Several authors refer to this as Routine Activities Theory (RAT); however, in this research, I use the original term concordant with the name used by Marcus Felson.
to explain the increases in crime rates between the 1960s and 1970s that conventional criminology theories and sociodemographic variables at that time could not. Felson and Cohen’s seminal work was one of the first to focus on the situational attributes of a criminal act rather than focusing on the personal characteristics that motivated the offender. RAA was ground-breaking because it shifted the focus towards analysing the act of crime rather than the criminal (Felson, 2017). The central premise of RAA is that most criminal acts are committed when a likely offender, a suitable target, and the absence of a capable guardian converge in space and time (Cohen & Felson, 1979).

In the original paper, Cohen and Felson began by considering only “direct contact predatory violations” because these crimes imply a direct interaction between an offender and their target (person or object) in a particular place. Their macro-level analysis considered that variations in crime trends are provoked by changes in the global environment that impact the structure of a society. In turn, these generate opportunities for offenders to engage in predatory crimes.

Felson later considered that “crime needs to be interpreted as part of the broad ecology of everyday life” (Felson, 2017, p. 88). In their original work on RAA, they drew from the “Human Ecological Theory” introduced by Amos Hawley (1950). Hawley’s theory suggested that human relations are performed over specific space and time and identified three fundamental components of any community structure: the rhythm of daily life (i.e., the periodicity of when events occur), tempo (i.e., the number of events per unit of time) and the timing (i.e., the interdependence between different events). Adapting these

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5 On the original paper, “Predatory Violations” was defined as illegal acts in which “someone definitely and intentionally takes or damages the person or property of another” (Glaser, 1971, p. 4).
concepts to the analysis of criminal activities, Cohen and Felson suggested that the analysis of crime trends eventually will come back to specific points in time and space that are directly impacted by changes in the routines of a society⁶.

RAA proposed a convergence of Hawley's concepts of *tempo* by considering the numbers of crimes and their variation regarding the *rhythm* of conventional activities of people (such as where and what they are doing). The timing between the lack of guardianship and a likely offender can similarly influence this convergence. This convergence is known as the chemistry of crime: that is, for a crime to occur, three elements must be present - a likely offender, a suitable target, and the absence of a guardian, with these components meeting in time and space (Felson, 1994).

Cohen and Felson identified that most crimes occurred when victims were conducting their conventional activities and when there was a lack of guardianship at the place where the crime was committed. Identifying the routines of a potential target and detecting opportunities that the lack of guardianship provides could motivate individuals to engage in criminal activities (Cohen & Felson, 1979). As Felson states: “Crime can be viewed as a routine activity that feeds on routine legal activities as people proceed to gain their daily bread” (Felson, 2002, p. 175).

### 2.2.2.1 Theoretical Extensions of RAA

RAA has become a recurrent theoretical framework for understanding criminal activities. It has evolved over time, but it retains its original simplicity and power. An example of the

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⁶ Cohen and Felson’s empirical work included a descriptive analysis using data from victimisation surveys, crime statistics and other statistics of consumer expenditures for goods; they focused on the temporal structure of the routine activities of the victims.
evolution of RAA was the improvement that Felson (1986) proposed with the inclusion of “the handler” as a form of a controller in the dynamics of crime. Drawing on the theoretical proposals of Hirschi (1969), the “handler” explains the relevance of individuals concerned with preventing potential offenders from becoming involved in criminal activities by providing social and emotional support. The relevance of including this new controller relied on its effectiveness in decreasing the offender’s motivation to be part of illegal activities. If the handler’s presence is effective, potential offenders are less motivated to commit crimes for fear of losing personal connections, the trustworthiness, and the emotional bonds of the handler (Eck & Madensen, 2015).

Countless scholars have used RAA as a fundamental grounding for their research. For example, Sherman, Gartin, and Burger (1989) pioneered the “high-crime place” concept to explain the concentration of crime in specific geographical spaces by drawing on RAA. In their study, they provide one of the first illustrations of the patterning of crime in high-crime places by relating it to the convergence of offenders and suitable targets at places. Sherman and colleagues emphasised the relevance of specific geographic places, their characteristics and how they affect the dynamics of criminal acts.

Building on the original concepts of RAA, Eck (1994) proposed the inclusion of another type of controller, a “place-manager”, to add to the concepts of guardianship and handlers of offenders. Eck suggested that although the RAA paid attention to the use of guardians as controllers of a target and the handler as a controller of offenders, there was no specific controller for the places where offenders and their targets converge. The “place manager” concept focuses on people or institutions who prevent crime from occurring at those
places by virtue of their employment or societal role. That is, place managers regulate people’s behaviour in specific frequented places.

Eck introduced the concept of the “Crime Triangle”7 to describe the interaction between the original RAA notion of the “chemistry of crime” and the position of controllers. The Crime Triangle has become a valuable tool for helping to explain RAA and has helped expand and apply this conceptual framework in many different settings. An example of its application is in the adoption of problem-oriented policing that encourages alternatives to arrest and how controllers can act to prevent crime (Braga et al., 2019a; Payne et al., 2013; Leigh et al., 1996; Sampson et al., 2010).

Madensen (2007) extended Eck’s place controller concept and proposed a “theory of place management” to describe the role of place managers in preventing crime and to articulate the externalities that could affect the place manager’s crime prevention efforts. An example of this was illustrated by Madensen & Eck (2008), who used the violent behaviour of the spectators in stadiums to explain the role of the police when designing an intervention in place management. In their study, Madensen and Eck enumerate the factors (externalities) that could impact the fans’ misbehaviour, such as the characteristics of the venue, the event, and the staff, as well as the potential responses of the authorities to tackle that problem.

Sampson et al. (2010) made a further theoretical extension to RAA, introducing the concept of “super-controllers”. In their research, they examined the factors related to the

7 Eck (2003, p. 112) mentions “that the “Crime Triangle” figure is a collaboration among William Spelman, Rana Sampson and himself at the Police Executive Research Forum in the early 1990s. Sampson developed the triangle to teach police problem analysis based on earlier work on Eck & Spelman, 1989 and Spelman & Eck, 1989”.
failures of crime prevention actions because of the absence or ineffectiveness of the controllers. As a result, they suggested that those failures were linked to the relationship between a controller and the persons, organisations, or governments that design and regulate laws or incentives to prevent crimes. Sampson referred to “super-controllers” as the institutions in positions of power and authority for preventing crimes. The primary role of a super-controller is to help ensure the handlers, guardians and place managers to operate effectively. Three types of super controllers have been defined:

- **Formal**: those who hold a position of authority (organisational, financial, regulatory, etc.) and can influence the behaviour of a controller.

- **Diffuse**: organisations without formal/legal authority but with the power to influence the decisions of the controllers (e.g., the media, political parties, or financial markets).

- **Personal**: members of the controller’s social network that could influence their actions (e.g., family and social groups).

The impact of a super-controller on crime is indirect; therefore, they must work with controllers to develop crime prevention strategies. Few empirical studies have, however, examined the role and effect of “super-controllers”. Exceptions to this include Townsley et al. (2016), who analysed the impact of super-controllers to prevent maritime piracy in the Arabian Sea. Another approach was developed by Klima (2011), who concluded (concerning smuggling using the transport industry in Belgium) that the ineffective actions of super-controllers (such as weak sector conditions and weak regulations) increased opportunities to commit crimes.
Figure 2.1 shows the evolution of the RAA since its introduction and the extensions that have been added over time (as described above). RAT 1 is the original work of Cohen and Felson and illustrates the chemistry of crime, including the protective influence of guardians as controllers over targets. RAT 2 is the first extension proposed by Felson in 1986 and includes the handler as a controller of potential offenders. RAT 3 shows an external triangle that includes the concept of place manager (Eck, 1994; Madensen, 2007). RAT 4 adds a new triangle, including the people and institutions controlling the controllers or the super controllers as Sampson, Eck and Dunham in 2010 define.

Figure 2.1. The development of the Routine Activity Approach
Source: Eck & Madensen, 2015.
The RAA has been an impactful theoretical framework for understanding crime patterns. Its flexibility and complementarities with other theoretical approaches, such as RCP, are fundamental to its success. The inclusion of routine activities in the rationality of the decision-making process of committing a crime has been adopted by many researchers. For example, Felson and Clarke have worked on this integration between RAA and RCP to propose a more general explanation of how opportunities facilitate criminal acts (Felson & Clarke, 1998). They also argue that both are mutually supportive and could be complementary to explaining criminal acts in a manner that is superior to theories based on criminal inclinations (Clarke & Felson, 1993b).

The use of RAA and RCP has facilitated the development of conceptual frameworks to explain how potential offenders choose their targets based on the opportunities identified at a suitable place. Additionally, the principles from these two theoretical approaches provide an initial overview of how offenders are influenced by the characteristics of the places where they commit crimes. As Felson and Clarke stated: “Opportunity is a root cause of crime” (Felson & Clarke, 1998, p. V).

2.3. Co-offending

Turning now to another component of the theoretical framework, the current research is predicated on the assumption that the commission of crimes by organised groups requires more than one offender. Cargo theft requires the coordination of offenders with different abilities to execute the crime (e.g., leaders who plan the crime and others who help to commit it), connections with other illegal groups to obtain the equipment (e.g., tools and guns) that the crime commission requires, and business partners who operate in illegal and legal markets to trade the illicit goods. To foreground the analysis of those
connections, it is necessary to introduce concepts from the co-offending literature, with a particular focus on the decision of a person to join a criminal group, the characteristics that lead offenders look for in a co-offender, the distribution of roles within the group, and the participation of multiple offenders in the crime commission process.

2.3.1. What is a co-offender?

RCP focuses on individual decisions and actions, and RAA identifies the opportunities to commit a crime. Considering co-offending requires taking the principles espoused by these theoretical frameworks and expanding them to include how offenders select and involve others in committing crimes. This includes considering how roles are assigned between offenders who co-offend and describing their roles in the group's activities.

To examine this process, we must first identify the characteristics that an offender is looking for in a co-offender, followed by the motivations of a person to join a criminal group and the assignment of roles inside a criminal group. Scholars have defined co-offending variously, including frameworks identifying co-offenders as persons committing crimes at the same place and time (Carrington, 2009; Reiss & Farrington, 1991; Weerman, 2014). For instance, Felson (2009, p. 1) mentions, “Co-offending means that offenders collaborate in committing a crime”, whereas Tremblay (1993) describes co-offenders as individuals that play a relevant role within the crime commission process.

Few scholars have included the spatial component in the co-offending definition. One rare exception is Felson (2003), who proposed that offenders tend to hang out in familiar places and find one another. However, not all offenders may be present for complex crimes, which is why I have not opted for Felson's definition. Then, for the purposes of this research, the definition of co-offending employed comes from van Mastigt &
Carrington (2019, p. 126): “the act of committing crime together with one or more other co-offenders”. The selection of this definition responds to the fact that crimes committed by organised groups require the participation of more than one person, that, in most cases, are people who share their knowledge and experience and could bring specific skills, tools, or resources to achieve their crime commission goals.

Pioneering studies to explain co-offending include those by Breckenridge & Abbott (1912), who presented research based on the court records of juvenile offenders in Cook County, Illinois. In that study, the researchers stated that “there is scarcely a type of delinquent boy who is not associated with others” (p. 35). Another ground-breaking study was presented by Shaw and McKay, who highlighted the impact of co-offending in the dynamic of juvenile delinquency, stating that young men initially became involved in crime via their induction by older and more experienced offenders (Shaw & McKay, 1931, 1942).

Since those seminal works, the study of co-offending has proliferated; however, scant theories explain this phenomenon. Most literature has focused on empirically identifying the co-offending trajectory over an individual’s life-course or how age impacts the formation of groups (Carrington & van Mastrigt, 2013; Morselli et al., 2006; Reiss & Farrington, 1991; Stolzenberg & D’Alessio, 2008; van Mastrigt & Farrington, 2009). Scholars have developed complementary approaches to describe particular aspects of the co-offending process, such as how co-offenders find each other (Carrington, 2014; Felson, 2003; Morselli & Tremblay, 2004); the understanding of the risks and costs of co-offending (Lantz & Ruback, 2017b; McCarthy et al., 1998; Ouellet et al., 2013; Papachristos et al., 2015); and the recruitment to be part of a criminal group (Hearnden & Magill, 2004; Lantz & Ruback, 2017a; Warr, 1996).
2.3.2. Co-offenders and criminal cooperation

Potential offenders identify suitable opportunities to commit a crime in places where the surrounding environment is familiar to them – their awareness space\(^8\) – and is aligned with potential targets. Since different types of crimes require specific offenders’ abilities, some offenders require criminal cooperation to commit certain criminal activities. This means they will need partners with specific skills that can play specific roles in the crime commission process.

Cooperation among criminals includes searching, selecting and engaging partners willing to commit an offence. This search includes identifying individuals motivated to be part of illegal activities with specific resources or information that the commission of a crime demands. In line with the rational choice perspective, this involves a previous decision-making process weighing the costs and potential rewards of recruiting a co-offender or a specific individual becoming a co-offender (Cornish & Clarke, 2003).

Weerman (2003) suggests that in the existing literature, eight common characteristics of co-offending can be identified:

1. Offenders vary in their preference for co-offending or solo-offending.
2. Different types of crimes will require different numbers of co-offenders.
3. Co-offending relationships are most common between similar age groups.
4. A lead co-offender usually instigates co-offending.
5. The crime in question could be simple or complex.
6. This usually takes place in small offending groups.

\(^8\) This concept is explained fully in subsection 2.4.1.
7. This usually takes place within relatively homogeneous offending groups.

8. This usually takes place within changing constellations.

In addition, Weerman proposed three perspectives to explain why people co-offend. The first perspective is the “group influence”, which explains co-offending as the result of social pressure of a group to be part of illegal activities. The second perspective, “social selection”, describes co-offending as a tendency of offenders to collaborate with individuals with similar characteristics. The third perspective was termed the “instrumental perspective”, which stated that the decision to join a criminal group could be considered part of the pursuit to maximise potential rewards.

As a result of analysing these characteristics and perspectives, Weerman proposed a theoretical framework to understand co-offending as a social exchange between individuals willing to co-offend and exchange their materials (e.g., tools and workforce) and immaterial goods (e.g., specific skills and knowledge). Further, these potential offenders perceive that being a co-offender is a beneficial activity where the expected rewards exceed the costs. Moreover, co-offenders are likely to be easy to contact, are trustworthy and have enough criminal capabilities to commit a crime. As other scholars have suggested, individuals are willing to exchange their resources and capacities to increase the possibility of obtaining more gains than acting as a solo-offender (McCarthy et al., 1998; Walsh, 1986).

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9 According to Weerman, “several scholars analyze co-offending from an instrumental or rational angle” (Weerman, 2014, p. 5175). In that regard, co-offending is analysed from a “Rational Choice perspective” too.
The co-offending and criminal cooperation literature includes studies on crimes such as burglary, robbery, motor vehicle theft and other minor offences typically executed by young offenders (Alarid et al., 2009; Carrington, 2002; van Mastrigt & Farrington, 2009). More recently, this literature has been expanded to analyse the dynamics and cooperation of co-offenders in the context of organised crime activities. This includes scholars and practitioners conducting studies to understand the co-offending relationship between offenders and criminal enterprises (e.g., transnational criminal groups) and how offenders create illicit networks with co-offenders in legal and illegal markets (Bruinsma & Bernasco, 2004; Holt, 2013; Malm et al., 2011; Malm & Bichler, 2011; Ruggiero, 2000).

2.3.3. Becoming a specialised co-offender

Some criminal activities require specialised labour. That implies that the search for co-offenders will likely focus on individuals with specific abilities and knowledge. The roles assigned and the co-offending activities are dynamic phenomena that vary over time as a function of the criminal groups’ requirements (Englefield & Ariel, 2017; Linton & Ariel, 2021; MacDonald et al., 2014). Nonetheless, group roles can be specialised. Scholars have documented that the older members of the group (most of the time, the leaders) oversee the distribution of labour and responsibilities within the crime commission process (Donald & Wilson, 2000; Einstadter, 1969; Fijnaut & Paoli, 2004; Shover, 1973). Thus far, it has been argued that co-offending can be a complex criminal cooperation phenomenon requiring specific characteristics and abilities from potential co-offenders. More complex crimes imply the possibility of extending cooperation to other criminal enterprises and developing a network of multiple groups of co-offenders. For example,
the analyses of patterns of co-offending by the sociocultural composition of a network (Bichler et al., 2017; Bouchard & Malm, 2016; Malm et al., 2011); Morselli’s research about social networks and co-offenders (Bouchard & Morselli, 2014; Descormiers & Morselli, 2011; Morselli, 2009b, 2009a), and the work of Andresen to identify the relation between co-offending, the urban space and the diversification of criminal activities (Andresen, 2011; Andresen & Felson, 2010, 2012).

Furthermore, Hammer & Madensen (2017), and Madensen (2017) have examined the aspects of co-offending and the places where crimes are committed. Their research delved into the dynamics of how individuals, often members of criminal groups, select and exploit specific geographic locations for their illicit activities. They propose that certain places situated in high-crime areas, go beyond mere physical locations. These places are likely to encapsulate the environmental conditions, social networks, and situational opportunities that co-offenders leverage to carry out criminal acts (Hammer & Madensen, 2017; Madensen, 2017). In Chapter Seven, I expand on the impact of their research as part of the GIM.

This section has reviewed the co-offending literature and salient theories and empirical examples of co-offending. Nevertheless, there are several theoretical gaps for future research, such as the relationship between specific types of co-offending in criminal groups and the association with individuals who operate in legal markets. There is likely to be value in exploring the links between offenders and individuals who operate in legal markets and examining how the associations and the activities contribute to committing a crime successfully.
2.4. The geographic patterning of crime

Although the theoretical principles of RCP, RAA and co-offending can be extrapolated to consider the role of a place within the crime commission process, a better approach to understanding the role of place is through the theoretical frameworks of the Geometry of Crime and Crime Pattern Theory. The following sections explore these theoretical frameworks regarding offenders’ identification and selection of places to commit crimes.

2.4.1. Crime patterns

Criminal activity can be a complex phenomenon. To be understood, it requires the analysis of patterns that can be observed, the places where opportunities for crime are present, and the offender’s decision-making in choosing those places. The spatial concentration of crime implies the existence of places with a combination of environmental, social, and economic characteristics that can create opportunities for criminal activity to occur. A criminological approach that explains the selection of these places is Crime Pattern Theory (CPT) which is a theoretical framework that explains the motives behind an offender’s decision to choose specific locations to commit their criminal activities (Brantingham et al., 2016; Chainey, 2021; Curtis-Ham et al., 2020).

According to CPT, criminal activity tends to cluster in specific locations over time, creating a pattern of crime concentration in these areas. The concentration of offenders’ activities involves using a rational decision-making process influenced by their familiarity with an area – or the knowledge of areas transferred by their criminal networks – and the refinements to this decision-making based on previous experiences. In the places where crime concentrates, several typologies have been introduced to describe the nature of
this concentration: crime generators, crime attractors, crime enablers, and crime-neutral places (Brantingham & Brantingham, 1995).

*Crime generators* are areas with a high flow of potential targets through and to nodal activity points (Brantingham et al., 2016; Weisel et al., 2006). These places provide a considerable range of opportunities for offenders. Examples of these types of locations include busy transit stations and shopping areas because of the large concentration of people at these places, providing opportunities for crime (Eck, 2003; Haberman & Ratcliffe, 2015; Lasky et al., 2017).

*Crime attractors* are places that generate specific opportunities and attract individuals willing to commit specific crimes (Ekblom & Tilley, 2017; Mccord & Ratcliffe, 2009; Weerman, 2014). The area’s reputation may attract offenders to these places because their specific criminal opportunities (Chainey & Ratcliffe, 2005). Examples of crime attractors include places that operate as drug markets or prostitution areas.

*Crime enablers* are likely to be isolated places that facilitate criminal activity to occur. These places are characterised by conditions that make them attractive to potential offenders, such as a lack of surveillance, poor lighting, or limited access control. Examples might include dark alleyways, abandoned buildings, or parking garages with inadequate security measures. Criminals are more likely to target these places because they offer opportunities to commit crimes without being seen or caught (Bullock et al., 2010; Clarke & Eck, 2005; Madensen, 2007).

*Crime neutral areas* are places that might not have any specific feature that facilitates or discourage criminal activity. Examples of crime neutral places are ordinary public spaces
that are not inherently risky or dangerous, such as certain parks, residential or entertainment areas, or public squares. However, they may still be the site of criminal activity if other factors are present, such as a lack of police presence or poor lighting at night (Brantingham & Brantingham, 1995; Clarke & Eck, 2005; Felson & Clarke, 1998).

Crime Pattern Theory provides insight into the decision-making process of offenders when selecting a location to commit a crime. The offender's knowledge and experience, as well as the characteristics of the location, play a significant role in this decision. Additionally, the offender's understanding of the routines and patterns of potential targets and their ability to exploit the surrounding environment further influences their choice of location. The following section reviews the theoretical concepts of the geometry of crime about selecting specific places to commit a crime.

2.4.2. Geometry of Crime

Crimes do not occur randomly or uniformly in space or time (Brantingham et al., 2016). The location of a crime is related to the offender's perception of the characteristics of the place where the crime occurs. The patterning of crime, such as its concentration in space, is a function of the routine activities of offenders, targets and guardians and an offender's decision-making.

One of the first theoretical perspectives to explain the spatial patterning of crime was proposed by Paul and Patricia Brantingham, who called it 'the geometry of crime'. They introduced this theoretical approach in 1981 as the third component of the “Environmental Criminology” framework (the other two being routine activities and rational choice). Before this, most research had focused on explaining how structural conditions of urban space
influenced the opportunities to commit a crime (Jeffery, 1971; Lynch, 1960; Mayhew, 1976). The Brantinghams’ model offered a different perspective by arguing that the geographic distribution of crime was related to the spatial distribution of the routines of potential victims and offenders within the environment. Therefore, the areas where crime occurs relate to the places where offenders intersect either with the targets that are there or where victims frequent.

2.4.2.1. Areas of crime occurrence

According to the Brantinghams, the places that are regularly visited or where time is frequently spent are called nodes. The routes that then connect these nodes are paths. As a person’s activities become habitualised (such as performing multiple activities around their nodes and travelling along their paths), this forms a cognitive map of places known to them (Brantingham & Brantingham, 1984). Over time, this cognitive map develops and charts the places where the person is knowledgeable about the characteristics of these places. Their typical pattern of movement and behaviour within this cognitive map becomes what Crime Pattern Theory calls the person’s “activity space.” The specific areas around the nodes and the pathways that become well-known within this activity space are defined as the person’s “awareness space” (Brantingham & Brantingham, 1981). Most research defines awareness space as the area of visual range from the person’s activity space (Brantingham & Brantingham, 1993; Curtis-Ham et al., 2020; Lammers, 2018); hence it is broader than just the activity space.

Like any other person, offenders perform routine activities, moving around nodes and along their regular paths. While doing so, they may identify opportunities to commit a crime in the places that are part of their awareness space. Crime opportunities are not
homogeneously distributed within a city or a country and instead are concentrated in places where suitable targets are located, where a lack of guardianship is present, and where the nature of the physical environment may facilitate crime commission. The hunt and identification of these locations form part of the offenders’ “search space” (Chainey & Ratcliffe, 2005). Within this space, the search for a particular target is known as “criminal activity space” (Rengert & Wasilchick, 2000). Within criminal activity space, the geographic distribution of opportunities and the offenders’ awareness space overlap are the most likely “areas of crime occurrence” (Chainey & Ratcliffe, 2005, p. 97). A graphic representation of these concepts is shown in Figure 2.2.

![Hypothetical model of the creation of criminal occurrence space](image)

Figure 2.2. Hypothetical model of the creation of criminal occurrence space
Source: Chainey and Ratcliffe, 2005.

2.4.2.2. Crime template and environmental backcloth

Another essential concept the Brantinghams introduced was the notion of an offender’s “crime template”, which influences the actual occurrence of crime (Brantingham et al., 2016; Brantingham & Brantingham, 1984; 1985). The crime template is developed based
on positive experiences and decisions made by the offender over time, which improves their criminal decision-making process (Chainey & Ratcliffe, 2005; Rengert & Wasilchick, 2000). Moreover, the crime template is also linked to the routines in places where potential targets are located and where the offender feels at ease. A diagram of a crime template about a potential offender’s decision-making is shown in Figure 2.3.

Crime templates, targets, offenders’ routine activities, and awareness spaces are not fixed. Offenders can adapt their templates, routines and awareness spaces to expand their cognitive maps to include new nodes and paths and develop or establish new templates as they learn from previous experiences of crime commission and from the experiences of others with whom they decide to co-offend (Costello & Wiles, 2001). A co-offender could bring more detailed knowledge of the temporal and spatial dynamics of an area inside a city where opportunities to offend are present, resulting in the generation of new nodes and pathways previously unfamiliar to the original offender.

Opportunities to commit crime are heavily influenced by the environmental backcloth in the areas where offenders identify potential targets (Brantingham, 1978; Brantingham & Brantingham, 1981; Brantingham & Brantingham, 1993). The *environmental backcloth*10 refers to the physical infrastructure such as buildings, areas of open space (e.g., parks),

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10 This research will refer to the concept of an environmental backcloth several times. It has a considerable influence on the crime commission process for cargo theft and the descriptive geographic profile that will be introduced later in this thesis.
road networks and the dynamic social, political, and economic settings within places. Together, these environmental factors affect where offenders decide to commit a crime (Jeffery, 1971; Mayhew, 1976).

2.4.3. The Concentration of Crime

Numerous studies have shown that criminal activity tends to concentrate at specific places and times (Curman et al., 2015; Eck & Weisburd, 1995; Rengert & Lockwood, 2009; Weisburd & Green, 1995; Wilcox & Eck, 2011). In that sense, identifying the spatial and temporal patterns of offenders’ activities has become a fundamental part of understanding crime commission (Eck, 1997; Pyle, 1976; Ratcliffe, 2006; Tompson & Bowers, 2013; Weisburd et al., 2016; 2009). Moreover, researchers have focused on identifying the characteristics of those places that make the commission of a crime feasible (Alonso Berbotto & Chainey, 2021; Bottoms & Wiles, 2002; Braga et al., 2011; Brantingham & Brantingham, 1991; Lee et al., 2017). Accordingly, this section reviews a theoretical framework of crime concentration in specific places.

2.4.3.1. Spatial Patterns of Crime

The spatial patterning of crime refers to the distribution of criminal activity across geographic space. Sherman, Gartin and Buerger (1989) were among the first scholars to examine specific places with higher crime concentration and link this with the “routine activities” of specific segments within a city. They introduced the concept of “Criminology of place”, with their central premise being that the combination of people’s routine activities with the characteristics of the physical environment affects potential offenders’ decisions to select those places to commit their criminal acts. Their study identified that
crime tends to concentrate at particular locations\textsuperscript{11}, influenced by these places' criminogenic opportunities and physical characteristics.

Since Sherman et al.’s ground-breaking work, the spatial definition of hot spots and the definition of an adequate \textit{geographic unit} to analyse crime has been a challenging scholarly topic. The definition of analytical units influences how the research is conducted and the results generated (Oberwittler & Wikström, 2009; Openshaw, 1984; Sherman & Weisburd, 1995; Tompson et al., 2009). The concentration of crime has been studied through a range of geographic scales, including inside countries (Ceccato & Uittenbogaard, 2014), among neighbourhoods (Chainey et al., 2008; Clarke & Harris, 1992; Copes & Cherbonneau, 2006), and at the micro-scale of street segments (Curman et al., 2015; O’Brien, 2019; Tompson, 2016). The study of “high-crime areas” within a city can then, in turn, help better understand spatial patterns of crime and the social, economic, and environmental factors contributing to crime concentration in specific areas.

\textbf{2.4.3.2. The Law of Crime Concentration}

One of the most significant contributions to the literature on the concentration of crime was proposed by Weisburd (2015), who conducted a cross-city comparison of crime concentration focused on street segments and crime incidents in eight urban cities in the United States and Israel\textsuperscript{12}. Weisburd found that crimes tend to concentrate in specific spatial bandwidths; for example: a cumulative proportion of 25 per cent of crime tended

\textsuperscript{11} Sherman et al. (1989) used street addresses and intersections in Minneapolis, Minnesota, as the urban space for their analysis.

\textsuperscript{12} Weisburd catalogued the cities as large and small. Large cities: Cincinnati, Ohio; Seattle, Washington; New York, New York; Sacramento, California and Tel Aviv-Yafo, Israel. Small cities: Ventura, California; Redlands, California and Brooklyn Park, Minnesota.
to concentrate in 0.4 to 1.6 per cent of all the areas examined\textsuperscript{13}. As a result of this analysis, Weisburd introduced the \textit{law of crime concentration (LCC)}, stating that: \textit{“For a defined measure of crime at a specific microgeographic unit, the concentration of crime will fall within a narrow bandwidth of percentages for a defined cumulative proportion of crime”} (Weisburd, 2015, p. 133).

The criminology of place and the LCC both emphasise the importance of understanding the environmental backcloth in shaping criminal behaviour and provide a framework for understanding an offender’s actions in places with higher crime concentration. Despite this interest, the literature on the factors that influence offender decision-making in specific places where crime concentrates (for example, determining the specific conditions that may need to be present) is underdeveloped. Ekblom and Tilley (2017) suggested that the geographic characteristics of an area may influence the equipment and skills required to complete a criminal activity (e.g., using a vehicle, using violence to commit an act of crime). However, hitherto, there is little research on how the characteristics of places may have an impact on the design of specific parts of the crime commission process and the roles that specific co-offenders perform.

\textbf{2.4.4. Geographic Profiling Analysis}

Geographic profiling is a field of study that focuses on the spatial and temporal analysis of crime patterns to aid in the identification of offenders’ spatial and hunting behaviours (Rossmo, 1995; 2000). Over the years, numerous scholars have contributed to the development of geographic profiling techniques and applications to better understand the

\textsuperscript{13} Weisburd identified that 50\% of crimes tend to concentrate between 2.1\% and 6\% of the area.
offenders’ target selection and their search and attack behaviours (Bernasco, 2007; Chainey, 2021; Levine & Block, 2011; Rossmo, 1996, 2000).

Geographic Profiling Analysis (GPA) is an investigative technique that examines the crime series’ locations to ascertain the most likely area where the offender resides or operates from (Rossmo, 2000). This approach has been widely employed to identify the strategic geographic locations of individual offenders. Scholars and law enforcement agencies have used GPA to investigate a variety of crimes, including burglaries, robberies, and sexual assaults (Daniell, 2008; Rossmo, 1997; Snook et al., 2004; Synnott et al., 2019).

A fundamental concept in geographic profiling relates to the seminal work of Zipf (1949), the least-effort principle. This principle holds particular significance in understanding the decision-making processes of offenders when contemplating whether to engage in criminal acts. When individuals perceive that the effort to commit a crime is low, they are more inclined to participate in criminal activities. Specifically, this least effort principle implies that offenders tend to travel short distances to commit crime, or in the very least perform more activities close to their homes (or other spatial nodes) rather than offending at their highest frequency a long distance from their home.

The rational choice theory posits that offenders weigh the potential benefits and costs of committing a crime and choose to engage in illegal behaviour when the perceived benefits outweigh the perceived costs (Clarke & Felson, 1993a; Cornish & Clarke, 2013; Lovett, 2006). By examining offenders’ motivations and the perceived utility of criminal actions, geographic profiling can gain insights into their decision-making processes and factors that influence their engagement in criminal behaviour.
The examination of offender spatial behaviour has become a prominent area of research within geographic profiling. Scholars have explored the principles of routine activity theory and crime pattern theory to understand how offenders select their target locations and navigate through the environment (Bernasco, 2007; Paulsen, 2007; Rossmo, 2000). Studies have identified patterns of journey-to-crime distances that provide insights into offender decision-making processes to define the places where they anchor their activities (Block & Bernasco, 2009; Lu, 2003; Smith et al., 2009a).

Another important aspect of the geographic profiling literature is the exploration of different mathematical models and algorithms employed in the field. Various techniques such as the circle hypothesis, distance decay, and nearest neighbour analysis have been utilised to identify spatial and temporal patterns to develop predictive models (Levine & Block, 2011; O’Leary, 2011; Rengert et al., 1999; Stamato et al., 2021). Researchers have also explored the use of geographic information systems (GIS) and crime mapping to visualise and analyse crime data more accurately (Curtis-Ham et al., 2022; Levine & Block, 2011; Lino et al., 2018; Rossmo, 2022).

Geographic profiling research has sought to enhance the interdisciplinary understanding of criminal behaviour, offender profiling, and crime prevention strategies (Curtis-Ham et al., 2022; Rossmo et al., 2008; Tonkin et al., 2009). The incorporation of socio-demographic factors, environmental characteristics, and situational contexts has enriched the analysis of crime patterns and improved the applicability of geographic profiling. Issues identified in the geographic profiling literature for examining offenders spatial behaviours include problems with data quality, sample representativeness, and the assumption of offender rationality (Paulsen, 2006; Rossmo, 2022, 2000; Snook et al.,
These limitations are some of the issues that GPA has to address to develop more robust and comprehensive approaches to geographic profiling (Canter & Hammond, 2006; Curtis-Ham et al., 2022; Rossmo & Velarde, 2008).

The application of GPA has been primarily focused on individual offenders in the past, aiming to identify the geographical space where they anchor their activities. However, recent research has started exploring the use of GPA for analysing organized criminal groups, where multiple individuals may be involved in criminal activities (Chainey, 2019, 2021). This extension of GPA poses new challenges and requires adaptations to account for the different dynamics and spatial patterns exhibited by groups compared to individual offenders. I examine this topic further in Chapter Seven.

2.5. Crime Intelligence

The pursuit of effective crime prevention strategies and public safety by law enforcement agencies has evolved significantly in recent decades. Integrating intelligence products into policing strategies has become pivotal in contemporary policing. Developing intelligence approaches and products has led to new methods and strategies to enhance understanding of crime issues that impact specific geographical areas (Innes et al., 2004; NCPE, 2005; Ratcliffe, 2004; Rossmo & Velarde, 2008). This section reviews theoretical frameworks related to crime intelligence and its application when analysing criminal activities.

Intelligence in the context of understanding and tackling criminal activities has been an elusive concept to define. Countless scholars, practitioners, and law enforcement agencies have proposed definitions of this concept. For example, Ekblom (2011, p. 85)
defines intelligence as “the tasks of gathering and analysing information and knowledge on crime, its nature, causes and harmful consequences”. Another example came from The National Centre for Policing Excellence, “information that has been subject to a defined evaluation and risk assessment process to assist with police decision making, with an afterthought: ‘In addition to being evaluated, information is analysed” (NCPE, 2005, p. 13).

Ratcliffe (2016) underscored the relevance of crime intelligence by explaining the DIKI continuum (data–information–knowledge–intelligence). Ratcliffe suggests that collecting crime data (measurements and observations about criminal activities), followed by analysing and disseminating that data, can generate information about criminal activities, patterns, and actors. This information can generate knowledge within an organisation, eventually becoming intelligence. This transformation process turns raw data into valuable knowledge, guiding strategic planning, operations, and policy development for improved outcomes and a competitive edge in an ever-evolving environment. This approach gives law enforcement agencies a nuanced understanding of criminal behaviours and motivations, enabling them to make informed decisions. This approach transcends the conventional reactive model of policing, which primarily focuses on responding to individual crimes after they occur.

The concept of crime intelligence in policing has evolved over time, giving rise to various approaches and strategies. One notable framework that has emerged is Intelligence-Led Policing (ILP). This approach represented a significant shift in how law enforcement
operated compared to previous policing models\textsuperscript{14}. ILP is a managerial system that involves formulating tactical and strategic policing strategies through an analytical process (Carter & Carter, 2009; Maguire & John, 2006; Ratcliffe, 2016; Tilley, 2003). This process aims to identify criminal trends and patterns, providing the foundation for proposing both tactical and strategic policing activities. In essence, ILP strongly emphasises data-driven decision-making and the proactive prevention of crime (Brown & Clarke, 2004; Innes & Sheptycki, 2004; John & Maguire, 2012).

Scholars and law enforcement agencies have suggested that this shift in law enforcement agencies have moved towards following an ILP approach allows for a more targeted and effective allocation of resources to combat crime and enhance public safety (Heaton, 2000; John & Maguire, 2012; NCIS, 2000; Ratcliffe, 2002). To understand this approach more comprehensively, it is imperative to explore its fundamental components. Firstly, ILP embodies a strategic orientation. Rather than being exclusively reactive, it involves identifying and prioritising specific problems or risks. Moreover, ILP is a targeted methodology focusing on specific crimes and individuals generating the highest impact. Then, ILP aims to maximise effectiveness and operational efficiency (Cope, 2004; Grieve, 2009; Innes et al., 2004; NCPE, 2005).

Furthermore, as a “businesslike” approach (James, 2003), the concepts of risk assessment and risk management are integral to intelligence-led policing (Flood & Gaspar, 2009; Kleiven, 2007; Maguire, 2000). This entails assessing and mitigating risks associated with crime activities in specific locations. Risk assessment and risk

\textsuperscript{14} For a more comprehensive review about different policing methods in comparation to ILP review (Heaton, 2000; Ratcliffe, 2002; Ratcliffe, 2016, pp. 49–67)
management involve identifying factors related to criminal behaviour (such as geographic, economic or sociodemographic conditions) and implementing measures to counteract them. Additionally, as part of the businesslike approach, collaboration is another relevant concept in ILP. A practical implementation often necessitates cooperation among agencies within and beyond law enforcement and the community (Brown & Clarke, 2004; Harfield & Harfield, 2008; Maguire & John, 2006). Then, an effective collaboration enhances the sharing of key information and resources.

Since its inception in the early 1990s, ILP has acquired attention and adoption within law enforcement agencies worldwide. One of the most relevant implementations has been in the United Kingdom. The National Intelligence Model (NIM) serves as a strategic foundation of policing activities; it is firmly rooted in the principles of ILP (NCIS, 2000; NCPE, 2005; Tilley, 2003). The NIM has been a managerial framework devised to enhance crime prevention and response by fostering collaboration and information sharing among Law enforcement agencies (Brown & Clarke, 2004; Flood & Gaspar, 2009; Grieve, 2009; Maguire & John, 2006).

Although ILP has gained widespread adoption and worldwide recognition, it is not without its critics. One of its key criticisms and challenges is that ILP can introduce bureaucratic processes within law enforcement agencies (Carter & Carter, 2009; James, 2003; Ratcliffe, 2016). ILP tends to be extensive in data collection and analysis, and reporting requirements are resource-intensive, potentially diverting resources from other essential policing activities. Scholars and practitioners have mentioned that implementing and

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15 Ratcliffe (2016, p. 3) mentioned the Law Enforcement Agencies that have adopted an ILP approach. For instance, Grieve (2009, pp. 42–46) presented a table with the evolution of police intelligence in the UK.
maintaining these processes can be expensive and time-consuming (Cope, 2004; Innes & Sheptycki, 2004; NCIS, 2000; Ratcliffe, 2000).

Other critics have argued that ILP may lead to overemphasising data and technology at the expense of traditional policing skills and community engagement (Cope, 2004; Maguire, 2000; Ratcliffe, 2002). This focus on data-driven decision-making might neglect the human element of policing, which includes the challenge of getting law enforcement agencies to cooperate and share information. This can represent a risk to ILP approaches, especially in cases where there is a lack of trust between agencies.

Besides the NIM in the UK, the ILP framework has been extensively adopted worldwide (Bullock, 2013; Carter et al., 2014; Delpeuch, 2024). Law enforcement agencies in the United States, Canada, Australia and New Zealand, among others, have developed their approaches (Burcher & Whelan, 2019; Carter & Phillips, 2015; Darroch & Mazerolle, 2013; Gemke et al., 2021; OSCE, 2021). Some of them have based the development of these products on Innes et al. (2004, p. 44):

“Four modes of intelligence are routinely manufactured:

1. Criminal Intelligence: detailing the activities of a ‘known’ suspect or suspects.

2. Crime Intelligence: enhancing the police’s understanding of a specific crime or series of crimes.

3. Community Intelligence: based upon data provided to the police by ‘ordinary’ public members.”
4. Contextual Intelligence: relating to wider social, economic and cultural factors that may impact crime levels and patterns of offending.

These four modes of intelligence are likely to develop a dynamic and interrelated framework that helps law enforcement agencies make informed decisions. Criminal intelligence can help to track down and arrest criminals. Crime intelligence can help to better understand the crime commission process. Community intelligence can help to build trust between the police and the community. Contextual intelligence can help to develop policies and programs that address the root causes of crime. Intelligence products become a comprehensive approach to developing effective strategies for preventing and solving crimes when utilising each mode strategically.

Crime intelligence and approaches such as ILP are proactive, data-driven, and forward-looking strategies to prevent crimes by raising awareness among decision-makers (Evans, 2009; Maguire & John, 2006; Ratcliffe, 2009). This marks a departure from the traditional reactive policing model, signifying a comprehensive shift towards a more integral and preventative approach. The generation of crime intelligence considering the risks, including the geographical and sociodemographic context, can play a pivotal role in enhancing public safety and the effectiveness of modern policing strategies.

2.6. Cargo theft in the criminology literature

Turning now to the crime type being studied in this research; cargo theft significantly impacts the global economy. In 2020, the Transport Asset Protection Association (TAPA) calculated a total loss of €172.5 million associated with cargo theft in the European,
Middle East and African region (EMEA)\textsuperscript{16}. This estimate does not include Brazil, India, Mexico, and Russia, which alongside the United States and the United Kingdom, are the countries that experience the most incidents of cargo theft (BSI et al., 2022; FBI, 2019; EUROPOL, 2009; SENSITECH, 2022a). Moreover, specialised consulting firms and law enforcement agencies have identified an increasing use of violence in the commission of cargo theft. This increase has been documented mainly in Mexico and Brazil, where criminal groups use more violent methods to commit robberies\textsuperscript{17}.

Literature associated with offender decision-making to commit cargo theft is scarce. There is little evidence of studies that have examined the involvement of criminal groups and their composition, the analysis of their geographic behaviour, and the geographical conditions where cargo theft has been most prevalent (Ekwall & Lantz, 2017, 2020; Justus et al., 2018). In the following subsections, I begin by discussing the different definitions of cargo theft that have been used to date and then elaborate on the limited research conducted about cargo theft.

### 2.6.1. Definition

To date, a standard international definition of cargo theft does not exist. Most studies about cargo theft use definitions based on the penal code or legal framework of the country where the research was conducted, such as Justus et al. (2018, p. 306) who refer to the Brazilian penal code that defines cargo theft as the “subtraction of goods for resale

\textsuperscript{16} The total value of losses includes miscellaneous products, theft of trucks and/or trailers, and other unspecified products. See: http://ace-cargadores.com/wp-content/uploads/2021/04/Boletin_1075/TAPA-EMEA-Incident-Information-Service-IIS-Cargo-Theft-Annual-Report.pdf (last reviewed on 06 of October of 2022)

\textsuperscript{17} A series of quarterly reports for Brazil, Mexico and the US can be viewed at: https://www.sensitech.com/en/intelligence/cargo-theft-reports/ (last reviewed 24 December 2022)
when they are being transported”. In the case of the European Union, EUROPOL stated that: “Road-Related cargo theft is defined as any theft of shipment committed during its road transportation or within a warehouse, but excluding internal petty theft” (EUROPOL, 2009, p. 4). Additionally, the US Criminal Justice Information Services (CJIS), a part of the Federal Bureau of Investigation (FBI), defines it as:

“Cargo Theft is the criminal taking of any cargo including, but not limited to, goods, chattels, money, or baggage that constitutes, in whole or in part, a commercial shipment of freight moving in commerce, from any pipeline system, railroad car, motortruck, or another vehicle, or from any tank or storage facility, station house, platform, or depot, or from any vessel or wharf, or from any aircraft, air terminal, airport, aircraft terminal or air navigation facility, or from any intermodal container, intermodal chassis, trailer, container freight station, warehouse, freight distribution facility, or freight consolidation facility”.

In Mexico, the definition of this crime is based on the Mexican Penal Code and is, rather generically, described as an act in which “whoever seizes someone else’s personal property, without right and without the consent of the person who can dispose of it under the law” (Article 376 Ter, Penal Code of 01 of June of 2021). Additionally, in Mexico, the Executive Secretariat of the National System for Public Security (SESNSP) defines cargo theft as “seizing a cargo transport, including traction vehicles designed for towing such as trailers, tank trucks, panel cabins, pipes, sheds, van, refuse collection trucks and

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18 Brazilian law number 8.072 of 25th July 1990
19 For reading the complete redaction in Spanish, go to: https://www.conceptosjuridicos.com/mx/codigo-penal-articulo-376-ter/ (last reviewed 06 of October 2022)
20 The Executive Secretariat of the National System for Public Security (SESNSP) is the Mexican authority in charge of collecting the crime data and statistics of all the prosecutors’ offices in the country. Chapter three details its role and its relevance to this research.
cranes, as well as transport movable property, with the intention of dominance and without the consent of the person legally can grant it."

(with or without the use of violence to commit the crime). For the purposes of the current research, I used the definition of cargo theft provided by the SESNSP. This definition relates to the data about cargo theft that are recorded and used in the first empirical analysis of this research.

2.6.2. Research about cargo theft

To date, most studies that have examined cargo theft have either focused on the types and value of goods stolen or the impact it has on the supply chain of goods. Few studies have examined the offenders’ modus operandi, the geographic distribution and temporal trends of these offences. The exceptions that have done the latter have been at a general (e.g., unspecific) level. Hence, our empirical understanding of cargo theft is very limited.

The types of products stolen via cargo theft varies worldwide (BSI and TT Club, 2021; Casella, 2011; Coughlin, 2012; SENSITECH, 2022d). In Brazil and African countries such as Nigeria and South Africa, the most frequently stolen commodities are electronics, food and beverage, metals, tobacco, and alcohol (BSI, 2018; Burges, 2013; Justus et al., 2018; Sensiguard, 2019). In European countries, the most commonly targeted goods are IT-related products (computational software and hardware), pharmaceuticals, metal, tobacco, and alcohol (BSI et al., 2022; Ekwall, 2012b; Ekwall et al., 2016a; Shepherd, 2017; TAPA, 2021). In Asian countries, the goods commonly stolen are food and beverage, cosmetic and hygiene products, metal, and electronics (BSI, 2018; David et al., 2016; Mayhew, 2001; SENSITECH, 2022b). In the case of Mexico, products such as

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21 Information consulted on: (last accessed 11 October 2021)
https://drive.google.com/file/d/1ZGUcrisaDhHuEkJ8sXZDUEbK3gxQFD2t/view
agricultural commodities, electronic goods, pharmaceuticals, and parts associated with the automotive industry, such as car wheels and specific mechanical components, are some of the most stolen goods (Chainey & Guerrero Rojas, 2019; de la Torre Romero et al., 2014; Sensiguard, 2019).

Independent of the region of the world, one observation that is apparent to all areas where cargo theft is prevalent is that most of the stolen goods can be regarded as “hot products”. Clarke (1999) defines these products as CRAVED: Concealable, Removable, Available, Valuable, Enjoyable, and Disposable. The types of products stolen, described above, are products that are typically in high demand in illegal markets. Most of the stolen products are highly valuable (e.g., electronics, cell phones, and clothing from specific brands) and are easy to hide and conceal, as well as easy to sell (Ekwall & Lantz, 2013, 2015a, 2016, 2019; Hayes, 2007; Justus et al., 2018; Palmer & Richardson, 2009). That is, it would appear the products that are prone to being stolen from cargo trucks do fit the CRAVED criteria and explain why they are products commonly targeted by offenders.

Goods stolen from cargo trucks also include items that may be stolen to support another type of criminal activity. For example, pharmaceutical goods are believed to be targeted for cargo theft for their use in producing illegal synthetic drugs (Burges, 2013; Ceniceros, 2011; Ekwall et al., 2016a; Marchione et al., 2020; Queiroz, 2012). Even in this case, when the stolen goods could act as precursors to other illegal commodities, the CRAVED criterion is still met. In the case of pharmaceutical goods, they are considered hot products that are easy to conceal, remove and dispose of.

Cargo theft interrupts the supply of commodities to markets or clients to which the cargo was intended. This crime negatively impacts the revenue of producers, logistics firms and
all supply chain members (Ekwall & Lantz, 2015, 2020; Juttner, 2005; Urciuoli, 2009). Most logistics firms consider cargo theft an inherent risk and a potential disturbance to the supply chain (Ekwall, 2012a; Hayes, 2007; Roscoe et al., 2020). For this reason, cargo theft researchers and practitioners have suggested generating an extensive risk security management system to improve the security process for logistics companies (Boone et al., 2016; Coughlin, 2012; Closs & McGarrell, 2004).

Despite its impact on national and global goods supply chains, there has been limited research about how offenders perform these criminal acts. Studies that have examined crimes similar to cargo theft include piracy (Onuoha, 2013; Petrig & Geiß, 2011; Storey, 2016) and rail cargo theft (Ashby & Bowers, 2015; Kit et al., 2019; Lorenc et al., 2020). These studies have provided valuable insights into the criminal activities of organised groups that steal commodities and how offenders conduct these criminal activities.

Several scholars and practitioners have noted certain differences between countries in the commission of cargo theft (BSI et al., 2022; Ellis, 2022; Sebyan Black & Fennelly, 2021; TAPA, 2021), such as the level of violence that is used in the commission of this crime in different countries (Analytica, 2017; Ekwall & Lantz, 2018; Queiroz, 2012). Burges (2013) argues that the way the “Rule of law” is applied and the “crime culture” of each country explains why the actions of offenders in some countries are more violent than others. For instance, in Mexico and Brazil criminal groups are more likely to use guns and violence in the commission of cargo theft than in European countries.

Regarding the modus operandi (MO), most current research has focused on categorising the locations where cargo theft occurs. The current literature has identified four types of
locations with more crime incidences and different modus operandi by the offenders. These types of locations are:

1. Non-secure parking locations. Scholars and practitioners have identified that cargo truck drivers tend to park their trucks in places with a considerable lack of guardianship, increasing the risk of theft (BSI and TT Club, 2021; Burges, 2013; Coughlin, 2012; Özberk, 2010). For example, in instances before unloading the truck, the driver may decide to park outside the installation (the location where the facilitation is located) of their final consumer. In these cases, it is possible that once they have left the truck, the merchandise or the truck itself is stolen.

2. Third-party facilities. Researchers have indicated that cargo thefts are committed at the destination or origin locations of the truck, such as at the locations where the logistics firms that are the owners of the cargo truck (and where the truck is loaded, ready to deliver its cargo), or at the locations of business where the cargo truck is loaded with merchandise (Ekwall & Lantz, 2016; Haelterman, 2016; Queiroz, 2012).

3. En-route transport mode facilities. Scholars and practitioners have found evidence that, where cargo theft is mainly non-violent, such as the USA or the EMEA region, the theft of cargo usually happens en-route to its destination (Friedman & Mitchell, 2003; International Road Transport Union, 2005; Mayhew, 2001). This occurs when the driver stops to eat, rest, or sleep at a petrol station, road siding or designated truck stop.

4. Supply chain facilities. Other research has shown that merchandise is stolen in the places where the cargo trucks are loaded (for example, the warehouse of an auto parts firm that contracts a cargo truck to move their merchandise to another firm). In this
case, researchers have noted that the workers of the supply chain company are likely to be involved in the crime (Haelterman, 2013; Lantz & Ekwall, 2020; Manuj & Mentzer, 2008; Rice Jr & Spayd, 2005; Urciuoli, 2010).

Although four types of locations have been identified with a higher prevalence of cargo theft, none of them involve highway segments when the truck is in transit. The lack of research about this type of location for cargo theft is likely due to the lack of adequate information to facilitate analysis of this particular modus operandi. To correctly identify the offenders' modus operandi requires identifying each act of theft on the highway where it is committed. Thus far, no known studies about cargo thefts on highways and the modus operandi that are used by offenders have been published.

A common finding in the literature is that cargo theft is usually not committed by a solo offender but involves a group of co-offenders with specific roles (Burges, 2013; Coughlin, 2012; Ekwall & Lantz, 2018; Sebyan Black & Fennelly, 2021). However, the specification of these roles has not been thoroughly explained. Overall, limited research exists about cargo theft on highways, the offenders' chosen modus operandi, and the role that offenders play in this co-offending activity.

Turning now to temporal and spatial patterns of cargo theft, several studies have identified seasonal patterns in cargo theft that are associated with social and economic factors. For example, some authors have identified that in the period prior to the Christmas shopping season, retailers require more merchandise. In turn, this implies that more trucks are required to transport goods around a country, creating more opportunities for offenders (Andresen & Malleson, 2013; Burges, 2013; Haelterman, 2009).
Ekwall and Lantz (2013) observed a concentration in cargo theft over the winter in the EMEA region (Europe, Middle East and Africa); this seasonality effect was related to the non-secured parking MO. Such an effect could be related to the attractiveness of the products that are commercially available in this season of the year. Other examples of seasonal effects on the levels of thefts that have been observed are associated with “extended three days weekends” (Burges, 2013; Coughlin, 2012; SENSITECH, 2022b).

As more cargo trucks are on the highways on three-day weekends, more opportunities exist to commit crimes.

Research on spatial patterning of cargo theft has been limited, focusing in identifying regions within a country where a higher level of incidence. Researchers have identified that cargo theft was higher in areas that are close to large cities and metropolitan areas, arguing that this is related to the increased economic activity in those places that facilitate the re-selling of stolen goods (Coughlin, 2012; De la Torre Romero et al., 2014; Justus et al., 2018). For instance, the metropolitan areas of Sao Paulo and Rio de Janeiro in Brazil (Aransiola et al., 2023; Guerin et al., 2021; Queiroz, 2012; Williams et al., 2013) and the metropolitan area of Mexico City in Mexico (Analytica, 2017; Beittel, 2022; de la Torre Romero et al., 2014) are areas that have been observed to experience higher incidences of cargo theft than other parts of their respective countries.

Burges (2013), identified in regions in Florida, Texas and California. He suggested that the demand for certain goods can change because of the high incidence of cargo thefts committed in commercial and logistics hubs in these US states. Ekwall (2009), Urciuoli (2010), Wagner & Bode (2008), mention that cargo theft tends to be more prevalent in areas with more industrial parks and logistics businesses. They suggest this prevalence
is associated with the significant concentration of firms representing more opportunities and less effort because of the close proximity of these businesses in certain areas.

Nonetheless, no known study to date has examined the spatial concentration patterns of cargo thefts on specific highway segments, despite highways being the main thoroughfare along which trucks travel. Moreover, research examining whether the geographic characteristics of particular highways and areas near them influence offenders’ choices about where they commit cargo theft has yet to be done. Both are novel proposals presented in this thesis.

2.7. Cargo theft as an example of the Geographic Intelligence Model

The proposed Geographic Intelligence Model (GIM) considers that offenders are likely to ponder and consider geographic conditions in their decision-making process associated with committing a cargo theft on highways. From planning the theft, the identification of suitable segments of the highway, the recruitment of co-offenders that are familiar with the geography of the places where offenders plan to act, and the activities after the robbery, are factors that offenders need to consider and are hypothesised to be influenced by geographic conditions.

In this chapter, I have reviewed the literature associated with the decision-making process of an offender, co-offending activities, the geographic patterning of crime and its concentration in specific places. I also examined the current literature on cargo theft incidence. The theoretical framework considered in this chapter will be revisited later in this thesis and will be expanded as part of the GIM.
This literature review presented in the current chapter provides a foundation for considering how applying the proposed GIM can help understand the geographical distribution of cargo theft on Mexican highways, identify the locations where offenders commit this crime, and the geographic conditions that influence the commission of these crimes. That is, it is likely that geography matters in the commission of cargo theft on highways in Mexico. The following empirical studies aim to introduce a methodological framework for a Geographic Intelligence Model about criminal activity illustrated using the example of cargo theft on highways in Mexico.
Chapter 3

A Methodological Framework to Analyse Cargo Theft on Mexican Highways

3.1. Introduction

Cargo theft is a crime that significantly impacts the flow of commodities and goods. This includes commodities associated with the automotive, pharmaceutical, electronics, and agriculture industries (Burges, 2013; Coughlin, 2012; Haelterman, 2013; Mayhew, 2001). Data about cargo theft are, however, often poorly recorded. Consequently, both scholars and practitioners have reported that the lack of data can complicate the analysis and the measurement of the impact of this crime (Criminal Justice Information Services Division, 2019; EUROPOL, 2009; Fischer et al., 2019; Williams et al., 2013).

Mexico is no exception. The collection of cargo theft data is a particular issue because of the differences in recording practices for cargo theft within the country’s law enforcement agencies (INEGI, 2021; Sensiguard, 2019; SENSITECH, 2020). No single consistent dataset on cargo theft on highways in Mexico exists. To address this problem and to ensure that data were of sufficient quality for the purposes of this doctoral thesis, two sources of cargo theft data were used. Details about these two sources are provided in the following sections. In the last section of this chapter, I also outline the techniques used to analyse these data. The chapters that relate to each specific empirical study provide more details about the methods used.
3.2. Mexican data sources of Cargo Theft

A comprehensive description of the crime commission process, as well as a spatial and temporal study of the evolution of cargo theft on Mexican highways should require a highly detailed examination of these incidents. To do so, information about when and how the offences were committed is required. The data must include information about the offenders’ behaviour and the geographic coordinates of the crimes. However, crime data that capture these spatial, temporal and modus operandi details in a single data source are limited in Mexico. To address this, I use data about cargo thefts from two sources:

1) the National Centre for Information (CNI) of the Executive Secretariat of the National System for Public Security (SESNSP) and

2) the National Institute of Transparency, Access to Information and Protection of Personal Data (INAI).

The reasons for using data from these two sources are explained in the following subsections. This includes a description of these data sources and how their content can be used for examining temporal, spatial and offender behaviour patterns about cargo thefts in Mexico.

3.2.1. Cargo Theft recorded by the SESNSP

The first data source on cargo theft in Mexico is recorded by the government institution responsible for generating and administering crime statistics in Mexico, the National System for Public Security (SNSP). The SNSP was created to manage the coordination between the federal, state and municipality institutions on matters relating to the
coordination of public security\textsuperscript{22}. An essential responsibility of the SNSP is to oversee the collection and generation of crime statistics. The Executive Secretariat of the SNSP (SESNSP) is responsible for reporting crime statistics to Mexico’s federal and state prosecutor’s offices. The SESNSP produces databases with criminal records and detailed monthly reports of national-level crime incidence from that information\textsuperscript{23}.

The databases managed by the SESNSP include administrative crime records of different types of crimes and whether the commission of the crime implies the use of violence or not. For the objectives of this research, only robberies of cargo trucks (with or without using violence in its commission) were considered. Cargo thefts are categorised in these data as “Robo” and by the subtype of “Robo a transportista”.

Although a highly detailed examination should involve specific geographic coordinates, hours and dates, the SESNSP’s information is only available as aggregated data at the state and municipality levels and is updated monthly. Crime data that is made available by the SESNSP is from January 2015\textsuperscript{24}. The SESNSP data is comprehensive in its national coverage and provides sufficiently detailed information for examining trends in cargo theft by month at the state and municipality levels. For the purposes of the current research, the data sourced from SESNSP was from January 2015 to December 2020.

\textsuperscript{22} The SNSP was created in 1995 by the Mexican Federal Government to encourage better coordination between the public security institutions, the police agencies, and the prosecutor’s offices of the three levels of government. Its functions are regulated by the “General Law of the National System of Public Security”. [http://www.diputados.gob.mx/LeyesBiblio/pdf/LGSNSP.pdf](http://www.diputados.gob.mx/LeyesBiblio/pdf/LGSNSP.pdf) (last accessed 20 May 2023)

\textsuperscript{23} Details of which can be found at [https://www.gob.mx/sesnsp/acciones-y-programas/incidencia-delictiva-87005?idiom=en](https://www.gob.mx/sesnsp/acciones-y-programas/incidencia-delictiva-87005?idiom=en) (last accessed 13 of December 2022)

\textsuperscript{24} There is an older version that considers a different definition of cargo theft on highways; however, the last report of that version is from 2017. In December 2014, the SNSP made the 09/XXXVII/14 agreement for which the “Instrumento para el Registro, Clasificación y Reporte de los Delitos y las Víctimas CNSP/38/15” (the new methodology) was mandatory for all the prosecutor’s office around the country. The legal framework for this change is found at: [http://www.dof.gob.mx/nota_detalle.php?codigo=5410499&fecha=05/10/2015](http://www.dof.gob.mx/nota_detalle.php?codigo=5410499&fecha=05/10/2015)
Figure 3.1 shows an example of the SESNSP data. These data include a data field with details about the year and month when the crime was registered. The data also includes the name of the state (ENT) and the municipality (MUN) where the crime was reported.

Section 2.5.1 mentioned the definition of cargo theft used by the SESNSP\textsuperscript{25}. Considering this definition, the SESNSP data is not sufficiently detailed to identify the exact locations (such as segments of the highways) where cargo thefts were committed – data are aggregated to municipalities and states. This limits what can be done with these data for the purposes of the proposed GIM in the current research. In the following section, I describe a second data source about cargo thefts. These data include precise information about where and when a national guard officer attended a cargo theft.

### 3.2.2. Cargo Theft on highways recorded by the National Guard

Mexican law\textsuperscript{26} states that when a police officer of the three levels of government – federal, state, and municipal – attends any crime event, the police officer is required to complete a form called the “Homologate Police Report” (“Informe Policial Homologado (IPH)”)\textsuperscript{27} to record their actions. On the IPH, the police officer records information about the type of

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\textsuperscript{25} SESNSP defines cargo theft as: “seizing a cargo transport, including traction vehicles designed for towing such as trailers, tank trucks, panel cabins, pipes, sheds, van, dump trucks and cranes, as well as transport movable property, with the intendment of dominance and without the consent of the person legally can grant it.”

\textsuperscript{26} Articles 41, fraction I; 43 y 77, fraction XI. General Law of the National System of Public Security

\textsuperscript{27} The IPH form can be reviewed here: [https://www.gob.mx/cms/uploads/attachment/file/527373/IPH-DELITOS.pdf](https://www.gob.mx/cms/uploads/attachment/file/527373/IPH-DELITOS.pdf) (last accessed 12 October 2021)
crime, the location where it occurred, and a description of the modus operandi. These data can hence provide another valuable data source about cargo theft for the current research.

Ideally, for the current research, the information recorded on IPHs would be available to study. However, access to the sensitive content in these reports is limited. To gain access to the IPH data, it was necessary to request this data from the National Institute of Transparency, Access to Information and Protection of Personal Data (INAI)\(^{28}\) in Mexico. The database includes information about highway cargo thefts between January 2016 to October 2020. The data shared by the INAI does not include all the details recorded for each cargo theft attended by the Mexican Federal Police/National Guard\(^{29}\) but contains sufficient information for research purposes. The data recorded by INAI does not, however, relate to all cargo thefts that have been committed. Instead, the INAI data refers to incidents of cargo theft that a National Guard officer has responded to and, in so doing, completed an IPH form.

The data provided by the INAI contains the name of the state (and in some cases, the municipality) where the cargo theft was committed, the date, time of the day, the code and name of the highway, and the kilometre marker (i.e., a 1 km reference point on the highway) where the theft was committed\(^{30}\). Although the INAI data is detailed, it does not include geographic coordinates for where the cargo theft occurred. The process for

\(^{28}\) As the National Guard receive public funds, they are obligated by the law to share some information if a person asks for it. In the cases of law enforcement agencies, they can reserve all or part of the information for “security reasons”. Details at https://home.inai.org.mx/ (last accessed 12 October 2021)

\(^{29}\) Since March 2019, the attribution of doing policing activities on federal highways corresponds to the National Guard, previously known as Federal Police. The legal details of that change could review at: http://www.diputados.gob.mx/LeyesBiblio/pdf/LGN_270519.pdf (last accessed 12 October 2021)

\(^{30}\) This information does not include the directionality on dual carriageway roads.
generating geographic coordinates for the INAI cargo theft data is explained in subsection

3.2.4. Figure 3.2 shows an example of the INAI data.

<table>
<thead>
<tr>
<th>Concept</th>
<th>Quantity</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of lines (segments) of the Federal highway network</td>
<td>115,151</td>
<td>Lines</td>
</tr>
<tr>
<td>Total kilometre length of the Federal highway network</td>
<td>50,685.63</td>
<td>kilometres</td>
</tr>
</tbody>
</table>

Table 3.1. Statistics of the Mexican National Highway Network (NHN) by Federal administration

31 In Spanish it is called “Red Nacional de Caminos”. It is updated yearly. The version used in this research can be consulted at [https://www.inegi.org.mx/app/biblioteca/ficha.html?upc=889463807452](https://www.inegi.org.mx/app/biblioteca/ficha.html?upc=889463807452) (last consulted 04 September 2022)

32 Just the Federal administration highways are included, given that the Mexican National Guard its primary jurisdiction relies on these highways.

33 The information of the NHN provided by the INEGI also includes data related to the localities, bridges, tunnels, and all the components of the Red Vial. Those objects are represented by points or polygons where it applies. For more details, review the “Documento Técnico Descriptivo Red Nacional de Caminos” (Instituto Nacional de Estadística Geografía e Informática (INEGI), 2019).
the NHN database have a series of attributes that distinguish them from others, such as official name, length, highway number, etc. Figure 3.3. shows an example of the NHN database. Figure 3.4 presents a visual representation of the NHN.

![Figure 3.3. Example of NHN database](image)

Source: INEGI
Figure 3.4. National Highway Network – Federal Highways
Although this data is valuable for the proposed study, a major issue with this data is the variation in the length of the highway segments. In some cases, the segments recorded in the NHN were 20 kilometres long, while others were as short as one metre. This variation in highway segment length could generate misleading results about cargo theft crime concentration if this not addressed, such as only long segments of highways being identified as routes of high cargo theft incidence. To address this, I developed a multistep geometric model to generate a dataset consisting of highway segments that were standardised to 10 kilometres in length (where possible). This process is described in section 5.3.3.34

### 3.2.4. Method for geocoding INAI information

One of the limitations of the INAI database is the absence of geographic coordinates. Although geocoding algorithms are available in various GIS software35, they tend to be unreliable for non-urban roads, and the coordinates assigned to the crime record does not reflect the real location of the crime (Bigham et al., 2009; Longley et al., 2005; Park et al., 2011; Wellner & Qin, 2011). For example, geocoding algorithms often generate coordinates corresponding to the centroid of a highway segment, which may not be the actual location of the incident. This is especially problematic in areas with long highway segments (+20kms), where the geographic context can vary significantly from the centroid to the start or end of the segment.

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34 10km was chosen as it offers a practical and significant level of detail for highway infrastructure analysis without overly fragmenting the highway segment network.
35 GIS software such as ArcMap or QGIS (via a plug-in called MMQGis) offers the possibility of geocoding an event with the name and number of the street/highway.
To match cargo theft to the geographic dataset of National Highway Network segments, I designed a process to transform and geocode the INAI database using tools and algorithms contained within QGIS software\textsuperscript{36}. Figure 3.2 shows that INAI's database contains information about the state (in some cases, the municipality), the name of the highway, date, time of day, and kilometre marker where the officer reported the cargo theft. This information makes it possible to locate the latitude and longitude of the cargo theft incident. To ensure the geocoded data were precise, I developed a method that included manually examining 100% of all the events reported. This method ensured that all incidents of cargo theft \((n=2,473)\) were geocoded to their nearest kilometre marker.

This manual process first looked to identify the start and end points of the segments described in the INAI database for each event. For this, a second dataset was used - “Datos viales 2020 (DV20)”\textsuperscript{37}. The DV20 data includes the name, code, and, most notably for the goals of this work, the start and end coordinates of each highway segment. The DV20 also contains information that offers a reference for looking for specific points along the Mexican highway network segments. Figure 3.5. shows an example of this data.

\textit{Figure 3.5. Example of the DV20 for the state of Guanajuato, highway: MEX-045}

\textit{Source: Datos Viales 2020, Ministry of Communications and Transports (SCT)}

\textsuperscript{36} Unless otherwise stated, the spatial exercises presented in this work were calculated using QGIS 3.16.0 with GRASS 7.8.4.

\textsuperscript{37} The information of the Mexican Highways Network is administrated by the Ministry of Communications and Transports (SCT). Available at: \url{https://www.sct.gob.mx/carreteras/direccion-general-de-servicios-tecnicos/datos-viales/2020/} (last consulted, 03 September 2022)
The process to geocode the INAI’s information was as follows:

1. Check the highway’s name and the segment where a national guard reported a cargo theft in the INAI’s database.

2. Search for the highway name and segment from step 1 in the DV20.

3. After identifying the segment in the DV20, extract from the column “coordenadas” the latitude and longitude of the segment (these coordinates are the closest point to the cargo theft).

4. In Google Maps, look for the coordinates extracted in point 3.

5. After identifying the location in point 4, look manually for the exact kilometre marker in the INAI’s database (which supposedly is closest to the coordinates identified in point 4).

6. Once the exact kilometre was identified using Google Maps, copy the coordinates and add them to the final database.

Figure 3.6 shows an example of identifying a segment’s geographical coordinates from DV20 and looking for the point where the cargo theft was reported.

![Image: Example of identification of coordinates on google maps]
The final step involved generating two variables in the original INAI database: the latitude and longitude of each reported cargo theft. Figure 3.7 shows an example of the final version of the database used in the subsequent analyses.

<table>
<thead>
<tr>
<th>ID</th>
<th>Year</th>
<th>Date</th>
<th>Time</th>
<th>Coordination</th>
<th>Municipality</th>
<th>PF station</th>
<th>Km</th>
<th>Code HIG</th>
<th>Highway</th>
<th>Segment</th>
<th>Ycoord</th>
<th>Xcoord</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010010001</td>
<td>2016</td>
<td>03/01/2016</td>
<td>12:00:00</td>
<td>GUANAJUATO</td>
<td>Celaya (Cto)</td>
<td>ESTACIÓN CE</td>
<td>47</td>
<td>45D</td>
<td>QUERÉTARO</td>
<td>QUERÉTARO</td>
<td>20.56</td>
<td>-100.097222</td>
</tr>
<tr>
<td>2010010002</td>
<td>2016</td>
<td>04/01/2016</td>
<td>11:20:00</td>
<td>ZACATECAS</td>
<td>ZACATECAS</td>
<td>ESTACIÓN ZA</td>
<td>54</td>
<td>54</td>
<td>ZACATECAS</td>
<td>ZACATECAS</td>
<td>23.250525</td>
<td>-102.339933</td>
</tr>
<tr>
<td>2010010003</td>
<td>2016</td>
<td>05/01/2016</td>
<td>01:05:00</td>
<td>VERACRUZ</td>
<td>VERACRUZ</td>
<td>ESTACIÓN CO</td>
<td>14</td>
<td>10D</td>
<td>COATZACAL</td>
<td>COATZACAL</td>
<td>18.000007</td>
<td>-94.503417</td>
</tr>
<tr>
<td>2010010004</td>
<td>2016</td>
<td>07/01/2016</td>
<td>01:30:00</td>
<td>GUANAJUATO</td>
<td>EL LLANO (A)</td>
<td>ESTACIÓN LLO</td>
<td>136.4</td>
<td>45</td>
<td>QUERÉTARO</td>
<td>BEJARATO-LE</td>
<td>20.87037888</td>
<td>-101.311092</td>
</tr>
<tr>
<td>2010010005</td>
<td>2016</td>
<td>08/01/2016</td>
<td>09:40:00</td>
<td>CUIDAD DE MÉRIDA</td>
<td>CÚCULAR</td>
<td>ESTACIÓN CM</td>
<td>92</td>
<td>57.0</td>
<td>MÉRIDA-M</td>
<td>PALACIO-TEC</td>
<td>19.99570101</td>
<td>-09.48175208</td>
</tr>
<tr>
<td>2010010006</td>
<td>2016</td>
<td>09/01/2016</td>
<td>05:00:00</td>
<td>TUXCALA</td>
<td>CALPULALPA</td>
<td>ESTACIÓN CA</td>
<td>192</td>
<td>57.0</td>
<td>ATLANCO-M</td>
<td>LIMITES DE</td>
<td>20.87030303</td>
<td>-95.642606</td>
</tr>
<tr>
<td>2010010007</td>
<td>2016</td>
<td>09/01/2016</td>
<td>08:30:00</td>
<td>IULUSCO</td>
<td>IULUSCO</td>
<td>ESTACIÓN IPS</td>
<td>51.1</td>
<td>00D</td>
<td>ZAPOTLAN-M</td>
<td>ZAPOTLAN-M</td>
<td>20.5523</td>
<td>-102.2911</td>
</tr>
</tbody>
</table>

Figure 3.7. Final geocoded database

Regarding the geographic precision, each of the cargo theft coordinates was recorded within 10 meters of the lines reported by INEGI, which represent the segments of the highways. Thus, this process ensures that the registered cargo thefts are in the locations reported by the National Guard officers.

Figure 3.8 shows an overview of the process developed to geocode the INAI database:

The geocoding of the INAI database was one of the most challenging activities of this research. The lack of information provided by the National Guard and the limited precision of the current GIS algorithms for geocoding at the highway level demanded significant research time. However, the proposed geographic intelligence model demands a level of detail that requires the identification of specific micro-places and time to infer the impact of the surrounding geographical conditions. Moreover, the process designed to ensure
the geocoded cargo theft data was intended to avoid the effect of a low geocoding hit rate. As Ratcliffe (2004, p. 71) states, “The lower the hit rate, the greater the potential for error in spatial patterns, and there certainly exists the potential to underestimate the magnitude of any problem”. The following subsection details the use of the INAI and the SESNSP databases as part of this research.

3.3. A strategy for using SESNSP and INAI data

As explained in the previous section the data available from SESNSP provides a complete national dataset about cargo theft in Mexico but is aggregated to states and municipalities. The INAI dataset is less complete, but it is more geographically precise, but only contains data on incidents that have been responded to by the National Guard. Consequently, I decided to use both datasets to conduct exploratory temporal and spatial analyses to identify patterns of cargo theft.

First, I used the SESNSP dataset to analyse the monthly evolution of cargo theft and its distribution by state and municipality. Second, I used the INAI dataset to conduct spatial analysis of cargo theft to identify patterns of crime concentration and the specific segments of the Mexican highway network with the most incidents and the specific hour when these incidents were committed.

The variations in reporting practices across the two data providers results in a different number of observed events. As mentioned in the previous section, the SESNSP includes all cargo theft incidents, including those committed in locations other than highways (for example, in the loading bay areas of logistics businesses, and in truck parking areas, among others). The INAI database includes only the cargo thefts committed on a highway
reported by the National Guard. Table 3.2 illustrates this difference, showing that the INAI only captures about 9% of the cargo thefts that are recorded in the SESNSP database.

Table 3.2. Observations by the source of cargo theft 2015 – 2020

<table>
<thead>
<tr>
<th>Year</th>
<th>SESNSP</th>
<th>INAI</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>6,741</td>
<td>0</td>
</tr>
<tr>
<td>2016</td>
<td>8,599</td>
<td>289</td>
</tr>
<tr>
<td>2017</td>
<td>12,031</td>
<td>339</td>
</tr>
<tr>
<td>2018</td>
<td>13,068</td>
<td>185</td>
</tr>
<tr>
<td>2019</td>
<td>11,659</td>
<td>894</td>
</tr>
<tr>
<td>2020</td>
<td>9,521</td>
<td>735</td>
</tr>
<tr>
<td>Total</td>
<td>61,619</td>
<td>2,442</td>
</tr>
</tbody>
</table>

Even though there is a substantial difference in the number of incidents recorded on these two databases, each data source has its merits. As mentioned above, each data source is valuable for different objectives. The data recorded by SESNSP can be used to identify patterns of cargo theft at the national level; for example, to identify geographic clusters with more cargo thefts and temporal trends. The data from INAI can be used to identify the specific segments of the highways where cargo thefts were attended (i.e., a micro-level spatial analysis), as well as a more detailed temporal analysis using hours. Identifying these micro-places and hours with more crimes is central to the proposed GIM. This INAI data was determined to be sufficiently complete to examine cargo theft concentration patterns, and whether variables such as the surrounding geographic conditions, sociodemographic, economic/industrial activities, or hours of the day (and their inherent conditions) influence the cargo theft commission process.

The variations between the SESNSP and INAI datasets stem from several factors, primarily their differing levels of granularity and reporting mechanisms. The SESNSP dataset aggregates cargo theft incidents at the broader municipality level, providing a general overview of crime trends across regions. In contrast, INAI’s data offers a more
granular perspective, but only refer to incidents attended by National Guard officers and documented through IPH forms. As a result, SESNSP’s dataset encompasses a broader range of incidents, potentially including unreported or unattended thefts, whereas INAI’s dataset only reflects incidents formally documented by law enforcement. This means that SESNSP data are higher in volume than that recorded by INAI, and that levels of incidents year on year between these two datasets may not follow the same temporal trends (as shown in Table 3.2). However, as will be shown in the results of subsequent studies, the spatial concentration patterning of cargo thefts from these two data sources are similar.

Another difference is the data periods of these two datasets. As Table 3.2 shows and mentioned in Section 1.2.2, the database provided by the INAI does not include information from 2015, nor November 2020 or December 2020. In that sense, the results of the temporal analyses between SESNSP and INAI are also not comparable. This was another reason for using SESNSP for the purpose of analysing general temporal patterns and using the INAI data for a more specific hour-oriented temporal analysis.

Although the two data sources do not have the same number of observations, using both data was the most practical solution to perform the proposed temporal and spatial analyses. This involved using the SESNSP data to initially identify if cargo thefts were unevenly geographically distributed at the state and municipality levels in Mexico. Then the INAI data were used to examine more precise spatial patterns within the areas where the SESNSP data reported high levels of cargo theft. These same data could also be used for temporal analyses. First, to identify trends and patterns of monthly concentration (using SESNSP data), and then to examine the time-of-day patterns (using INAI data).
3.4. Analytical Methods

To test the hypotheses proposed in this thesis (as described in section 1.3), I used a mixed-method research design that involved applying a set of quantitative and qualitative techniques. First, quantitative techniques were used to examine the spatial and temporal patterns and calculate the concentration level of cargo thefts. These studies are presented in Chapters Four and Five.

The second part of the research involved a qualitative process for examining the crime commission of cargo theft. This drew from the analysis of SESNSP and INAI data, but also, I used open-source intelligence (OSINT) about cargo theft to perform crime script analysis of the crime commission of cargo theft. This study, and details about the use of OSINT, is presented in Chapter Six.

The final part of the research used the principles of geographic profiling to analyse the cargo thieves’ spatial decision-making behaviours to identify strategic locations that are potentially important to their operational activities. This geographic profiling analysis considers the influence of geographic conditions of the micro-places where cargo theft occurs, alongside considerations of offenders’ journey to crime and geographic activity nodes (i.e., places from which offenders conduct activities associated with their criminal behaviour). This study is presented in Chapter seven.

Collectively, these empirical studies form the inputs of the proposed Geographic Intelligence Model (see Figure 3.9.)
The next chapter describes the first part of spatial analysis, involving analysing cargo theft at the state and municipal levels.
Chapter 4

Spatial and Temporal Patterns of Cargo Theft across Mexico

4.1. Introduction

The spatial and temporal concentration of crime has been a central research focus in criminology and crime science. Chapter Two mentioned that numerous studies have demonstrated that crime is not randomly distributed across time and space but instead exhibits a marked tendency to cluster in specific locations and at particular times. Researchers have used various methods to explore these patterns, including many different spatial and temporal clustering techniques. The insights gained from these studies have led to the development of a range of targeted crime prevention and reduction strategies, including problem-oriented policing, situational crime prevention, hot spots policing and intelligence-led policing (Braga et al., 2019; Clarke, 1997; Madensen & Eck, 2008; Ratcliffe, 2016).

This chapter introduces initial temporal and spatial analyses as part of the proposed Geographic Intelligence Model on criminal groups (GIM). I present a temporal component to evaluate the monthly evolution of cargo theft over the study period. The second part is the spatial component; here, I focus on macro-level spatial analysis identifying Mexican municipalities with higher concentration of cargo theft. Then, the second part of the spatial analysis identifies statistically significant clusters of municipalities with more crimes.

Drawing on an extensive dataset of cargo theft incidents across Mexico, I employ various spatial and temporal analysis techniques to identify the locations with a higher
concentration of cargo theft over time. The findings aim to show that criminal groups tend to identify places with particular conditions that facilitate the commission of this crime type. The central objective of this chapter is to answer the first research question:

- **Is cargo theft unevenly distributed across Mexico in space and time?**

To respond to this question, I propose the following hypothesis:

- **Hypothesis 1**: cargo thefts across Mexico are concentrated in specific months.
- **Hypothesis 2**: cargo theft is spatially clustered at the municipal level across Mexico.

The initial empirical investigation explores whether cargo theft exhibits non-uniform distribution along January 2015 to December 2020. Employing months as the unit of analysis due to the minimal temporal granularity provided by SESNSP, I use an Exploratory Data Analysis (EDA) approach to evaluate hypothesis 1. Further details on this analysis are provided in subsection 4.3.1.1, where I justify the selection of specific statistical techniques for identifying temporal concentration.

For hypothesis 2, the analysis investigates the spatial clustering of cargo theft incidents using Mexico’s 32 states and 2,471 municipalities as the areal units of analysis. Adopting an Exploratory Spatial Data Analysis (ESDA) approach and examining spatial autocorrelations, I aim to identify statistically significant clusters of cargo theft across Mexico. A more comprehensive explanation is provided in subsection 4.3.1.2

In addition to the present introduction, this chapter proceeds as follows: First, I refer to the relevant literature on spatial and temporal crime concentration. Second, I describe the analytical techniques for examining temporal and spatial patterns. Next, I present the results from exploratory temporal and spatial analyses of cargo theft at the state and
municipal levels. I then use spatial analyses to identify statistically significant clusters of cargo theft across Mexico. After presenting the results, I discuss municipalities and regions with the highest levels of cargo theft and the potential implication of these results as part of the proposed GIM. By doing so, this initial spatial analysis leads to hypothesising why cargo thefts concentrate in certain regions and foregrounding the ensuing empirical studies. In the last sections of this chapter, the main limitations of using the proposed techniques are discussed, and the key findings of the current study are reviewed to determine if the results provide sufficient evidence to accept or reject the proposed hypotheses related to the temporal and spatial concentration of cargo theft.

4.2. Temporal and Spatial Concentration of criminal activity

The spatial and temporal concentration of criminal activity refers to the observation that crime occurs in a minority of geographic regions and at specific times. This section presents a discussion of the literature on temporal concentration and is followed by the theoretical reasoning for spatial concentration. Both approaches include concepts such as the routine activity approach, crime pattern theory and specific methodologies to explain the temporal and spatial concentration of criminal activity.

The time when a crime occurs is not random (Chainey, 2021; Gill et al., 2007; Pyle, 1976; Rossmo, 1995b). Potential offenders look for opportunities depending on the conditions that a specific time of day or the year's season can offer (such as the lack of light or products in-demand in certain seasons). In that sense, scholars have suggested that identifying temporal concentration is an important component in studying crime patterns and offender decision-making because it helps identify the temporal patterns of crime and
potential causal forces contributing to them (Ceccato, 2005; Haberman & Ratcliffe, 2015; Ratcliffe, 2006; Vilalta, 2013).

The temporality of settings can play a significant role in determining the surrounding conditions that incentivise the commission of a crime (Brunsdon et al., 2007; Johnson & Bowers, 2010; Ratcliffe, 2006; Roth et al., 2013). Crimes occur when offenders identify a potential target/victim due to a lack of guardianship. The geographical space and the time when offenders and targets/victims converge affect this chemistry of crime. That is, offenders are likely to choose when to commit a crime because of the presence of suitable targets and the absence of capable guardians (Beauregard et al., 2007; Coughlin, 2012; McCutcheon et al., 2016), which vary over time. Studies have shown that crime is not randomly distributed across temporal periods, illustrating specific months, days and even hours when more crime occurs (Boldt & Borg, 2017; Haberman et al., 2017; Ratcliffe, 2010; Tompson, 2016).

The temporal concentration of crime can be identified at different temporal aggregation levels. Such temporal concentration can be short-term patterns (hourly, daily or weekly) through to longer-term patterns over months and years. Identifying temporal trends, specifically at monthly or seasonal incidence, helps to identify the underlying factors contributing to the fluctuations in specific crime types. For example, whether weather impacts the temporal distribution of criminal activity (Ceccato, 2005; Haelterman, 2013; van Sleeuwen et al., 2021), or, pertinent to this research, the demand patterns for particular products over time (Andresen & Malleson, 2013; Ekwall & Lantz, 2013; Justus et al., 2018). Perhaps, because of the impact that a particular seasonal condition has on
potential offenders’ decision-making, seasonal patterns in crime have been studied extensively (for a recent literature review check (Castle & Kovacs, 2021)).

Regarding the spatial concentration of crime, it can occur at different levels of geographic aggregation, from large areas like regions of a country or cities to smaller areas like blocks and street segments. Academics have shown that crime tends to concentrate in certain areas, with a small number of locations accounting for a large proportion of criminal activity (Bernasco & Steenbeek, 2017; Hardyns et al., 2019; Levin et al., 2017; Weisburd, 2015). Environmental factors and sociodemographic variables often influence the high level of crimes in those areas (Bichler et al., 2012; Ekwall, 2012a; Morselli, 2009a). As this thesis strives to show, the surrounding geographical context plays a significant role in the decision-making of offenders’ when committing a crime in a specific location.

Researchers and practitioners have long been interested in examining the level of geographic resolution to identify the “high-crime areas” of criminal activity (Chainey & Ratcliffe, 2005; Eck et al., 2005, 2017; Oberwittler & Wikström, 2009; Openshaw, 1984; Sherman & Weisburd, 1995; Tompson et al., 2009). Sherman et al. (1989) pioneered the study of crime concentration, introducing the term “hot spot” to identify specific places where criminal activity is concentrated. They identified that most of the calls to the police concerned very few places within Minneapolis and that these places had particular characteristics that could facilitate the commission of a crime. The measurement of spatial concentration of crime pertains to the uneven distribution of opportunities for crime throughout geographical space. Many spatial and statistical techniques, such as spatial

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38 Sherman et al. based their analysis on examples of carcinogenic “hot spots” (Mason et al., 1985) that are locations with highly high cancer mortality rates. As well as examples of rural western counties related to automobile fatalities in the United States (Baker et al., 1987).
autocorrelation analysis and kernel density estimation, are used to identify the specific places where crimes are observed to concentrate (Andresen, 2011; Bernasco & Elffers, 2010; Chainey & Ratcliffe, 2005; Tita & Greenbaum, 2009; Townsley, 2009).

Understanding the spatial concentration of crime is essential to identifying potential causes of crime and risk factors that contribute to its concentration in specific areas. The geographical attributes of “high-crime areas” can offer opportunities for crime in those locations; for example, highways with junctions to secondary roads can facilitate the offenders’ escape (Agnew, 2020; Van Daele & Beken, 2011). Identifying the spatial concentration of crime is hence critical for highlighting the geographic conditions and the environmental backcloth related to the criminal activities carried out in “high-crime areas” and “hot spots”.

Regarding cargo theft, previous research has emphasised the relevance of studying seasons rather than study variation over months because crime distribution can be analysed in relation to its association to the retail season (Boldt & Borg, 2016; Ekwall & Lantz, 2013, 2015b; Justus et al., 2018). Such studies have shown that the season of the year is likely to influence offenders' decision-making to commit cargo theft. Depending on the season, potential offenders look for specific products to sell in legal and illegal markets. Additionally, offenders consider sociodemographic, economic, or weather conditions to define the most appropriate time to commit the crime and the necessary

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39 The concept of environmental backcloth was initially mentioned in section 2.4.2 and refers to environmental factors such as buildings, parks, road networks, and sociodemographic variables, among others, that affect where offenders decide to commit a crime (Jeffery, 1971; Mayhew, 1976).
equipment that is needed at these times to accomplish the robbery (Analytica, 2017; Casella, 2011; Ekwall, 2009; Shepherd, 2017).

Research on cargo theft has highlighted the relevance of studying specific regions with high crime concentrations due to the significant economic losses and supply chain disruptions caused by the thefts (Burges, 2013; Ekwall & Lantz, 2016, 2018; Haelterman, 2013; Hayes, 2007). However, few studies have focused on analysing specific clusters of spatial concentration of this type of crime. Therefore, proposing statistical spatial analysis to identify clusters of municipalities with higher incidences of cargo theft in Mexico is a novel approach to complement current research about this type of crime.

4.3. Data and Methods to identify patterns of temporal and spatial cargo theft

Chapter three described the two primary data sources (SESNSP and INAI databases) for this research and the strategy for using them to develop the GIM. This chapter uses the data provided by the SESNSP to conduct temporal and spatial analyses. The SESNSP database, as described in section 3.2, consists of monthly aggregate counts of cargo thefts at the state and municipality levels. The analyses presented in this Chapter include cargo theft of all types included in the SESNSP’s definition

\footnote{As mentioned in Section 2.6.1., the SESNSP defines cargo thefts as: “seizing a cargo transport, including traction vehicles designed for towing such as trailers, tank trucks, panel cabins, pipes, sheds, van, dump trucks and cranes, as well as transport movable property, with the intention of dominance and without the consent of the person legally can grant it.”}
office from January 2015 to December 2020. The temporal and spatial analyses presented here include a descriptive analysis of the monthly and annual trends and the spatial distribution of cargo thefts at the state and municipality levels.

4.3.1. Exploratory Spatio-temporal Data Analysis

Exploratory Spatial Data Analysis (ESDA) is a method for statistically examining a variable in a determined space (Anselin, 1996). ESDA is defined as,

“The extension of exploratory data analysis (EDA) to the problem of detecting spatial properties of data sets where, for each attribute value, there is a locational datum. This locational datum references the point or the area to which the attribute refers.” (Haining et al., 1998, p. 1).

The exploratory data analysis conducted in this chapter is part of the analytical process to identify spatial and temporal patterns in cargo theft data. These methods should be “considered as data-driven analysis” (Anselin, 1996, p. 113). Such analysis aims to provide some initial insights into the patterning of cargo thefts in time and space in Mexico.

4.3.1.1. Examining temporal distribution

Academics and practitioners have used several statistical methods to measure the temporal concentration of crime, including time series analysis, seasonality analysis (using statistical techniques, such as ANOVA or t-tests), and event clustering analysis (Chainey, 2021; Khalid et al., 2018; Ratcliffe, 2006; Rossmo et al., 2012; Wheeler, 2016). Using these methods, researchers can identify specific periods with statistically significant changes in crime and the intensity and duration of these changes. To date, there is limited research that has used these techniques for examining temporal patterns of cargo theft.
Hence, in this research, I propose a complementary approach to understanding the impact of time on offenders’ decision-making.

In what follows, I use an ESDA approach to visualise the temporal patterns in the cargo theft data. The first task involves a descriptive analysis of temporal patterns of cargo theft. This analysis begins by examining the monthly evolution of cargo theft to determine if certain months experience more incidents than others. Following the work of others (Boldt & Borg, 2016; Chainey, 2021; Roth et al., 2013), I use a “temporal heatmap” to visualise the concentration by month of each year for which data were available. To statistically test the temporal concentration, I used a one sample statistical test. As a parametric test, the one-sample \( t \)-test determines whether the mean of a single sample (the temporal distribution of cargo theft) differs from a specified value. However, this test is only valid if the data follows a normal distribution or if the sample size is large enough, as guaranteed by the central limit theorem (Parab & Bhalerao, 2010; Ramachandran & Tsokos, 2021).

Considering the tendency of certain crimes to concentrate in specific places, scholars have noted that crime is likely to present a non-normal statistical distribution. In these cases, they have used alternative tests such as Wilcoxon signed rank test or the Kolmogorov-Smirnov test (Andresen & Malleson, 2011; Curtis-Ham et al., 2022; Fisher, 2021; Bowers, 2004). Assuming that cargo theft does not present a normal distribution, I use the one-sample Wilcoxon signed-rank test, also known as the one-sample Wilcoxon test (Wilcoxon, 1945). Unlike parametric tests, non-parametric tests like the one-sample Wilcoxon test do not require data to belong to any particular parametric family of
probability distribution. The Wilcoxon test was applied using the R package ggstatplot: v0.11.1.9000; (Patil, 2021)41

4.3.1.2. Examining spatial distribution

Maps that show spatial patterns of crime are popular tools that police agencies use to illustrate the places where criminal activity occurs (Chainey et al., 2008; Chainey, Serrano–Berthet et al., 2021; Ratcliffe, 2000). A straightforward technique for visualising crime patterns by geographical area is choropleth maps (Almeida et al., 2003; Ashby, 2016; Monmonier, 1974). Choropleth maps “are used to symbolize data of this type and when there is considerable range in ratio values the data are classed into relatively few groups” (Jenks, 1963, p. 18).

Choropleth mapping42 is a helpful technique to show spatial patterns, statistical variation and the different values of the variable of interest on a map (Schiewe, 2019; Stewart & Kennelly, 2010). Because of their utility and ease of interpretation, scholars and practitioners have used these maps to represent the concentration or patterning of different types of crimes (Brunsdon et al., 2007; Chainey & Ratcliffe, 2005; Roth et al., 2013). Choropleth maps require selecting an appropriate geographic unit, such as a county or state, and shading the areal units based on the magnitude of the variable of interest, which for the current research is cargo theft in Mexico.

Defining thematic classes or categories in a choropleth map requires careful consideration for meaningful data representation. An incorrect definition of the categories

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41 For a more detailed explanation of this package: https://indrajeetpatil.github.io/ggstatsplot/index.html (last reviewed 09 May 2023)
42 Maps generated in this section used QGIS, version 3.16. Examples of choropleth maps in other software can be consulted: https://datavizcatalogue.com/methods/choropleth.html (last accessed 21 May 2022)
can lead to a misinterpretation of the geographical concentration of the variable (Jenks & Caspall, 1971; Slocum et al., 2008; Stewart & Kennelly, 2010). The most common data categorisation systems used in choropleth mapping are equal intervals, equal frequencies of objects in the classes, and statistically optimal classification (Andrienko et al., 2001; Schiewe, 2019; Slocum et al., 2008).

A choropleth map requires considering the statistical data distribution of the variable subject to analysis because it impacts the classification method and the number of categories. In cases when the data is strongly skewed (like much crime count data), scholars suggest not using equal intervals or quantiles to represent the data (Andrienko, et al., 2001; Chen et al., 2013; Jenks & Caspall, 1971; Schiewe, 2019). In such cases, using natural breaks may be more appropriate43. The Jenks’ breaks method reduces each group’s average deviation from the group, meanwhile maximising each group’s deviation from the means of the other groups (Brewer & Pickle, 2002; Chen et al., 2013; Jenks, 1963). Hence, I use the natural breaks method because of the skewed data distribution.

4.3.2. Spatial autocorrelation methods

This part of the analytical process aims to identify if a statistically significant spatial pattern of cargo theft exists in Mexico. This involves examining the concepts of global and local autocorrelation. Global spatial autocorrelation is used to examine whether the levels of a variable of interest (in this case, crime) in areas that neighbour each other are similar. Local spatial autocorrelation can be used to identify where spatial clusters of similar

43 Most choropleth maps in this chapter were created using the "Natural Breaks (Jenks)" statistical distribution. Nonetheless, throughout this thesis, there are instances where maps were generated using an alternative statistical distribution. This was done because equal intervals proved to be a more practical approach for conveying the research objectives by accurately representing the underlying data.
values are observed. The proposed spatial autocorrelation methods focus on the municipality level. In the next subsections, details of these spatial analysis methods are described. The software employed to run the statistical analysis is the open-source software GeoDa\textsuperscript{44}.

\subsection*{4.3.2.1. Moran’s I}

Introduced by Moran (1948), the global autocorrelation measure Moran’s I indicates the relationship between the variable of interest and its spatial lag, considering the variable in deviations from its mean (Anselin, 1995). The null hypothesis behind Moran’s I is that the variable of interest exhibits spatial randomness. This suggests that the attributes of the location of a variable are not a function of the attribute at surrounding locations (Almeida et al., 2003; Griffith & Chun, 2014). Formally the Moran’s I equation is:

\[ I = \frac{n}{\sum \sum w_{ij}} \frac{\sum \sum w_{ij} (y_i - \bar{y})(y_j - \bar{y})}{\sum (y_i - \bar{y})^2} \]

Where \( n \) is the number of geographic locations, \( y \) is the value of the observation (i.e., number of cargo thefts), and \( w_{ij} \) is a spatial weight for the locations \( i \) and \( j \). The two sigma represent the sum of all the spatial weights (Anselin, 1995, 1996, 2020). The result of the \( I \) value needs to be tested by a normal distribution with Z values (Cliff et al., 1981; Goodchild & Mark, 1987).

As a regular statistical correlation, the values of Moran’s I are between [-1, 1]. When the value is greater than 0, positive spatial autocorrelation is present. This means that

\textsuperscript{44} GeoDa is an open-source software developed by Dr Luc Anselin and his team to do spatial data science. It can be downloaded from: \url{https://geodacenter.github.io/index.html} (last accessed 09 of November 2021)
geographic areas have similar values to their neighbouring areas. When the value is less than 0, negative spatial autocorrelation is present. This means that geographic areas have values that are different from their neighbours. If the value is zero, it implies that the values are randomly distributed (Anselin, 1996; Chainey & Ratcliffe, 2005; Townsley, 2009). Studies that have examined the spatial autocorrelation of crime at various geographic scales have tended to show that positive spatial autocorrelation is observed (Almeida et al., 2003; Andresen, 2011; Anselin, 2003; Getis, 2010; Messner et al., 1999).

When using spatial autocorrelation it is essential to consider the dimension of the dataset. The concept of dimension refers to the number of spatial coordinates used to represent a location (Anselin, 1988; Bivard et al., 2013; Cliff and Ord, 1970; Griffith, 1992). Three types of dimension have been proposed:

One-dimensional spatial autocorrelation: the aerial unit of analysis is represented by a single coordinate, such as distance along a line. This might be used to analyse changes in a variable along a specific road.

Two-dimensional spatial autocorrelation: the aerial unit of analysis is represented by two coordinates, typically latitude and longitude, allowing for analysis on a map. It is often used to analyse the spatial distribution of crime (Anselin, Cohen et al., 2000; Baller et al., 2001; Chakravorty, 1995).

Three-dimensional spatial autocorrelation, the aerial unit of analysis is represented by three coordinates: latitude, longitude, and altitude. This can be used to analyse spatial patterns in data points across three dimensions, such as the distribution of air pollution at different elevations.
When examining the spatial autocorrelation of cargo theft at the state and municipal level, the data can be described as two-dimensional. In this instance, each state and municipality occupies a specific position on a map, identified uniquely by two coordinates: latitude and longitude. Then, the spatial autocorrelation analysis considers not only the relationships between neighbouring states or municipalities but also their relative positions in geographical space.

4.3.2.2. Spatial Contiguity

A matrix of spatial weights with information about the surrounding areas is required to calculate Moran's I. The matrix of spatial weights is a concept inherent to examining spatial autocorrelation (Anselin, 1995; Getis, 2009; Griffith, 2003; Ord & Getis, 1995). Creating a spatial weight matrix requires representing spatial contiguity.

Spatial contiguity refers to how to define whether surrounding geographic units share a border or not. As Griffith defined: “Nearby or neighboring georeferenced values of the same variable can be identified by an n-by-n binary geographic connectivity/weights matrix, say, $c_i$; if two locations are neighbors, then $c_{ij} = 1$; if not, $c_{ij} = 0$” (Griffith, 2003, p. 3). This means that a binary criterion of a neighbourhood can be generated, which in the case of two geographic places is to determine if they are neighbours (share a boundary). Hence, a value of 1 is assigned if they share a boundary, and a zero value is assigned if this is not the case. Two of the most common spatial contiguity arrangements are the “Rook contiguity” and the “Queen contiguity”. As their name indicates, both are analogous to the same-named pieces of chess and their respective movements.
A “Rook contiguity” relates to geographic units that share at least one vertex with a neighbour. “Queen contiguity” is a matrix where the geographic units have a common border (edge or vertex). Queen neighbours will be at least as large as the defined number of geographic units in the “rook neighbourhood” (Anselin, 2003; Anselin & Rey, 2014). An example of how Queen and Rook adjacency look is provided in Figure 4.1. In the current study, Moran’s I for cargo thefts at the municipality level was calculated using both the Rook and Queens contiguities and the results were compared.

4.3.2.3. Moran’s I scatter plot

The Moran scatter plot is a graphical way to represent Moran’s I autocorrelation values (Anselin, 1996). The horizontal axis represents the values of the variable of interest $y_i$, the vertical axis represents the spatial lag of $W_y$, that is, the average of the values of the closest places defined by the rook or queen contiguity; the top of the chart shows the autocorrelation’s value. Anselin (1996) states that this bivariate scatter plot helps visualise the linear association between $W_y$ against $y_i$, which is the relationship between the average number of events that happen around the place of interest and this place itself.

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45 For a more detailed analysis of the technical characteristics, see: (Anselin & Rey, 2014; Getis, 2009)
In this study, I used Moran’s I to show if the levels of cargo theft in areas that neighbour each other are similar. If they are similar, I will assume a statistical association that can be positive or negative. Figure 4.2. is an example of a Moran’s I scatter plot. The figure is divided into four quadrants arranged around the 0,0 axis. Each quadrant represents a different association between the value of $y_i$ at any given location and its surrounding spatial lag $w_iy_i$ (Anselin, 1996). Figure 4.3. summarises how to interpret each quadrant:
4.3.3. Local Indicators of Spatial Association (LISA)

Local Indicators of Spatial Association (LISA) (Anselin, 1995) can be applied to identify geographical clusters of areas with high values surrounded by other areas with high values. Anselin (1995, p. 94) defined the method as follows:

a. “The LISA for each observation gives an indication of the extent of significant spatial clustering of similar values around that observation.

b. The sum of LISAs for all observations is proportional to a global indicator of spatial association.”

In the current research, two LISA methods are used to identify local spatial association,
1. *Local Moran’s I*, as proposed by Anselin (1995), and

2. *G_i* statistic, as proposed by Getis and Ord (1992).

Each technique is explained in the following subsections.

### 4.3.3.1. Local Moran’s I

The first LISA method used in the current study is Local Moran’s I. Mathematically; the following equation represents this:\footnote{For a more technical explanation review (Anselin, 1995; Getis & Ord, 1992; Ord & Getis, 1995). For practical issues, refer to: \url{https://geodacenter.github.io/workbook/6a_local_auto/lab6a.html} (last reviewed 11 November 2021)}

\[
I_i = \frac{\sum_j w_{ij} (y_i - \bar{y}) (y_j - \bar{y})}{\sum_i (y_i - \bar{y})^2}
\]

This expression means that the relation between the place \(y_i\) is a function of the weighted sum \((w_{ij})\) of the values at neighbouring locations \(y_j\). In this sense, it is possible to infer if specific places of the geographic region of interest are related to each other. Intuitively, if values around the observation of interest have similar values, the area will likely form a spatial cluster.

Figure 4.3 shows an example of a Moran’s I scatter plot with four quadrants representing different spatial relationships between the place of interest and its neighbours. The local Moran’s I statistic expands this plot by generating results that can be mapped to show the four types of local spatial autocorrelation (high-high, low-low, high-low, low-high) (Anselin et al., 2013; Chainey & Ratcliffe, 2005). In the current study, *Local Moran’s I* is applied to cargo theft data to determine the types of spatial autocorrelation patterns observed at the local level (i.e., between municipalities).

I opted to use municipalities as they serve as the smallest administrative units with distinct boundaries, offering discrete spatial units for analysis. By applying spatial autocorrelation
techniques, it is possible to measure the degree of similarity or dissimilarity in attribute values, such as cargo theft incidents), among neighbouring municipalities. Moreover, municipalities as the unit of analysis simplify the comparison of spatial patterns and enable the identification of spatial clusters at the local or regional scale. The result of the analysis can be expressed in one of four categories:

- **High-High** refers to municipalities with a high number of cargo thefts being surrounded by other municipalities with a high number of thefts reported.
- **Low-Low** refers to municipalities with a low number of cargo thefts being surrounded by other municipalities with a low number of reported thefts.
- **High-Low** refers to municipalities with a high number of cargo thefts being neighbours of other municipalities with a low number of reported thefts.
- **Low-High** refers to municipalities with a low number of cargo thefts being neighbours of other municipalities with a high number of reported thefts.

### 4.3.3.2. $G^*_i$ statistic

The family of $G$ statistics ($G_i$ and $G^*_i$), was introduced by Getis and Ord in 1992. As they stated in their innovative work, the objective of $G$ statistics is “to evaluate the spatial association of a variable within a specified distance of a single point” (Getis & Ord, 1992, p.1). Getis and Ord proposed these statistics to complement Moran’s I to identify clusters of spatial dependency that a global spatial autocorrelation measure does not detect\(^{47}\). $G_i$ and $G^*_i$ are written as follows:

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For both statistics, the concentration of an observation (or lack of it) is calculated by summing the weighted average of the values of the neighbours $y_j$ of the variable $y_i$ in the region of analysis. The interpretation of the $G$ statistic is straightforward following the interpretation of Moran’s $I$ scatter plot; if the value of the $G$ statistic is larger than the mean, it suggests a High-High cluster. If the value of $G$ is smaller than the mean, it suggests a Low-Low cluster. The main difference between the two statistics is that the $G_i$ statistic does not include the value at the location $y_i$ whereas $G_i^*$ does. For this research, I used the $G_i^*$ statistic to complement Moran’s $I$ and the Local Moran I cluster analysis to examine if cargo thefts were unevenly distributed across Mexico.

To elaborate on the statistical exercises presented in this chapter, I used the municipality boundaries as the input field to calculate the $G_i^*$. Whereby if a “High-High cluster” is detected, it implies that municipalities with high levels of cargo thefts surround other municipalities with high levels of cargo theft. If it is a “Low-Low cluster”, those municipalities do not represent a cluster of cargo theft concentration. When a High-Low or Low-High cluster is detected, these two categories denote a mixed pattern of dissimilar values (municipalities with higher levels are neighboured by municipalities with low thefts). The following section presents the main results of this first empirical study.
4.4. Results: Temporal and Spatial concentration of cargo theft across Mexico

4.4.1. Temporal Distribution

Starting with annual patterns, Table 4.1 shows the changes in the number of cargo thefts in Mexico between 2015 to 2020 and the per cent variation from the previous year. From this, we see that cargo theft peaked in 2018. The increase between 2016 and 2017 was the greatest between any two consecutive years when reported thefts increased by ~40%. After 2018 a decrease was observed, and by 2020 there were 27.2% fewer cargo thefts compared to 2018. However, cargo thefts reported in 2020 were 30% higher than in 2015.

<table>
<thead>
<tr>
<th>Year</th>
<th>Total cargo thefts</th>
<th>Per cent variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>6,741</td>
<td></td>
</tr>
<tr>
<td>2016</td>
<td>8,599</td>
<td>27.6%</td>
</tr>
<tr>
<td>2017</td>
<td>12,031</td>
<td>39.9%</td>
</tr>
<tr>
<td>2018</td>
<td>13,068</td>
<td>8.6%</td>
</tr>
<tr>
<td>2019</td>
<td>11,659</td>
<td>-10.8%</td>
</tr>
<tr>
<td>2020</td>
<td>9,521</td>
<td>-18.3%</td>
</tr>
</tbody>
</table>

Source: SESNSP (last reviewed 10/11/2021)

Figure 4.4 shows the concentration of thefts by month over the five-year data period. There was a consistent increase in cargo thefts between the second half of 2016 and November 2018, when incidents of cargo thefts peaked at 1,245 cargo thefts in that month. After 2018 the level of cargo thefts remained stable until May 2020, after which declines were observed in 2021.

This temporal analysis aims to answer the research question: Is cargo theft unevenly distributed across Mexico in time? and test the hypothesis if cargo thefts across Mexico
are concentrated in specific months. As an initial result, Figure 4.4 shows that the
distribution of crimes does not look concentrated in any particular month during the study
period (i.e., a month that consistently is orange or red each year). While November and
December had the highest concentration of crimes in 2017 and 2018, this was not the
case in all years.

![Figure 4.4. Evolution of Cargo theft, January 2015 to December 2020](image)

Although Figure 4.4 suggests the non-existence of monthly concentration, it is necessary
to carry out a statistical test to reject or accept the hypothesis of temporal concentration.
As mentioned in section 4.3.1.1, I use parametric and non-parametric statistical one-
sample tests to examine if cargo thefts across Mexico are concentrated in specific months
using as a null hypothesis there is no concentration. Table 4.2 shows the distribution per
month over the six years in the study period, and the associated descriptive statistics.
Table 4.2. Distribution total of cargo theft per month

<table>
<thead>
<tr>
<th>Month</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>4,950</td>
</tr>
<tr>
<td>February</td>
<td>4,899</td>
</tr>
<tr>
<td>March</td>
<td>5,284</td>
</tr>
<tr>
<td>April</td>
<td>5,010</td>
</tr>
<tr>
<td>May</td>
<td>4,943</td>
</tr>
<tr>
<td>June</td>
<td>4,856</td>
</tr>
<tr>
<td>July</td>
<td>4,978</td>
</tr>
<tr>
<td>August</td>
<td>5,142</td>
</tr>
<tr>
<td>September</td>
<td>5,044</td>
</tr>
<tr>
<td>October</td>
<td>5,480</td>
</tr>
<tr>
<td>November</td>
<td>5,646</td>
</tr>
<tr>
<td>December</td>
<td>5,387</td>
</tr>
<tr>
<td>Total</td>
<td>61,619</td>
</tr>
<tr>
<td>Mean</td>
<td>5,135</td>
</tr>
<tr>
<td>Median</td>
<td>5,027</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>255.67</td>
</tr>
<tr>
<td>Skewness</td>
<td>0.79</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>-0.36</td>
</tr>
</tbody>
</table>

As with Figure 4.4, Table 4.2 shows that no month has a value considerably different from the mean and the median. However, the positive skewness value reflects that the data do not conform to a normal distribution. As the skewness value is marginally greater than zero, the distribution can be considered non-normal. I next use a non-parametric Wilcoxon test to examine if cargo theft is statistically concentrated. Figure 4.5 presents the result.

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48 A distribution with a positive skewness is considered to be right-skewed. This implies that the mean is greater than the median and the mode.
Figure 4.5. Histogram of cargo theft per month and Wilcoxon test

Figure 4.5 shows a p-value that is less than 0.05, indicating that there is less than a 5% probability that the difference between the observed mean and the expected mean could have a random occurrence. As the result is statistically significant, I can reject the null hypothesis that the means are equal.

The results of the statistical analyses of temporal patterns of cargo thefts suggests that specific months of the year present a trend to concentrate more crimes than others. Based on Figure 4.4 and Table 4.2, November experienced most incidents of cargo theft. This means there is trend in that in November there are more cargo thefts in Mexico than at any other month in the year.
4.4.2. Geographical Distribution of Cargo Theft in Mexico

The results for the geographic distribution of cargo theft in Mexico are presented using the statistical approaches described in section 4.3. First, the results of the ESDA are presented using choropleth maps to show the distribution of cargo theft by states and municipalities. The second approach shows the results from the spatial autocorrelation techniques. Finally, the third approach uses LISA techniques to identify statistically significant clusters of municipalities with higher levels of cargo theft concentration.

4.4.2.1. State level distribution

Descriptive statistics for this distribution of cargo thefts across the 32 states in Mexico are provided in Table 4.3.

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Cargo thefts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>0</td>
</tr>
<tr>
<td>Maximum</td>
<td>22,125</td>
</tr>
<tr>
<td>Mean</td>
<td>1,925.59</td>
</tr>
<tr>
<td>Median</td>
<td>199.50</td>
</tr>
<tr>
<td>Std Deviation</td>
<td>4,326.49</td>
</tr>
<tr>
<td>Std error</td>
<td>764.82</td>
</tr>
<tr>
<td>Skewness</td>
<td>3.66</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>15.65</td>
</tr>
<tr>
<td>1st quartile</td>
<td>24.25</td>
</tr>
<tr>
<td>3rd quartile</td>
<td>1,290.50</td>
</tr>
<tr>
<td>Interquartile range</td>
<td>1,266.25</td>
</tr>
<tr>
<td>n</td>
<td>61,619</td>
</tr>
</tbody>
</table>

Table 4.3 shows a considerable variation in the data; for example, one state reported more than twenty-two thousand cargo thefts, and at least one reported zero. Similar to the temporal analysis, the skewness is positive, which means a non-normal distribution.
The high Kurtosis value implies that a few extreme values are far from the mean. This suggests there are certain States where cargo theft is more prevalent than in others. This result provides the first indication of an uneven distribution of cargo thefts in states across Mexico and that incidents of cargo theft are likely to be concentrated in a small number of states.

While past findings can suggest a potential uneven distribution, it is important to consider the probable impact of the “edge effects” (Cliff and Ord, 1980 and Griffith, 1983, 1988). The non-uniform boundaries of states (as well as municipalities) may bias the results observed in the Kurtosis and the Skewness values. For instance, a heavily skewed distribution of cargo theft can be linked to variables such as economic activity, geographic centrality, and population. Multiple factors can contribute to the spatial patterns of criminal activities, and cargo theft is no exception. I delve further into this topic in section 4.6.

Figure 4.6 shows the distribution of the cargo thefts across Mexican states between 2015 and 2020. This result shows that cargo theft was committed in 30 of the 32 states in Mexico during the study period. Figure 4.6 also shows that seven states recorded levels of cargo above the mean: Estado México, Puebla, Michoacán, Nuevo León, Morelos, Jalisco and Tlaxcala.
Figure 4.6. Distribution of Cargo Theft by Mexican States

Figure 4.7 shows a map of the number of cargo theft incidents for each state. This map was generated using the quartiles classification \(^{49}\); with the data divided into five groups, each representing approximately 20% of the total data points in each group.

Visual inspection of Figure 4.7 suggests three areas of the country with a higher incidence of cargo thefts. These areas are located in the central area of the country, the west-Pacific coast, and the Northeast area of Mexico. Within these regions are eight states (25% of all the Mexican states) that collectively accounted for 93% of all the cargo thefts reported in Mexico during the study period \(^{50}\). The main result of this first step of the study is that cargo thefts appear unevenly distributed at the state level across Mexico.

\(^{49}\) The quantile statistical classification method places the same number of observations within each class. With five classes, the maps were quintile maps.

\(^{50}\) The data on cargo theft by the 32 states are presented in Annexes.
Figure 4.7. Geographical distribution of cargo thefts at the state level between 2015-2020
4.4.2.2. Municipal level concentration

Table 4.4 shows the descriptive statistics of the distribution of cargo thefts across the 2,471 Mexican municipalities.

Table 4.4. Summary statistic for cargo theft in Mexico per municipality January 2015 to December 2020

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Cargo thefts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>0</td>
</tr>
<tr>
<td>Maximum</td>
<td>3,260</td>
</tr>
<tr>
<td>Mean</td>
<td>24.92</td>
</tr>
<tr>
<td>Median</td>
<td>0</td>
</tr>
<tr>
<td>Std Deviation</td>
<td>153.27</td>
</tr>
<tr>
<td>Std error</td>
<td>3.08</td>
</tr>
<tr>
<td>Skewness</td>
<td>12.88</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>205.92</td>
</tr>
<tr>
<td>1st quartile</td>
<td>0</td>
</tr>
<tr>
<td>3rd quartile</td>
<td>3</td>
</tr>
<tr>
<td>n&lt;sup&gt;51&lt;/sup&gt;</td>
<td>61,375</td>
</tr>
</tbody>
</table>

Similar to the distribution of cargo thefts across states, the municipalities show a high variation in the data. The Skewness and Kurtosis values at the municipal level are much higher than those recorded at the state level. This implies that certain municipalities have a much higher incidence of cargo theft than the mean. The heavier skew in these findings are discussed in section 4.6.

Figure 4.8 plots the cargo theft distribution by municipalities, showing the number of incidents for the five municipalities with the most cargo thefts. – each of these

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<sup>51</sup> Despite being the same temporality, the number of cargo thefts varies between states and municipalities. In the SESNSP registers, some thefts were not reported in a particular municipality and were only added to the total by state.
municipalities experienced over 1,900 incidents of cargo theft. These results indicate that cargo thefts are concentrated at the municipal level in Mexico.

Figure 4.8. Distribution of cargo theft by Mexican Municipalities

Figure 4.9. shows a municipal-level choropleth map\(^5\) to visualise the distribution of cargo theft and identifies the municipalities with higher levels of cargo theft incidence. Like the state level, Figure 4.9 shows that most of the municipalities with the highest cargo thefts were located in the country’s central area.

---
\(^5\) As mentioned in section 4.3.1.2, the “Natural breaks (Jenks)” statistical distribution is an acceptable classification method for cases when the data distribution shows high variability, as is the case of cargo thefts at the municipal level. Based on that irregular distribution, I selected this type of distribution because it reduces each group’s average deviation from the group.
Figure 4.9. Distribution of cargo thefts at the municipal level between 2015-2020

Source: Secretariado Ejecutivo del Sistema Nacional de Seguridad Pública (SESNSP)
Note: Values varies respect with the states because in some of them the cargo theft was registered on the state without the detail of the municipality where the theft was committed.
Between 2015 and 2020, 1,082 municipalities in Mexico registered at least one cargo theft, representing 44% of all municipalities. Of these, only 103 municipalities (4.2% of all municipalities) experienced more than 100 cargo thefts, accounting for 82% of all cargo thefts registered during the study period. These results suggest that cargo thefts are unevenly distributed across Mexico and appear to concentrate in a relatively small number of municipalities.

4.4.2.3. Identification of cargo theft clusters using autocorrelation techniques

The second statistical approach concerns the spatial autocorrelation of cargo theft, the results of which are presented in Table 4.5. This shows evidence of positive spatial autocorrelation ($I$ statistic > 0 and $p < 0.01$) for cargo theft across Mexican municipalities each year and for each measure of queen and rook spatial contiguity. These results mean that municipalities are likely to be surrounded by other municipalities with similar levels of cargo theft. These levels of cargo theft could be high (i.e., high-high areas) or low (i.e., low-low areas).

<table>
<thead>
<tr>
<th>Years</th>
<th>Convention</th>
<th>$I$ statistic</th>
<th>Probability level*</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015 to 2020</td>
<td>Queen</td>
<td>0.320</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>Rook</td>
<td>0.323</td>
<td>0.001</td>
</tr>
<tr>
<td>2017</td>
<td>Queen</td>
<td>0.278</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>Rook</td>
<td>0.279</td>
<td>0.001</td>
</tr>
<tr>
<td>2018</td>
<td>Queen</td>
<td>0.328</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>Rook</td>
<td>0.331</td>
<td>0.001</td>
</tr>
<tr>
<td>2019</td>
<td>Queen</td>
<td>0.360</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>Rook</td>
<td>0.365</td>
<td>0.001</td>
</tr>
<tr>
<td>2020</td>
<td>Queen</td>
<td>0.322</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>Rook</td>
<td>0.327</td>
<td>0.001</td>
</tr>
</tbody>
</table>

* Empirical pseudo-significance based on 999 random permutations
Figures 4.10 and 4.11 show Moran I scatter plots of cargo thefts for each type of spatial contiguity matrix. The results illustrate that most values in both scatter plots are in the upper right quadrant, representing high-high areas. That is, the main pattern of spatial autocorrelation observed is where municipalities with a high number of thefts were surrounded by other municipalities with a high number of thefts.

Table 4.5, Figures 4.11 and 4.12 show that cargo theft in Mexico presents a positive global spatial association between 2015 to 2020, which is preliminary evidence of no spatial randomness of the distribution of cargo theft within Mexican municipalities.
4.4.2.4. Local Moran I of cargo theft

Turning to the local spatial autocorrelation statistics (LISA), Figures 4.12 and 4.13 show the Local Moran’s I results for both Queen and Rook spatial contiguities. Both contiguities are used to avoid any potential bias\textsuperscript{53} of using administrative boundaries (municipalities) to measure spatial concentration. Both results show evidence of significant spatial concentration ($p < 0.01$) of cargo thefts across Mexico.

Of most interest in Figures 4.12 and 4.13 are the areas identified as high-high. The existence of these areas reveals clusters of municipalities that experienced high levels of cargo theft. Both contiguities (Queen and Rook) show six groups of municipalities with statistically significant clusters of cargo theft (the high-high areas). Although the "high-high" areas can be considered the most relevant, other areas to highlight are the "high-low" and "low-high" areas. These two areas indicate the existence of municipalities with a high level of cargo thefts surrounded by municipalities where few thefts were reported.

4.4.2.5. $G_i^*$ clusters of cargo theft

Figure 4.14 shows the $G_i^*$ statistic results for cargo theft in Mexican municipalities. Several high-high (in red) and low-low (in blue) areas of significant spatial association of cargo thefts are observed. Nevertheless, the same six specific clusters of municipalities with high-high values as identified using Local Moran’s I were identified using $G_i^*$\textsuperscript{54}. These municipalities are located in the states of Estado de México, Puebla, Michoacán, Morelos, Tlaxcala, Michoacán y Jalisco. The $G_i^*$ results provide further support that cargo theft is significantly clustered in a few areas in Mexico. Section 4.5 discusses these results.

\begin{footnotesize}
\begin{enumerate}
\item Potential bias explanation is discussed in the Limitations section.
\item Annex 9.2. shows the significance map of $G_i^*$ statistic cluster by Queen & Rook contiguity.
\end{enumerate}
\end{footnotesize}
Figure 4.12. Map of LISA local Moran I clusters for cargo theft 2015-2020 – Queen contiguity

Cluster map "Queen Contiguity"
- High-High (122)
- Low-Low (282)
- Low-High (68)
- High-Low (2)
- Not significant (1995)

Note: The weights to calculate the spatial correlation were created using the "Queen contiguity"
Figure 4.13. Map of LISA local Moran I clusters for cargo theft 2015-2020 – Rook contiguity
Figure 4.14. Map of the $G_i^*$ clusters for High cargo theft incidence 2015-2020 – Queen Contiguity

Note: The weights to calculate the spatial correlation were created using the “Queen contiguity”
4.5. Discussion - Cargo theft Clusters

The main objective of this first empirical study was to investigate the distribution of cargo theft across Mexico in space and time. To achieve this, I conducted a series of descriptive temporal and spatial analyses to identify trends in the concentration of cargo theft incidents on a monthly and state level. Additionally, I employed a statistical approach to examine the spatial concentration of cargo theft at the municipal level.

The findings of the study indicated evidence of trends of temporal concentration of cargo theft, particularly during October, November, and December. These findings are consistent with previous research that has identified a higher concentration of cargo thefts in the months leading up to high-consumption seasons, such as the Christmas season (Burges, 2012; Justus et al., 2018). These findings suggest that cargo thefts do not occur randomly throughout the year but exhibit distinct patterns and concentrations during specific periods. Offenders may strategically target these times, such as the period before Christmas when there is an increased demand for goods, making them more available, more valuable and desirable targets.

Turning to spatial concentration, the initial exploratory analysis using choropleth maps revealed that cargo thefts were unevenly distributed across Mexico from 2015 to 2020. 93% of all the cargo thefts reported were committed in eight states out of 32 (25%). Only 100 municipalities out of 2,407 (4.2%) accounted for 80% of thefts. This high level of concentration underscores the need to identify the factors that influence offenders' decisions to target specific areas (Andresen et al., 2017; Ashby & Bowers, 2015; Chainey et al., 2019; Chalfin et al., 2021; O'Brien, 2019). The selection of specific locations to commit a crime may respond to specific conditions at those places, as suggested by crime
pattern theory (Almeida et al., 2003; Andresen & Kinney, 2012; Ekwall et al., 2016b). This concentration may be influenced by various factors, including geographical conditions, economic activities, and sociodemographic characteristics.

Statistical analyses using Moran's I confirmed positive spatial autocorrelation, indicating that municipalities with high cargo theft incidence tend to be surrounded by others with similarly high levels of theft. Furthermore, using Local Indicators of Spatial Association (LISA) identified six clusters of high cargo theft activity in Mexico. These clusters suggest that while cargo theft occurs in many municipalities across the country, only a small number of them appear to have optimal conditions that facilitate multiple cargo thefts.

Another relevant finding was the existence of high-low and low-high clusters. This means that some municipalities recorded high incidence of cargo thefts, but their neighbours recorded lower levels. This is one the most interesting findings of this study. This suggests that some municipalities have very specific conditions that their neighbours do not have. Considering the theoretical principles of rational choice, crime pattern theory and journey to crime that suggest that offenders are likely to consider the effort and risk versus potential earnings, these high-low clusters suggest that certain municipalities have specific conditions that attracts offenders. Meanwhile, other municipalities nearby do not have these conditions. For example, municipalities near industrial areas could be more attractive to cargo thieves, and their neighbours without industrial activities may not be attractive to cargo theft. Acknowledging these conditions can help to better understand potential risk factors linked to cargo theft commission. Identifying specific characteristics that facilitate the commission of a crime is one of the main objectives of the proposed GIM.
The findings of the temporal and spatial analyses have important implications for the understanding of crime pattern theory, crime generators, and rational choice theory with respect to cargo theft. Identifying six clusters of cargo theft activity in Mexico suggests a potential relationship with these theoretical principles. Crime pattern theory posits that criminal activities are not randomly distributed but rather exhibit patterns and concentrations (Andresen & Kinney, 2012; Andresen & Malleson, 2011; Brantingham et al., 2016; Brantingham & Brantingham, 1984). The presence of these clusters aligns with the idea that certain areas may have conditions that are strongly conducive to the commission of cargo theft.

Meanwhile, rational choice theory posits that offenders make decisions based on a cost-benefit analysis, weighing the potential rewards against the risks involved (Bowers, 2014; Brantingham & Brantingham, 1993a; Cornish & Clarke, 2013). The clustering of cargo thefts in certain municipalities and states suggests that offenders are likely influenced by the perceived benefits and risks associated with targeting these areas. Factors such as the presence of valuable cargo, inadequate security measures, or limited law enforcement resources may make these locations more attractive for cargo thieves.

Furthermore, the clusters with high levels of cargo theft may possess characteristics such as economic opportunities, transportation infrastructure, or specific socio-demographic conditions that attract a high volume of suitable targets and facilitate the cargo theft. In that sense, these clusters can be considered as a crime enablers places. The environmental factors that facilitate criminal activity (Bernasco & Block, 2011; Brantingham & Brantingham, 1995; Leonard, 2017) can be applied to these clusters, albeit to the coarse geography of municipalities, rather than specific places.
When examining the spatial distribution of cargo theft, it is important to address the issue of spatial concentration and its relationship with population distribution. While areas with higher population density are more likely to experience higher levels of cargo theft, this alone does not fully explain the spatial distribution observed. The spatial concentration of cargo theft may be influenced by many factors beyond population density, such as economic activities, transportation infrastructure, and specific sociodemographic conditions. These factors create circumstances that can attract a higher volume of suitable targets for cargo theft and facilitate the commission of such crimes.

To gain deeper insights beyond mere population distribution, it is crucial to consider denominators that account for the potential targets and opportunities within each area. While the numerator is directly related to the crime in analysis, the denominator is often tricky to define (Boggs, 1965; Clarke, 2002; Harries, 1981). For example, an ideal denominator would be the number of trucks that cross through each municipality's highways. This would allow us to compare cargo theft incidents to the actual exposure and vulnerability, providing a more nuanced understanding of spatial risk. Unfortunately, data for this denominator was unavailable.

Despite this limitation, the findings still provide valuable insights into areas with more cargo theft incidences. For instance, the results can identify opportunities for targeted interventions that help to reduce the number of cargo thefts. Understanding what makes specific highways more vulnerable than others is better examined when specific highway segments that experience high levels of theft are identified. This is a topic of study that follows in the subsequent chapters.
4.6. Limitations and further work

An initial limitation of the current study is its reliance on the police-recorded crime data. The database provided by the SESNSP relies on each state police agency to record cargo thefts. This data, however, could be subject to differences in recording practices by each state police agency in Mexico. Identifying differences in police crime recording practices and addressing this limitation was not within the scope of this current study. Although the findings of this chapter are of value, it is important to acknowledge that the precision of the data at the state and municipality levels limit a comprehensive consideration of these theoretical principles.

A second limitation relies in the temporal component. As mentioned in section 4.4.1, a statistical test was carried out to identify monthly concentration and evidence of this was found. However, the lack of temporal detail, such as specific hours at the state and municipal level, means that the results cannot be considered conclusive. This is especially the case because of the high-level of spatial concentration, which can bias the results at the national level. As reported in subsection 4.4.2.1, only five states reported most of the thefts; then, the effect can be representative only for those states even when cargo theft is widespread at the national level.

The main limitation of this chapter is related to the choice of geographic unit of analysis. This choice can significantly impact the validity and reliability of the study’s findings. For example, using broad geographic areas to analyse highly concentrated crimes, can lead to inaccurate or misleading results. Using fixed geographic units, such as state or municipality administrative boundaries, may not account for changes in the environmental background that affect crime concentration over time and space.
Using geographic units not explicitly created for research purposes is a prevalent issue for most spatially aggregated data. This problem has been recognised for a long time, with Openshaw coining this ‘the modifiable areal unit problem’ (MAUP). As Openshaw states (1984, p. 3) "the areal units (zonal objects) used in many geographical studies are arbitrary, modifiable, and subject to the whims and fancies of whoever is doing, or did, the aggregating". Scholars have identified that boundary changes can affect crime pattern concentration. For example, potential changes in administrative units can modify the results between different study periods (Jaitman & Ajzenman, 2016; Mohler et al., 2019; Prieto Curiel & Bishop, 2016; Weisburd et al., 2016).

In the spatial analyses presented in this chapter, the effect of the MAUP is a possible limitation, as the results of the spatial analyses can be sensitive to the size and shape of the areal units used. This issue arises due to adopting fixed administrative boundaries as the geographic units for analysis, which may result in a bias in detecting crime pattern distributions. For example, using municipalities that are irregular in shape may make it difficult to accurately measure the spatial concentration of cargo theft. Larger municipalities may hide the spatial concentration of cargo theft that is evident in the smaller geographic units.

While acknowledging the potential impact of the MAUP on the analysis conducted in the current study, the analysis was limited to using municipalities because this was the smallest geographic area to which the information from SESNSP on cargo theft is disaggregated. Additionally, it is the largest data set available on cargo theft in Mexico. Though the analysis conducted in this first empirical approach provides valuable insights into the spatial concentration of cargo theft and the identification of clusters, further
examination at a more granular level, would provide a deeper understanding of the underlying factors and mechanisms driving crime patterns.

Another potential limitation regarding the geographical unit of analysis is related to the edge effects. The edge effect\(^{55}\) refers to border-zone areas that show a higher crime concentration than internal areas of the geographical area in analysis. The non-homogeneous distribution are likely to be related to changes in the characteristics of the borders between the analysed region (Brantingham and Brantingham, 1975, 1978; Song et al., 2015; Theter et al., 2020).

At the geographic unit of analysis presented in this Chapter, cargo theft patterns may exhibit "edge effects" at the boundaries of different states and municipalities. These effects can manifest in variations in the frequency, intensity, or modus operandi of cargo theft incidents. The conditions contributing to these variations might include the following:

- Variability at their borders: as states and municipalities do not have a homogeneous shape, this can create distinctive patterns that deviate from the interior of each area.

- Law enforcement disparities: Variances in strategies and effectiveness between municipalities could contribute to shifts in criminal behaviour at these boundaries.

- Economic and Infrastructural Influences: Socioeconomic factors, transportation networks, and the presence of key facilities like warehouses or industrial zones can contribute to "edge effects" in cargo theft.

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\(^{55}\) Also known as “border-zone hypothesis” (Brantingham and Brantingham, 1975).
• Organised criminal groups: The activities of these groups might be influenced by the geographic conditions at the edges of municipalities, affecting their modus operandi and target selection.

It is imperative to consider the impact of edge effects when conducting a spatial analysis of cargo theft concentration at the state and municipal levels. This allows for a thorough comprehension of crime patterns. Edge effects acknowledge that criminal activities may not be constrained to administrative boundaries but can spill over into neighbouring regions. Potential offenders may exploit vulnerabilities in adjacent areas, and the patterns of theft in one state or municipality can be influenced by some of the described conditions along its borders.

Finally, another potential concern is the ecological fallacy (Robinson, 1950). The aggregate measures, such as counts per geographic unit, may oversimplify crime patterns and hide variations within geographic units. Scholars have mentioned that the ecological fallacy can result in misinterpreting crime concentration and potentially lead to biased outputs (Chainey & Ratcliffe, 2005; Hipp, 2007; Hipp & Kim, 2017; Steenbeek & Weisburd, 2016). Mainly, this can be a concern when examining cargo theft at the macro level. Assuming that characteristics observed at the municipal or state level accurately represent the behaviour or characteristics of micro-units (such as highway segments) within those regions would be a fallacy.

For instance, it would be incorrect to assume that all potential offenders within a state with a higher incidence of cargo theft are equally likely to engage in cargo theft. This is because aggregate-level data may not fully capture the heterogeneity and complexities present at the micro-level. Thus, conclusions made solely from macro-level analyses may
not accurately reflect the behaviours, motivations, or circumstances of individuals involved in cargo theft. To address this potential issue, the second empirical study in this thesis examines the distribution of cargo thefts using highway segments as the geographic unit of analysis.

4.7. Conclusions

The empirical study presented in this chapter has examined whether cargo theft is distributed unevenly across Mexico in time and space. I conducted a series of exploratory temporal and spatial analyses to identify clusters of cargo theft by months, states and municipalities. The analysis identified that cargo theft was concentrated in specific municipality clusters nationwide. I found only weak statistical evidence of temporal concentration at the monthly level, but there was significant statistical evidence of spatial clustering at the municipal level. In particular, the analyses demonstrated the spatial concentration of cargo theft by identifying positive autocorrelation and six specific clusters. Overall, these results suggest not rejecting the hypothesis of temporal and spatial concentration of cargo theft in Mexico.

The spatial clustering of cargo theft results suggests there would be value in conducting a more geographically precise analysis to understand the conditions within these regions that contribute to the occurrence of the crime. Factors such as temporal conditions (such as the lack of light), target selection, and the geographic proximity to urban areas are likely to play a role in the persistence of cargo theft in these areas.

To fully explore the theoretical principles exposed in the literature review, it would be necessary to access more detailed data that captures the micro-level spatial patterns of
cargo theft incidents. This would enable a more precise analysis of the relationship between various characteristics of specific locations, such as land use and demographic characteristics, and the patterning of crime. Such a detailed analysis would contribute to a more nuanced understanding of the factors influencing cargo theft and inform targeted interventions to disrupt criminal activities, as the GIM attempts to do.

Hence, the next part of the research aims to examine whether cargo theft is concentrated at specific highway segments and then analyse if geographical and sociodemographic characteristics in these locations’ influence the commission of cargo theft.
Chapter 5

Micro-places with a higher concentration of cargo thefts on Mexican highways

5.1. Introduction

Identifying locations that experience high levels of crime is a key component of the proposed Geographic Intelligence Model (GIM). The spatial analyses presented in the previous chapter revealed that just 4.2% of all Mexican municipalities experienced 82% of all registered cargo thefts. Furthermore, the analyses showed six clusters of municipalities where high levels of cargo theft were statistically significant. These results showed that cargo theft is a highly concentrated type of crime and suggests that certain conditions likely influence its commission in the locations where the thefts are committed.

Once the states, municipalities and clusters with higher incidence have been identified, the next step was to identify the distribution of cargo theft within these clusters. To do this involved identifying the specific locations where cargo thefts occur.

Identifying specific segments of highways can provide further insights into the unequal distribution of cargo thefts. Specific highway segments where these thefts occur may experience geographical conditions that explain why certain segments experience more cargo thefts than others across the highway network. Such highway segments may only experience cargo thefts at particular times. The next stage of the proposed GIM involves examining the specific micro-places where most cargo theft occurs and when these places experience these offences.
The primary objective of the study presented in this chapter is to answer the following research questions and they respective hypotheses:

*Research question 1: Are cargo thefts across Mexico concentrated in specific hours?*

Hypothesis: cargo thefts across Mexico are concentrated in specific hours of the day.

*Research question 2: Are cargo thefts across Mexico concentrated in a small proportion of highway segments?*

Hypothesis: cargo thefts across Mexico are concentrated in a small proportion of highway segments.

To address the first question, I employ Exploratory Data Analysis (EDA) to visualise the temporal distribution for specific hours of the day. Leveraging the detailed hour information provided by the INAI database, I conduct an analysis at specific hours and employ statistical techniques to evaluate the significance of potential temporal concentration. Further methodological details are outlined in subsection 5.3.1.

For the second research question, I employ the Mexican highway network as the areal units of analysis. By examining highway segments, I aim to identify concentrations and potential correlations with surrounding conditions in micro-areas. Additionally, I use Lorenz curves and the Gini coefficient to explore the concentration of cargo theft across highway segments and its statistical significance. A detailed discussion of these statistical and spatial methods is presented in sections 5.3.2. and 5.3.3.

In the next section, I begin by presenting a theoretical discussion that draws from the existing literature on the concentration of crime in micro-places. The third section
describes the data and methods used for the proposed temporal and spatial analyses. In the fourth section, the results are presented, followed by a discussion of these results, the limitations of the current study, and conclusions.

5.2. Spatial concentration at micro-places

Despite extensive literature about the concentration of crime at micro-places, almost all this research has been developed to examine these concentration patterns in cities. To date, just a few studies have been conducted about the micro-places of crime concentration across a country. For instance, Agnew (2020) found that the spatial distribution of burglary was influenced by proximity to motorway construction in Ireland. Another example is provided by Ashby and Bowers (2015). They studied the spatial association between the locations of scrap yards and metal thefts from railway lines in England. They found a positive association between the locations of scrap yards and the locations of metal thefts. Another example is the work of Weisel et al. (2006), who studied vehicle theft in non-urban regions. A relevant finding of their work was that business premises - "risky facilities" such as car dealerships and repair shops - were common theft locations. Therefore, identifying specific places where crime concentrates can lead to a more complete understanding of the influence of salient geographical characteristics for particular crime types that happen in those places (Braga et al., 2019; Chainey & Ratcliffe, 2005; Rengert & Lockwood, 2009; Weisburd et al., 2009).

Attention to examining crime at the micro-place level has included defining what a micro-place means (Groff et al., 2009; Hipp, 2007; Sherman et al., 1989; Spelman, 1995). The emergence of micro-place-oriented studies over the last three decades is in part, because
of improvements in the precision of geocoded crime data. This more precise data has made it possible to examine criminal activities at specific locations in greater detail (Chainey & Ratcliffe, 2005; Ratcliffe, 2010; Rossmo, 1995; Tita & Greenbaum, 2009).

Although the geocoding of crime by law enforcement agencies has improved greatly, limitations with these data persist. In some cases, the high precision of these data means they are sensitive data because they identify specific individuals. This may mean that these data are not available for academic study and can only be used by the agency that records these data (Christen, 2009; McCarthy & Ratcliffe, 2005; Ratcliffe, 2002). In other cases, the quality of the geocoded crime data may not be sufficient for certain types of analysis to be performed, such as micro-place analysis. For certain types of criminal activity, it is not possible to pinpoint the exact location where a crime took place, for example, poaching activities in a forest or the specific location on a street where a violent assault took place. In addition, in some places, the practices that police agencies use for recording geographic information about where a crime took place may introduce data recording errors, such as the mis-spelling of locations or incorrect address numbers (Bichler & Balchak, 2007; Brimicombe et al., 2007; Hart & Zandbergen, 2013).

As mentioned in Chapter Three, Ratcliffe (2004) suggests that the minimal geocoding hit rate of crime data when used for spatial analysis is 85% of the total of the observations (section 3.2.3 explains the geocoding process proposed in this research). A high hit rate (>85%) suggests that most addresses in the dataset can be accurately located and that the spatial analysis of these data will be reliable. A low geocoding hit rate may introduce biases and inaccuracies in the analysis, and underrepresentation or overrepresentation
of certain areas or populations. Therefore, using high-quality geocoded data is necessary for generating an informative spatial analysis of criminal offences.

The spatiotemporal conditions of the places where offenders commit crime are likely to play an influencing role in their decision-making process. Offenders are likely to commit crime in areas that are familiar to them (Alonso Berbotto & Chainey, 2021; Ceccato & Uittenbogaard, 2014; Donohue, 1997; Smith & Cornish, 2006). Familiarity extends into non-urban areas, and is time-varying insofar that a place may be familiar at one time but not another. Hence, as well as the location, the time of day when offenders plan to act also plays a significant role in deciding their illegal actions (Brown, 1995; Burges, 2013; Ekwall & Lantz, 2013; Justus et al., 2018).

Regarding temporal conditions, academics have suggested that different hours of the day can offer different opportunities for committing a crime. The light of the day can be a deterrence factor; in contrast, the lack of light could facilitate the commission of night-time crimes. For example, Tompson and Bowers (2013) found that the lack of light in Glasgow and London can facilitate street robberies. Coupe and Blake (2006) suggest that the time of day can influence the offenders’ strategies to commit a burglary. They found evidence that older offenders prefer to work alone at night hours; while, younger offenders preferred to commit burglaries during daylight hours. Ceccato and Uittenbogaard (2014) suggest that crimes at transport nodes may be related to surrounding conditions such as the lack of lighting, finding that bus stations were more likely to experience crimes at night-time. Therefore, the hour of the day when a potential offender plans to commit a crime is a relevant variable within crime commission.
One of the most significant theoretical additions to the crime concentration literature in recent years is Weisburd’s “Law of crime concentration”, which states: “For a defined measure of crime at a specific microgeographic unit, the concentration of crime will fall within a narrow bandwidth of percentages for a defined cumulative proportion of crime” (Weisburd, 2015, p. 133). This suggests that crimes tend to concentrate in a small number of micro-places, and that most other locations experience little or no crime. Weisburd suggests that this trend is stable across different crime categories and geographic regions, and the concentration of crime typically falls within a comparatively uniform range. Weisburd found that for a cumulative proportion of crime of 25%, crime tends to concentrate in between 0.4 and 1.6% of all the areas examined, and for a cumulative proportion of 50% of crime, the bandwidth is between 2.1 and 6% of all the areas examined (Weisburd, 2015, p. 143).

To complement the bandwidths of crime concentration, statistical methods traditionally used to analyse income inequality and income distribution such as Lorenz Curves and the Gini Coefficient (Dorfman, 1979; Farris, 2010; Gastwirth, 1972; Kakwani, 1977), have also been used to examine crime concentration (Bernasco & Steenbeek, 2017; Davies & Johnson, 2015; Johnson & Bowers, 2010; Mohler et al., 2019; O’Brien, 2019; Tseloni & Pease, 2005). Using these techniques, scholars worldwide have found evidence of crime concentration across different cities and various types of crimes (Bernasco & Steenbeek, 2017; Haberman et al., 2017; Levin et al., 2017; Mohler et al., 2019; Schnell et al., 2017). In these studies, the geographic unit of analysis has usually been the street segment. Applications of Weisburd’s law of crime concentration, the Lorenz curve and Gini coefficient have, however, been limited to particular urban contexts, be it for areas within
a city or for the whole city; no known studies have examined crime concentration for larger areas such as regions or the patterns of crime concentration across a country. The current study aims to address this by examining the concentration of cargo thefts for the country of Mexico, using highway segments as the geographic unit of study.

The following section presents the data and methods used in this chapter to identify the segments of highway in Mexico that experience the highest incidence of cargo theft.

5.3. Data and Methods to identify micro-places of cargo theft concentration in Mexican highways

The focus of the current chapter is to measure the cargo theft concentration across the Mexican highway network and identify micro-places where cargo thefts are highly concentrated. In chapter three, the two sources of data used for the study of cargo theft in Mexico in the current research were described. The current chapter uses the second data source from the National Institute of Transparency, Access to Information and Protection of Personal Data (INAI). This database includes the geographical coordinates of cargo theft offences reported by national guard officers (the process for geocoding these data was described in section 3.2.3). There was a total of 2,473 cargo thefts reported by the National Guard between January 2016 and October 2020.

The INAI’s data are more geographically precise than the SESNSP data, meaning that it is possible to identify the segments of the highways that experience the highest levels of cargo thefts. These data also include the time when the offence occurred, meaning that a more precise temporal analysis of cargo theft can be conducted. The following sections
describe the methods used to identify micro-places and particular hours with more cargo thefts across specific segments of Mexican highways.

5.3.1. Temporal distribution – hourly specification

The temporal exercises followed an Exploratory Data Analysis approach (Andrienko et al., 2003; Andrienko & Gennady, 2006; Wheeler, 2016). The first task was to create theoretically-motivated units of analysis at the sub-day level. Garde et al. (2020), James et al. (2018), Taylor et al. (2019) suggest that offenders can take advantage of the fatigue of police officers (especially in night-shifts). Also, scholars such as Burges (2013) and Haelterman (2009, 2013) suggest that the lack of patrolling on highways at certain hours can influence the cargo thieves’ decision-making. Drawing from these findings, I conduct a “shift-oriented” temporal analysis to examine the potential impact of specific hours in the commission of cargo theft on Mexican highways. The proposed approach required a new variable generated in the INAI data that relates to different police operational shifts:

1) 00:00 to 05:59 – night shift
2) 06:00 to 11:59 – morning shift
3) 12:00 to 17:59 – afternoon shift
4) 18:00 to 23:59 – evening shift

Using these shifts, I generate a data clock graph showing the temporal distribution of cargo theft. A data-clock is a chart that is used to visualise temporal data. It is useful for identifying temporal patterns in data (Chainey, 2021). This chart was generated using Microsoft Excel.
To examine if a statistically significant relationship exists between hours and days of the week, I used a chi-squared test. This statistical test compares the observed frequencies of crime to the expected frequencies, assuming that all days of the week are equally likely to have cargo thefts. If the chi-squared test is significant, then it means that there is a difference in the observed and expected frequencies and that one day of the week is more likely to have crime than the others (Barroga & Matanguihan, 2022; Parab & Bhalerao, 2010; van Sleeuwen et al., 2021). The chi-squared test was done using the “stats” package in R (R Core Team, 2021).

5.3.2. Statistical methods to identify micro-places crime concentration on Mexican highways

5.3.2.1. Lorenz Curves

The Lorenz curve method identifies the distribution and concentration of a variable of interest in a population. Originally developed to measure the concentration of wealth (Lorenz, 1905), in recent decades the Lorenz curve has been used in studies of crime concentration to summarise how concentrated crime is at micro-places. The Lorenz curve of crime plots the cumulative percentage of micro-places on the X-axis, and the cumulative percentage of crimes committed at those places on the Y-axis (Bernasco & Steenbeek, 2017). In mathematical terms, Dagum (1980) and Damgaard & Weiner (2000) define the Lorenz curve as follows:

\[
L(y) = \int_0^y \frac{x}{\mu} \, dF(x)
\]

where \(F(x)\) represents the function of the cumulative distribution of crime, and \(\mu\) is the average quantity of crimes committed.
As Bernasco and Steenbeek (2017) noted, in most cases, the number of crimes is much less than the number of micro-place units in a study area. To address this issue, they proposed a generalised version of the Lorenz Curve. Considering that cargo theft is not committed on every segment of the national highway network, the current study calculates both the standard and generalised versions of the Lorenz curves.

5.3.2.2. Gini coefficient

The Gini coefficient (Gini, 1912) is an index to measure the degree of concentration. Its values range between 0 and 1. Like the Lorenz curve, its origins are related to measuring the unequal distribution of income. The Gini Coefficient calculates the difference between the expected line of equality against the observed line (Lorenz curve), resulting in a coefficient between 0 to 1 (Gini, 1914). Therefore, the interpretation is that if the coefficient value is closer to zero, the distribution is more equal. In contrast, a value closer to one means the variable of interest shows an uneven distribution.

The Gini coefficient is easy to interpret and for this reason has gained popularity in explaining crime concentration at micro-places (Davies & Johnson, 2015; Hardyns et al., 2019; Johnson & Bowers, 2010; Umar et al., 2020). Despite being a relatively simple and effective method for measuring concentration, the Gini coefficient is not without certain limitations. The main limitation in its use for examining crime concentration is when the number of crimes is fewer than the number of geographic units in a study area. This can cause bias in the results (Andresen & Malleson, 2011; Bernasco & Steenbeek, 2017).

To address the issue of potential bias, Bernasco & Steenbeek (2017), based on Damgaard & Weiner (2000), proposed a Generalised Gini Coefficient (\(G'\)) that considers
the ratio of the number of places (n) and the number of crimes (c)\textsuperscript{56}. They propose the following formula to calculate the \((G')\) index:

\[
G' = \max\left(\frac{1}{c}, \frac{1}{n}\right) \left(2 \sum_{i=1}^{n} i y_i - n - 1\right) - \max\left(\frac{n}{c}, 1\right) + 1
\]

As there are many more highway segments than crimes, using this \(G'\) provides a more objective approach to identify the concentration level of cargo theft along the highway network. Hence, in the current study both the standard and the generalised Gini Coefficient are calculated. The Lorenz Curve and Gini Coefficient were calculated using the following R packages:

- Ineq: (v0.2-13; Zeileis, 2014)\textsuperscript{57}
- lorenzgini: (v0.1.2; Steenbeek & Bernasco, 2022).\textsuperscript{58}

\textbf{5.3.3. Method to generate highway network segments}

Even though cargo theft is considered a global issue\textsuperscript{59}, no known research to date identifies segments of highways where these types of crime concentrate. In part this may be because structured data on highways is limited in countries where cargo theft is a particular problem. Although highway segment data exists in Mexico, a significant amount of time was spent in the current study to prepare the data for its intended analysis. This data preparation stage is described in full below.

\textsuperscript{56} For a more detailed mathematical explanation, review Bernasco & Steenbeek, 2017, p. 458-459 & 465.
\textsuperscript{57} For a more detailed explanation of this package: \texttt{https://cran.r-project.org/web/packages/ineq/ineq.pdf} (last reviewed 12 December 2022)
\textsuperscript{58} Details of this package: \texttt{https://github.com/wsteenbeek/lorenzgini} (last reviewed 12 December 2022)
\textsuperscript{59} Countries as Mexico, Brazil, India, the USA, and Nigeria, among others, experience most incidences of this type of crime (BSI and TT Club, 2021)
Two types of crime concentration analysis of cargo thefts on highways were performed. The first approach used a processed version of the Mexican National Highway Network (NHN) segments. The second approach used a Standardised Highway Network (SHN) that I customised to produce a more homogeneous highway segment dataset. This second approach (SHN) responds to the necessity of having a manageable unit of measurement that allows for a more detailed examination of specific sections of the NHN. By breaking down the NHN into homogeneous segments, it helps to identify patterns and concentrations of cargo theft incidents within these segments. Furthermore, using more homogeneous segments can facilitate more meaningful comparisons across different sections of the highway network.

As mentioned in Chapter 2 and Section 5.2, to date the academic research on cargo theft distribution at the regional level is scarce. Hitherto, no known research on cargo thefts at highway segments exists. Hence, determining the most reliable segments length to represent the spatial distribution of cargo theft was a challenge. To achieve the goals of this research, I used a distance of 10 kilometres to standardise the segments. This distance was determined because 10km is often practical and meaningful measurement unit in the context of highway infrastructure and planning (Black, 1991; Laudares et al., 2016; McCutcheon et al., 2016). Moreover, this distance provides a reasonable level of detail for analysis without creating a highway segment network across Mexico that is too fragmented.

The process to standardise the segments started by revising how INEGI describes the connection between lines that form a highway. INEGI defines these lines as “the geometric representation consisting of a series of two or more distinct pairs of sequentially
linked coordinates (vertices)”. The sets of coordinates should correspond to the reference plane (X, Y)”. Figure 5.1. shows the geometrical representation of a highway.

After identifying the connections between the highway segments, I used QGIS to merge each connected line (highway segment) using the merge object function. The output of this process was a dataset of a continuous network. Then, I used the QGIS function split lines\(^6\) to generate a more homogeneous network that consisted of highway segments that were 10 km in length (where possible).

Figure 5.2. presents a diagram of the process to generate homogeneous segments:

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\(^6\) For more details of this algorithms review: https://docs.qgis.org/3.28/en/docs/user_manual/processing_algs/qgis/vectoroverlay.html
This process generated a “Standardised Highway Network (SHN)”. Table 5.1. shows that this process reduced the number of highway segments from 115,151 to 19,160. Rather than all highway segments being created so they were 10km in length, this was not possible as shown by the minimum length of a highway segment being less than 1m and the mean length of all segments being 3.346 km.

<table>
<thead>
<tr>
<th>Concept</th>
<th>Quantity</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Count</td>
<td>19,160</td>
<td>Lines</td>
</tr>
<tr>
<td>Minimum value</td>
<td>3.53004e-10</td>
<td>metres</td>
</tr>
<tr>
<td>Maximum value</td>
<td>9.978</td>
<td>kilometres</td>
</tr>
<tr>
<td>Range</td>
<td>9.978</td>
<td>kilometres</td>
</tr>
<tr>
<td>Mean value</td>
<td>3.346</td>
<td>kilometres</td>
</tr>
<tr>
<td>Median value</td>
<td>1.391</td>
<td>kilometres</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>3.687</td>
<td>Kilometres</td>
</tr>
<tr>
<td>First quantile</td>
<td>325.728</td>
<td>metres</td>
</tr>
<tr>
<td>Third quartile</td>
<td>6.521</td>
<td>kilometres</td>
</tr>
<tr>
<td>Interquartile Range (IQR)</td>
<td>6.195</td>
<td>kilometres</td>
</tr>
</tbody>
</table>

By developing this joining procedure, I aim to create a continuous and uniform network of highway segments to improve the accuracy and depth of micro-level analyses of cargo theft dynamics. This increased level of detail makes it possible to detect trends and patterns more precisely, leading to a better understanding of the underlying factors driving criminal behaviour.

However, after many attempts, it was not possible to generate a highway network for Mexico where each highway segment was standardised to 10km. This was because of the presence of junctions, unions and other intersections interrupting or altering the connectivity of the vector lines in the highway data. As shown in Figure 5.3, certain
junctons could not be connected and in instances where they were, it was not possible to create a segment with a length of 10 km.

The image on the left in Figure 5.3. shows intersections between each segment and their respective junctions. The image on the right shows another example of a roundabout with multiple connections. In both images, there are intersections representing the end point of the geometric representation for all the objects present at the connection point. These examples illustrate that it was not possible to connect all segments in a manner to create a homogenous dataset that consisted of only highway segments that were 10km in length.

The geometry of the line data in the original NHN makes standardisation of highway segments difficult. However, the geometric process used for the current study generated a network that was sufficiently homogenous and is aligned with the total length of the original NHN data. Table 5.2. shows relevant statistics that illustrate the main differences between NHN and SHN.
Table 5.2. Comparative of statistics of the NHN and SHN

<table>
<thead>
<tr>
<th>Concept</th>
<th>NHN</th>
<th>SHN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Segments</td>
<td>115,151 lines</td>
<td>19,160 lines</td>
</tr>
<tr>
<td>Minimum value</td>
<td>1.02035e-3 km</td>
<td>3.53004e-10 km</td>
</tr>
<tr>
<td>Maximum value</td>
<td>37.409 km</td>
<td>9.978 km</td>
</tr>
<tr>
<td>Range</td>
<td>37.408 km</td>
<td>9.978 km</td>
</tr>
<tr>
<td>Mean value</td>
<td>0.555 km</td>
<td>3.346 km</td>
</tr>
<tr>
<td>Median value</td>
<td>0.194 km</td>
<td>1.391 km</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>1.114 km</td>
<td>3.687 km</td>
</tr>
</tbody>
</table>

As Table 5.2. illustrates, the 19,160 lines of the SHN represent 16.6% of all the lines/segments that make up the NHN. A significant difference can be observed in the maximum values, where the NHN contained a segment that was over 37 km long. The maximum length of a segment in the SHN data was 10 km. As a result, it is hypothesised that the SHN provides a better template for examining highway segments in Mexico that experience the highest concentration of cargo thefts because this highway data can minimise potential biases from the heterogeneous distances of the highway segments in the NHN data.

5.3.4. Method for joining geocoded information to the highway network

The next part of the study involved joining the geocoded INAI database to the NHN and the SHN segments respectively. For that purpose, I designed a five-step process to join the cargo theft events to the highway segments. This process of joining the geocoded cargo theft data to their respective NHN and SHN segments allows specific micro-places with higher incidences of cargo theft to be identified.
The first step of the process involved using a spatial algorithm to join the cargo theft points to the nearest highway segments of the NHN and SHN. This spatial exercise used the “Join Attributes by Nearest (JAN)” algorithm in QGIS, which merges the attribute data of two input layers, a vector layer containing the cargo theft points and a second input layer with the NHN and SHN highway segments. The algorithm then creates a new vector layer that extends the input layer of points and includes the new attributes obtained from the lines layer, resulting in a new lines-to-points layer with updated attribute data.

The JAN algorithm establishes a maximum distance to join the attributes and a maximum of nearest neighbours to match (this is the main difference versus similar matching algorithms). i.e., only the features that are closest to the established distance are paired. For the objectives of this research, I determined a maximum distance of 10 metres and only one neighbour between the points and the lines. Consequently, each cargo theft was paired with a single highway segment, specifically the closest one. Figure 5.4. shows an example of how the JAN algorithm in QGIS was used.

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61 For a more detailed description of this algorithm review: https://docs.qgis.org/3.16/en/docs/user_manual/processing_algs/qgis/vectorgeneral.html?highlight=join%20attributes%20nearest#join-attributes-by-nearest (last reviewed on 20 of October 2022)
After creating a new layer containing information on the highway network segment corresponding to each cargo theft point, the second step involved exporting this data as a “.xlsx” file and generating a pivot table in Excel of the number of thefts committed on each segment. Figure 5.5. provides a visual representation of this process.
Figure 5.6. shows the third step of this process. It involved adding the Excel file to QGIS and joining the Pivot table, summarising the thefts by segment to the NHN and SHN layers using the ID variable.

After joining the cargo thefts to their corresponding highway segments, the next step in the spatial process was to create choropleth maps to show the concentration of cargo theft across the segments.
The Jenks classification method was used to visualise the variation in cargo theft across highway segments because it minimises the variation within classes (Chen et al., 2013; Jenks & Caspall, 1971). Figure 5.7. shows an example of the thematic categories used in the NHN and SHN.

Figure 5.7. Example of Jenks method on NHN segments

Although the methods to generate more homogeneous highway segments and to join the points (crimes) to the lines (segments) offer a good enough approximation to identify the specific micro-places with higher concentrations, these methods are not without limitations. Another method that could help to better identify and understand this crime is applying a gravity model (Stewart, 1941, 1948; Tinbergen, 1962; Zipf, 1946) to identify cargo trucks’ flows and better characterise this crime. I further discuss the possibility of using a gravity model in section 5.6, however, a key point to note at this stage relates to the need to have suitable denominators as additional inputs to a gravity model. Suitable
denominators could include the number of truck rest stops or the number of trucks traversing along each highway segment during certain time periods. These data were not available and hence the focus of the analysis remained as being oriented to examining spatial concentrations of cargo thefts on highways in the manner similar to previous studies that have examined micro-place crime concentration without the use of denominators.

5.4. Results - temporal and spatial concentration of cargo theft on Mexican highways

In this section, I begin by presenting the results of the temporal distribution of cargo thefts based on aggregation into police operational shifts. Next, the results concerning Weisburd’s Law of Crime Concentration applied to cargo theft in Mexican highways are presented. I then present the results from the analysis using Lorenz curves and the Gini coefficient. Lastly, maps of the NHN and the SHN are shown to identify specific highway segments with a higher incidence of cargo thefts.

5.4.1. Temporal dispersion of geocoded information

A significant advantage of using the INAI database is the potential for generating temporal analyses with detailed information about when National Guard Officers responded to cargo theft incidents by the time of day. Figure 5.8. shows levels of cargo theft incidence for each of the four operational shift periods. The peak periods for cargo theft were during the overnight hours, with one in three thefts occurring between midnight and 6 a.m. and a further three in ten in the morning period from 6 a.m. to 11:59 a.m. These two periods accounted for around two-thirds of all cargo.
Figure 5.9. shows the distribution of cargo thefts by day of the week, using the same operational shift periods. These results show that Tuesday and Thursday experienced higher levels of crime between 06:00 and 11.59 and that Fridays experienced high levels of crime in the overnight shift.

<table>
<thead>
<tr>
<th>Day</th>
<th>00:00 - 05:59</th>
<th>06:00 - 11:59</th>
<th>12:00 - 17:59</th>
<th>18:00 - 23:59</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>15</td>
<td>16</td>
<td>25</td>
<td>12</td>
</tr>
<tr>
<td>Tuesday</td>
<td>39</td>
<td>48</td>
<td>32</td>
<td>17</td>
</tr>
<tr>
<td>Wednesday</td>
<td>35</td>
<td>41</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>Thursday</td>
<td>32</td>
<td>54</td>
<td>30</td>
<td>17</td>
</tr>
<tr>
<td>Friday</td>
<td>49</td>
<td>32</td>
<td>27</td>
<td>21</td>
</tr>
<tr>
<td>Saturday</td>
<td>29</td>
<td>31</td>
<td>18</td>
<td>5</td>
</tr>
<tr>
<td>Sunday</td>
<td>24</td>
<td>15</td>
<td>10</td>
<td>13</td>
</tr>
</tbody>
</table>

Figure 5.9. Distribution of cargo theft per shift and weekday, January 2016 – October 2020

Analysing the association between the day of the week and the hours when cargo thefts were reported, the Chi-squared test of independence reveals a statistically significant relationship ($\chi^2 = 34.157, df = 18, \rho = 0.01205$). These results suggest that cargo theft
is a temporally concentrated crime. That is, cargo theft is more likely to occur on certain
days of the week and during certain hours. Hence rejecting the null hypothesis of
independence between hours and days. In Section 5.5 I return to discuss these results
in terms of the impact of variables such as lighting conditions, lack of surveillance where
the crimes were committed, and driver fatigue on when cargo thefts were committed.

5.4.2. Statistics of cargo thefts on Mexican highways and Weisburd’s Law of
Crime Concentration using NHN and SHN
Table 5.3. presents the descriptive statistics of cargo theft by the NHN and SHN
segments. The table shows that both sets of highway networks have high Kurtosis, which
suggests that cargo theft is highly concentrated in few segments of the NHN and the SHN.
The distribution also presents high skewness, suggesting that cargo theft on Mexican
highways is not normally distributed and that there is a significant deviation from the
mean. These results suggest an uneven distribution of cargo theft along both networks.

Table 5.3. Summary statistics for cargo theft per segment of NHN

<table>
<thead>
<tr>
<th>Statistics</th>
<th>NHN</th>
<th>SHN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Maximum</td>
<td>81</td>
<td>57</td>
</tr>
<tr>
<td>Mean</td>
<td>0.02</td>
<td>0.12</td>
</tr>
<tr>
<td>Std Deviation</td>
<td>0.39</td>
<td>1.11</td>
</tr>
<tr>
<td>Std Error</td>
<td>0.001</td>
<td>0.008</td>
</tr>
<tr>
<td>1-st quartile</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Median</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3-rd quartile</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Skewness</td>
<td>98.53</td>
<td>24.65</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>16,723.69</td>
<td>924.39</td>
</tr>
<tr>
<td>Cargo thefts</td>
<td>2,473</td>
<td>2,473</td>
</tr>
<tr>
<td>Segments</td>
<td>115,151</td>
<td>19,160</td>
</tr>
<tr>
<td>Segments with at least 1 cargo theft</td>
<td>1,215</td>
<td>915</td>
</tr>
</tbody>
</table>
Table 5.4 shows the uneven distribution of cargo theft for both the NHN and SHN data. The NHN results shows that only 1,215 highway segments experienced at least 1 cargo theft. This means that all the cargo thefts in Mexico were committed on just 1.05% of all the highway segments. The SHN results show that 915 segments (4.77% of all highway segments) experienced at least 1 cargo theft. In each case, 45 segments experienced 7 to 44 cargo thefts. That is, for both the NHN and SHN data, a small proportion of the highway segments accounted for a large proportion of the cargo thefts committed in the study period.

Table 5.4. Cargo theft per segment of SHN with at least one theft reported

<table>
<thead>
<tr>
<th>Thefts</th>
<th>Segments SHN</th>
<th>Percentage SHN</th>
<th>Segments NHN</th>
<th>Percentage NHN</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>500</td>
<td>54.64%</td>
<td>761</td>
<td>62.63%</td>
</tr>
<tr>
<td>02</td>
<td>158</td>
<td>17.27%</td>
<td>236</td>
<td>19.42%</td>
</tr>
<tr>
<td>03 – 06</td>
<td>210</td>
<td>22.95%</td>
<td>171</td>
<td>14.07%</td>
</tr>
<tr>
<td>07 – 44</td>
<td>45</td>
<td>4.92%</td>
<td>45</td>
<td>3.71%</td>
</tr>
<tr>
<td>45 – 57</td>
<td>2</td>
<td>0.22%</td>
<td>2</td>
<td>0.16%</td>
</tr>
</tbody>
</table>

Figure 5.10. shows that cargo theft exhibits a pattern of crime concentration, with these patterns being apparent for both highway network datasets. In the case of the NHN, 50% of all cargo thefts were concentrated in 0.19% of all highway segments. When using the SHN data, 0.68% of all highway segments accounted for 50% of all recorded cargo thefts.
Both results show that cargo theft is even more concentrated than Weisburd’s proposed bandwidths. These results imply that cargo theft is likely to concentrate in specific places. The small proportion of highway segments where crimes are more concentrated suggest that when analysing crimes at national level, the concentration is higher than urban environments. This finding is discussed in section 5.5.

In line with Weisburd’s work, the next two graphs show the levels of crime concentration of cargo theft by year. These graphs illustrate the proportion of total segments in the NHN and SHN that concentrate 25% and 50% of all cargo theft incidents for each year. Figure 5.11. presents the results for the NHN, and Figure 5.12. presents the results for the SHN.
To interpret Figures 5.11. and 5.12., the smaller the grey and black bars, the more concentrated the distribution of cargo theft. When using the NHN data, in 2019, 25% of all cargo thefts were committed on just 0.013% of all segments. In 2020, 25% of cargo thefts were committed on 0.037% of all segments. Regardless of the year, less than 0.1% of all segments accounted for 50% of all cargo thefts. These findings suggest that high levels of crime concentration have persisted across all years of the study period when using the NHN.

These same findings – high levels of crime concentration for each year, with less than 0.1% of all segments accounting for 50% of all cargo thefts – are also apparent when using the SHN data (see Figure 5.12), albeit slightly lower than the crime concentration results when using the NHN. This can be attributed to the SHN's standardised length, which provides the basis for a more accurate measure of cargo theft crime concentration.
These findings suggest that utilising more homogeneous segments can enhance our understanding of the spatial concentration of cargo thefts.

Figure 5.12. Weisburd’s Law of Crime Concentration per year on SHN

5.4.3. Presence and extent of micro-place crime concentration

5.4.3.1. Lorenz curves of concentration of cargo theft

A second approach to measure the concentration of cargo theft at the highway segment level is with the use of the Lorenz curve and the Gini Coefficient. First, I present the Lorenz curves for both highway networks. Figure 5.13 presents the conventional Lorenz curves, and Figure 5.14 presents the Generalised Lorenz curve (GLC) for the NHN.
If cargo theft is equally distributed, it would appear as a diagonal line in the Lorenz curves’ graphs. Figure 5.13 shows there is a considerable difference between the blue and equality lines, indicating that cargo thefts are geographically concentrated. Figure 5.14 presents the results of using the GLC; this graph also suggests that cargo theft is highly concentrated, with a small number of segments having a large proportion of cargo theft.
Figures 5.15. and 5.16. show the result of the Lorenz curve and the GLC using the SHN data. The figure shows that the pattern of crime concentration is like the pattern observed for the NHN data. That is, cargo thefts are highly concentrated across the SHN.

The Lorenz curve of the SHN is also separate from the line of equality, suggesting cargo thefts are spatially concentrated across the SHN.
5.4.3.2. Gini Coefficient of Concentration of cargo theft

Next, the Gini coefficient (GC) and the Generalised Gini coefficient (GGC) are presented for both networks (NHN and SHN).

Table 5.5. Generalised Gini Coefficient for cargo theft in Mexico per segment

<table>
<thead>
<tr>
<th></th>
<th>NHN</th>
<th>SHN</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gini Coefficient</strong></td>
<td>0.993795</td>
<td>0.9759474</td>
</tr>
<tr>
<td><strong>Generalised Gini Coefficient</strong></td>
<td>0.7110757</td>
<td>0.8136479</td>
</tr>
</tbody>
</table>

Table 5.5. shows that GC and GGC are closer to 1 than 0, meaning cargo theft is spatially concentrated along the highway network segments. The results of the GC show that cargo thefts on the NHN were marginally more concentrated i.e., higher coefficient value. This result is reflective of the NHN having more segments without crimes.

To summarise, the results of all the statistical methods show that cargo theft is unevenly distributed and highly concentrated across a small number of highway segments.

5.4.4. The spatial visualisation of cargo theft across the Mexican highway networks

5.4.4.1. Concentration based on the National Highway Network

I now turn to the spatial visualisation of cargo theft concentration. As observed in the preceding analytical findings, most segments did not experience cargo thefts. This means that cargo thefts were highly concentrated across the NHN. Figure 5.17. presents a choropleth map identifying the highway segments with the highest incidence of cargo theft across the NHN. The categories in the map were calculated using a Jenks – Natural Breaks technique as mentioned in section 5.3.4.
Figure 5.17. Cargo thefts by segments of National Highway Network (NHN)
Figure 5.17. offers visual support for the results from the previous sections of the current study. The map shows that a small proportion of segments accounted for most of the cargo thefts. 1,215 segments reported at least one cargo theft, representing only 1.05% of the total 115,151 NHN segments. Furthermore, 47 segments (0.04% of the total of the NHN segments) accounted for 572 cargo thefts (23.12% of all the thefts).

Figure 5.17. shows that cargo theft is highly concentrated across the central states in the country. Table 5.6. presents the distribution of cargo theft by the Mexican states with higher incidence using the NHN data. The table shows nine states (out of 32) that reported more than 100 thefts. These nine states accounted for 85.4% of all the cargo thefts.

<table>
<thead>
<tr>
<th>State</th>
<th>Cargo thefts</th>
<th>Percentage of the total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Puebla</td>
<td>561</td>
<td>22.7%</td>
</tr>
<tr>
<td>Guanajuato</td>
<td>341</td>
<td>13.8%</td>
</tr>
<tr>
<td>Veracruz</td>
<td>332</td>
<td>13.4%</td>
</tr>
<tr>
<td>Estado de México</td>
<td>171</td>
<td>6.9%</td>
</tr>
<tr>
<td>Jalisco</td>
<td>169</td>
<td>6.8%</td>
</tr>
<tr>
<td>Michoacán</td>
<td>167</td>
<td>6.8%</td>
</tr>
<tr>
<td>San Luis Potosí</td>
<td>137</td>
<td>5.5%</td>
</tr>
<tr>
<td>Tlaxcala</td>
<td>128</td>
<td>5.2%</td>
</tr>
<tr>
<td>Querétaro</td>
<td>108</td>
<td>4.7%</td>
</tr>
</tbody>
</table>

In the first empirical study, Estado de México was the state with the highest levels of cargo theft. When using the INAI data, Puebla was the state with most cargo thefts reported. Figure 5.18. shows the segments in the central states of Mexico with most incidents of cargo theft.
Figure 5.18. States with more incidence of cargo thefts by segment of the National Highway Network

Figure 5.18. States with more cargo theft per Segment of NHN
January 2016 to October 2020

Source: Instituto Nacional de Transparencia, Acceso a la Información y Protección de Datos Personales (INAI)
Further analysis identified that ten segments from the NHN data (0.008% of all the NHN) accounted for 10.5% of all the cargo thefts reported by the National Guard. Table 5.7. lists these ten segments including their highway ID and code, the highway’s name, the length of the segment, the number of thefts committed on each segment, and the state where the segment was located. These 10 segments were in just three states – Puebla, Guanajuato and Veracruz.

Table 5.7. The ten highway segments with most cargo thefts in Mexico, per segment of NHN

<table>
<thead>
<tr>
<th>ID Segment</th>
<th>Code Highway</th>
<th>Name Highway</th>
<th>Length</th>
<th>Cargo thefts</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>NHN_140745</td>
<td>150D</td>
<td>Puebla-Córdoba</td>
<td>12,642.77</td>
<td>81</td>
<td>Puebla</td>
</tr>
<tr>
<td>NHN_137478</td>
<td>150D</td>
<td>Puebla-Córdoba</td>
<td>1,757.69</td>
<td>45</td>
<td>Puebla</td>
</tr>
<tr>
<td>NHN_135094</td>
<td>150D</td>
<td>Puebla-Córdoba</td>
<td>5,320.73</td>
<td>34</td>
<td>Puebla</td>
</tr>
<tr>
<td>NHN_2120978</td>
<td>150D</td>
<td>Puebla-Córdoba</td>
<td>3,393.46</td>
<td>22</td>
<td>Puebla</td>
</tr>
<tr>
<td>NHN_146388</td>
<td>150D</td>
<td>Puebla-Córdoba</td>
<td>2,327.21</td>
<td>16</td>
<td>Puebla</td>
</tr>
<tr>
<td>NHN_1642840</td>
<td>45</td>
<td>Querétaro-León</td>
<td>507.24</td>
<td>14</td>
<td>Guanajuato</td>
</tr>
<tr>
<td>NHN_158016</td>
<td>140D</td>
<td>Amozoc-Perote</td>
<td>16,677.04</td>
<td>13</td>
<td>Veracruz</td>
</tr>
<tr>
<td>NHN_1024205</td>
<td>150D</td>
<td>Puebla-Córdoba</td>
<td>2,041.30</td>
<td>12</td>
<td>Puebla</td>
</tr>
<tr>
<td>NHN_172400</td>
<td>150D</td>
<td>México-Puebla</td>
<td>805.38</td>
<td>12</td>
<td>Puebla</td>
</tr>
<tr>
<td>NHN_145857</td>
<td>150D</td>
<td>Puebla-Córdoba</td>
<td>3,795.33</td>
<td>12</td>
<td>Puebla</td>
</tr>
</tbody>
</table>

This pattern of concentration suggests that in the places where most cargo thefts were committed there are likely to be specific geographic and sociodemographic conditions that influence the commission of cargo thefts. However, as previously discussed, due to the heterogeneity of segments length, the NHN data may mask certain micro-place patterns of cargo theft. The following section presents the results when using SHN data.

5.4.4.2. Concentration Based on the Standardised Segments of the Highway Network (SHN)

Figure 5.19. shows the distribution of cargo thefts in Mexico using the SHN data.
Figure 5.19. Cargo thefts by segment of Standardise Highway Network

Legend:
- States
- Federal Highways 2020

Thefts per SHN segment:
- 01 - 04 (793)
- 05 - 15 (107)
- 15 - 34 (13)
- 34 - 57 (02)

Categorisation method: Jenks - Natural Breaks
Figures 5.17. (NHN) and 5.19. (SHN) show notable similarities in the concentration of cargo theft. However, there are slight variations which result in differences in the identified segments. These differences can be attributed to the improved standardisation of highway segment length.

Although the states and highways with the highest number of crimes remain consistent with the NHN results, the segments with the highest incidence are different when using the SHN. Using the same variables than Table 5.7., Table 5.8. lists the ten SHN segments where more thefts were reported.

<table>
<thead>
<tr>
<th>ID Segment</th>
<th>Code Highway</th>
<th>Name Highway</th>
<th>Length</th>
<th>Cargo thefts</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHN_14666</td>
<td>150D</td>
<td>Puebla-Córdoba</td>
<td>9,530.76</td>
<td>57</td>
<td>Puebla</td>
</tr>
<tr>
<td>SHN_15206</td>
<td>150D</td>
<td>Puebla-Córdoba</td>
<td>7,280.44</td>
<td>55</td>
<td>Puebla</td>
</tr>
<tr>
<td>SHN_9101</td>
<td>45</td>
<td>Querétaro-León</td>
<td>9,511.80</td>
<td>34</td>
<td>Guanajuato</td>
</tr>
<tr>
<td>SHN_13503</td>
<td>150D</td>
<td>Puebla-Córdoba</td>
<td>9,669.78</td>
<td>32</td>
<td>Puebla</td>
</tr>
<tr>
<td>SHN_14667</td>
<td>150D</td>
<td>Puebla-Córdoba</td>
<td>4,678.27</td>
<td>28</td>
<td>Puebla</td>
</tr>
<tr>
<td>SHN_14909</td>
<td>150D</td>
<td>Querétaro-León</td>
<td>9,624.41</td>
<td>28</td>
<td>Guanajuato</td>
</tr>
<tr>
<td>SHN_14277</td>
<td>150D</td>
<td>Puebla-Córdoba</td>
<td>9,524.76</td>
<td>27</td>
<td>Puebla</td>
</tr>
<tr>
<td>SHN_15311</td>
<td>150D</td>
<td>Puebla-Córdoba</td>
<td>9,723.52</td>
<td>27</td>
<td>Veracruz</td>
</tr>
<tr>
<td>SHN_15313</td>
<td>150D</td>
<td>Puebla-Córdoba</td>
<td>9,597.46</td>
<td>24</td>
<td>Puebla</td>
</tr>
<tr>
<td>SHN_13045</td>
<td>150D</td>
<td>México-Puebla</td>
<td>9,595.73</td>
<td>23</td>
<td>Puebla</td>
</tr>
</tbody>
</table>

Table 5.8 shows that the length of these 10 highway segments is more similar to each other than the top ten segments identified using the NHN data. Most of the ten segments identified using the SHN were about 10 km in length. The top ten NHN segments varied in length from 500m to 16.7km.

This improved standardisation of highway segment length also changes the ranking of highway segments. For example, segment SHN_9101 in Table 5.8 had the third-highest
incidence whereas in Table 5.7, this segment (NHN_1642840) was ranked sixth. This difference is primarily due to the difference in segment length because of standardisation. As a NHN highway segment, this segment had a length of 0.562 km. When standardised, the length of this highway segment increased to 9.512 km. It appears, with this example, there were several other cargo thefts on segments that were connected to the original NHN version of this highway segment.

To visually identify the specific highway segments with higher cargo theft concentration (when using the SHN), Figure 5.20. shows the top five segments and the nine states with the highest incidence of cargo theft. Similar to Figure 5.21., most of the segments with higher concentration were in the state of Puebla. However, Figure 5.20. shows that segment SHN_9101, which was not on the map of NHN segments, is now the third segment with the highest incidence. This difference is associated with differences in the length of the segments, with more homogenous segments appearing to be better at identifying the places where cargo thefts concentrate.

While utilising 10km segments can enhance the identification of micro-places, it is crucial to consider certain concerns that may arise as a result of using this geographic unit. One such concern is the impact of road layout on the occurrence of events at intersections and junctions within these segments. Although a lower likelihood of events might be expected, it cannot be generalised to all segments. In fact, during certain times of the day, such junctions may experience significant traffic due to commuting to nearby locations. Further elaboration on this topic is provided in the subsequent section.
Figure 5.20. Cargo thefts by segment and states with more incidences of Standardise Highway Network
The concentration of cargo thefts along specific segments of the Mexican highway network suggests that certain conditions are likely to be present in those areas that influence why offenders choose these locations to commit these offences. Nonetheless, this concentration would be linked to specific conditions that this spatial analysis have not identified. Hence, in the discussion section, I consider the reasons for this high concentration of cargo thefts that ground the following GIM empirical studies.

Supporting Weisburd’s LCC, the Lorenz Curves and Gini Coefficients results shown earlier in this chapter, along with the spatial analyses in this section indicate that cargo theft is an unevenly distributed event and highly concentrated in specific places. The ten segments with most cargo thefts comprise 10.55% of all crimes, and those ten segments have a length of just 49.27km, representing just 0.002% of the total length of the NHN. Section 5.5 discusses these results and explores potential factors related to the high concentration of this criminal activity in a few states.

5.5. Discussion - using highway segments to identify cargo theft concentration

What offenders need to commit a cargo theft varies significantly depending on where and when they plan to act (Coughlin, 2012; McCutcheon et al., 2016; Toth, 1998). As part of generating geographic intelligence, this chapter presented a series of temporal and spatial analysis to identify specific times and places where cargo theft is committed. The temporal analysis revealed specific days and hours with a higher concentration of cargo theft incidents. This concentration on Tuesdays and Thursdays during the morning
hours, as well as Fridays during the overnight shift, suggests that offenders are likely to consider factors such as lack of guardianship, increased vulnerability, and reduced surveillance during these times. This finding aligns with the rational choice perspective, where offenders make decisions based on the perceived risks and rewards associated with a particular time and place (Becker, 1968; Coupe & Blake, 2006; Vandeviver et al., 2015).

The temporal analyses results may indicate that the lack of guardianship and higher levels of vulnerability could be related to the higher levels of cargo theft incidence during these times. For instance, the lack of daylight can inhibit effective surveillance, making targets more vulnerable and creating opportunities for offenders to attack (Ceccato, 2005; James et al., 2018; Smith, 1997; Tompson & Bowers, 2013). Additionally, drivers' fatigue and tiredness during the overnight shift may impact their driving performance and vigilance, making them more susceptible to potential threats on the highway (Garde et al., 2020; Miller, 2010; Taylor et al., 2019).

Therefore, the high concentration of cargo thefts on specific days and during certain hours of the day can also be explained using the theoretical framework of the routine activities approach. The findings of this temporal analysis suggest the convergence of likely offenders (the cargo thieves), suitable targets (cargo trucks transporting valuable merchandise), and the absence of capable guardians (lack of light, and lack of patrolling). Then, the convergence of these factors may be related to a higher concentration of cargo thefts on specific days and during certain hours of the day.

The second part of this chapter includes statistical and spatial analyses that consistently revealed that an extremely small percentage of NHN and SHN segments accounted for
most cargo thefts. Examples of this concentration are the results shown in Table 5.10 that showed that 25% of all cargo thefts occurred in only 0.025-0.037% of the two highway networks. Although these results support Weisburd’s LCC, a significant result of this study is the implication that looking at crime concentration over a country can be even more concentrated than the originally considered by Weisburd (2015) at the city level.

Furthermore, the NHN and SHN Lorenz curves and Gini coefficients illustrate an unequal distribution of cargo theft incidents along the two highway networks. The NHN data generated slightly higher measures than the SHN, indicating that fewer segments of the NHN reported more cargo thefts than SHN. This concentration can be explained by the fact that the NHN has many segments that are extremely long, and many that are very short, and this difference can bias the analysis. Therefore, developing more homogeneous segments can help to better identify and characterise the places where crime is concentrated.

The third empirical approach focuses on visually identifying the specific segments along the NHN and SHN where cargo theft is more concentrated. The findings from both networks were largely consistent, with many segments identified in the NHN also appearing in the SHN analysis. However, certain segments shifted in their ranking of high-theft segments depending on whether the NHN or SHN data were employed. These results imply that using more homogeneous segments can enhance the identification of places where crime concentrates and the identification of the potential surrounding conditions on these highway segments that are linked to cargo theft. When segments are similar in terms of length, this allows for more accurate and consistent comparisons between different areas or regions. Moreover, homogeneous segments contribute to the
reliability and validity of statistical analyses. By ensuring that the segments have similar length, it reduces a potential bias that may influence the analysis. This enhances the robustness of the findings and increases confidence in the conclusions drawn.

The segments identified in Tables 5.7. and 5.8. are considered as the places with more cargo thefts along the NHN and the SHN respectively. Independent of which highway network was utilised, all the segments in the top ten were located in the states of Puebla, Guanajuato and Veracruz. The identified highway segments serve as crucial connectors for states such as Puebla, Guanajuato, Estado de México, Veracruz and Jalisco that are characterised by high levels of industrial activity. These states rank among the top ten contributors to Mexico’s GDP and account for 45.6% of the country’s total population. Therefore, these results suggest that the demographic and economic characteristics of these states facilitate high traffic volume along the highways, providing numerous potential opportunities for offenders.

Offenders are likely to be aware of specific geographical, sociodemographic and economic conditions along these segments of highways. Moreover, these segments with higher concentration can be part of the cargo thieves’ “awareness space” (Brantingham & Brantingham, 1981), and their “search space” (Chainey & Ratcliffe, 2005). As potential cargo thieves can be familiar with the traffic volume and the patrolling schedule on the identified segments, they can search for particular targets (Felson, 1986;

Information consulted at (Last reviewed 10 November 2022).
Information consulted at https://www.inegi.org.mx/app/tabulados/interactivos/?pxq=Poblacion_Poblacion_01_e60cd8cf-927f-4b94-823e-972457a12d4b&idrt=123&opc=t (last consulted 10 of September of 2022)
The effect of these sociodemographic conditions is retaken in Chapter Six to explain the offenders’ spatial behaviour in those micro-places.
Kleemans et al., 2012; Tremblay, 1993). The knowledge of these routines and the surrounding physical environment can generate the “cargo thieves activity space” following the concept of “criminal activity space” (Rengert & Wasilchick, 2000). Then, adapted from Chainey and Ratcliffe (2005), these segments can be considered as “places of cargo theft occurrence”. Figure 5.21. illustrates this concept.

A relevant consideration is the high concentration on a few segments might suggest that crime displacement will occur if these segments are better policed. Then, while a stronger police presence may initially deter crime in targeted areas, it could also lead to offenders adjusting their tactics, such as moving their operations to nearby regions or changing their modus operandi. This potential spatial displacement underscores the relevance of
identifying how offenders are likely to consider the geographical conditions as part of their decision-making process to look for other places to commit their crimes.

To date, spatial and temporal analyses of cargo theft have been limited in the academic literature. While several studies have focused on identifying when and where cargo thefts occur, understanding the underlying reasons for offenders' choices requires a broader consideration of the surrounding conditions and the time of day. The findings presented in this chapter suggest that geographic and temporal conditions play significant roles in the offenders’ cargo theft commission.

5.6. Limitations and further work to identify highway segments of cargo theft concentration

This chapter has presented various analytic techniques for identifying and describing segments with higher cargo theft incidence. However, these analyses faced technical limitations that must be acknowledged. This section describes the most relevant limitations and how they were addressed.

Chapter Three outlined the geocoding process of the INAI database, where it was explained that the approach taken in this study provides more reliable information than the GIS geocoders. However, this method is time-consuming and may lead to inefficient use of resources. Ideally, georeferenced information would have been directly obtained from official sources such as the National Guard or the SESNSP. Another potential solution is to develop a geocoder algorithm that can generate a more reliable pin-pointing process, similar to the approach by Laudares et al. (2016). They generated a dataset over
2 million highway properties and assigned a unique identifier to each of them. Then, they calculated the distance of these properties and infer the coordinates of the locations between those properties. Nevertheless, the potential solution that this represents, the solution they proposed exceeded the scope of the current research.

Another limitation of this study is the reliance on crime data from official sources. While these sources offer a comprehensive view of cargo theft across Mexico, it is crucial to acknowledge that not all crimes are reported to the National Guard. Therefore, the data may not reflect the full extent of the problem. Additionally, the cargo theft data used in this study only includes incidents reported by the national guard, and it is possible that some incidents were not reported by cargo theft companies or truck drivers or that the police were not able to respond to an incident they were alerted to e.g., because they did not have patrol resources available at that time.

The data’s quality and quantity provided by the INAI have implications for the limitations of the spatial and temporal analyses. As explained in Chapter three, the data is based on reports filed by national guard officers who responded to cargo theft incidents (the IPH form described in chapter 3.2.2). These reports may not contain the exact location of the crime, as officers may fill out the IPH with the location where they attended, which may not be the same place where the crime was committed. Additionally, some reports do not provide the exact hour when the theft occurred, and the reported time may be when the officer filled the IPH. Further research could involve interviewing national guard officers who patrol the highways to improve the spatial and temporal data accuracy of incident reports.
Working with a discontinuous network poses several methodological challenges. One challenge is that the segments of the network may be of different lengths, which can make it difficult to compare data across segments. In this project, I attempted to address this challenge by standardising the length of the segments in the National Highway Network (NHN). However, even with sophisticated GIS algorithms and a detailed manual process, it was not possible to perfectly standardise the segments’ length. A non-homogeneous length of segments could lead to biased results.

Furthermore, at the end of section 5.3.4., I stated that using a “gravity model” could help to better understand the dynamic of cargo theft at specific micro-places. This model is based on the principle of gravitational attraction, where the flow between two locations is influenced by their mass (population, economic activity, etc.) and distance from each other (Smith, 1976; Tinbergen, 1962; Wiseman & Walker, 2017). Identifying the cargo trucks’ flows can help to explain some of the concentrations on specific segments as the maps in this Chapter showed. By applying this model, further research can analyse trade patterns, cargo flows, and transportation networks (Section 8.5 presents a more detailed proposal on this).

Finally, the results from the current study may not be generalisable to cargo theft experienced in other countries. Despite the limitations, a comprehensive analysis has been provided of cargo theft concentration in specific micro-places suggesting valuable insights into the factors associated with its commission.
5.7. Conclusions

This empirical study has shed light on the highly concentrated nature of cargo theft in Mexico, with a significant number of incidents occurring in a few specific segments of the highway network. The statistical analyses revealed that a fraction of NHN and SHN segments accounted for most reported crimes, consistent with Weisburd’s Law of Crime Concentration (2015). Indeed, the analyses presented herein extend the evidence base on the law of crime concentration in three important ways:

1. With a new, hitherto unstudied, crime type, cargo theft.
2. In a national setting.
3. Using highway segments as the unit of analysis.

The spatial and temporal analyses provided valuable insights into the identification of micro-places with higher cargo theft concentration. Furthermore, the temporal analysis showed statistically significant concentration of cargo theft. First, on Tuesdays and Thursdays in early-morning hours, this can be related with an increase in the cargo truck traffic because of the need to move merchandise during these times. A second result shows that cargo theft is concentrated on Fridays late-night hours, which may be related to lack of guardianship, or that driver fatigue may impair their attention to potential risks.

Another relevant result is that using the NHN data, the ten segments with most cargo thefts (0.008% of the highway) accounted for 261 thefts, representing 10.5% of all the crimes. In contrast, using the SHN data, the ten segments with most incidences accounted for 335 thefts, representing 13.5% of all the thefts. The statistical results suggest that cargo theft is unevenly distributed and highly concentrated in specific
segments of the highway network and that using standardised high segments may provide a more accurate and reveal a more concentrated pattern of cargo theft.

The findings presented in this chapter suggest that offenders choose to commit crime in very narrowly defined units of highway space and during certain time periods more than others. Those decisions potentially can be related to the conditions of the places where they have found it suitable to commit their criminal activities. This conclusion offers initial evidence of the relevance of the geographic conditions, time of day, and environmental factors in the commission of cargo theft.

In summary, the temporal, and spatial analyses conducted in this study indicate a high concentration of cargo theft in specific segments of the highway network. The findings presented in this chapter offer significant statistical evidence to not accept the null hypothesis of no concentration. Instead, cargo thefts across Mexico are concentrated in a very small proportion of highway segments.

The spatial component of the GIM can help understand the impact of the surrounding conditions of the specific locations where organised criminal groups develop their crime commission process. However, so far in the current research, only specific locations and times with higher incidences of cargo theft have been identified; at this point, it is not possible to identify the conditions that give rise to these patterns. Hence, in the following chapter, I will introduce a qualitative method to analyse how the surrounding conditions of the highway segments influence the commission of cargo theft.\(^{65}\)

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\(^{65}\) A special thanks to Analhí López-Viveros, Marlen García-Torres, Josué González-Torres, and Gerson Mata for all the learning we shared. Chapters 4 and 5 represent part of the work we did during our time at CNS.
Chapter 6

Crime Script Analysis of Cargo Theft on Mexican Highways

6.1. Introduction

The proposed GIM is a methodological framework that involves a mixed methods approach to generate intelligence that aims to understand the dynamics of offenders and the influence that places have on their criminal activities. The first stage of the GIM is based on quantitative analysis of temporal and spatial concentrations of criminal activity. The second stage uses qualitative methods to examine and interpret the activities of offenders across the crime commission process (CCP).

In previous chapters, spatial analyses of cargo thefts identified the Mexican states, municipalities, and highways that experienced higher levels of cargo thefts. The findings showed that cargo theft was unevenly distributed across Mexico and was highly concentrated at the highway segment level. That is, a small number of highway segments accounted for a large number of cargo thefts in Mexico. Drawing from these findings, in this chapter I aim to examine offenders’ decision-making in selecting the highway segments where cargo theft concentrates. In particular, I am interested in examining if the surrounding geographic and sociodemographic conditions of these highway segments’ influence where offences occur. In addition, in this chapter I also aim to identify how other geographic locations play a role in how cargo thieves operate (e.g., where they take the stolen merchandise). A qualitative method\textsuperscript{66}, “Crime Script Analysis (CSA)”,

\textsuperscript{66} Qualitative methods investigate how individuals decide their actions based on how they experience their surrounding space (Given, 2008; Topalli & Wright, 2013). Many scholars have noted that using qualitative
examines these aspects of offender decision-making and geographic choices. I expect that geographic and socioeconomic conditions do influence the decisions made by offenders involved in the commission of cargo theft.

This empirical study aimed to answer the following research questions:

1. *What geographic conditions do offenders consider when involved in the commission of cargo theft on highways?*

2. *What specific skills are required to commit cargo theft?*

3. *What is the role of the locations’ environmental background in the design of the cargo theft commission process?*

This chapter includes six sections, including the current introduction. The following section describes the origins and theoretical framework of crime script analysis, and how it is used in the current research. Then, the methods used for creating the crime script, including how data was collected to populate the crime script, are outlined. The fourth section presents the crime script of cargo thefts on highways in Mexico. This is followed by the limitations of using this approach, and a discussion of the crime script results and conclusions.

### 6.2. Crime Scripts: describing the offenders’ decision-making process

Qualitative methods have long been used in criminology to develop theoretical concepts related to offenders’ decisions to commit crime (Miller & Palacios, 2017; Newburn et al., 2012; Wright & Bouffard, 2016) as well as to answer two of the most recurrent questions methods helps respond to the question of *why* individuals act or develop certain types of behaviours (Given, 2008; Wright et al., 2015).
in crime research: how individuals’ acts are performed and why certain types of behaviour develop (Burcher & Whelan, 2018a; Herz et al., 2015; Jacobs & Cherbonneau, 2019). Research has also demonstrated that qualitative approaches can help explore various aspects of criminal behaviour, such as offender-targeting strategies, situational factors, and the characteristics of crime events (Bernasco et al., 2017; Miller & Palacios, 2017; Natarajan, 2006; Wright & Bouffard, 2016).

Scholars have suggested that committing a crime involves a process of actions and decisions that consists of a sequence of stages (Cornish, 1990; Ekblom & Gill, 2016; Nisbett & Ross, 1980; Schank & Abelson, 1977). Within each stage of this crime commission process (CCP), an offender must consider progressing to the next stage. An offender’s decision-making framework associated with the progression through the stages of the CCP is influenced by the type of criminal activity they consider committing and other factors such as their knowledge, experience, confidence, and rationality for their actions. In situations where the CCP involves more than one person, rather than each person performing every activity that is involved in the commission of a crime, each person within this process may play a role in one or more of these activities across multiple stages of the criminal activity (Ekblom & Tilley, 2017; Hockey & Honey, 2013; Kronenfeld et al., 1978; Nee & Meenaghan, 2006).

To ensure a crime is completed successfully, each person involved in a criminal group activity will likely possess specific skills, experience or knowledge related to their role. Although each person may not be fully aware of the role of all others in the CCP, it is likely that the success of the criminal activity, in part, relies on the success of each person’s contribution (Hutchings & Holt, 2015; Leclerc, 2014; Wortley & Mazerolle, 2008).
Therefore, if certain group members’ actions are conducted poorly (or are ineffective), the criminal activity is likely to be at risk of failing.

The CCP can be considered analogous to a theatrical script (Cornish, 1990; Schank & Abelson, 1977). A theatrical script is organised across acts, has different scenes, and involves actors, each of them playing roles that may require specific knowledge and skills to perform, supported by adequate equipment that enables them to execute their actions (Borrion, 2013; Sosnowski et al., 2020; Tompson & Chainey, 2011). As in any theatrical play, for the story to be effectively performed it requires each cast member to play their assigned role and follow a process that brings a coherent sequence to the theatrical play’s many parts.

Crime Script Analysis (CSA) involves attempting to describe how an offence or criminal activity unfolds and makes explicit the series of decision-making points within the CCP. This qualitative research method helps to elicit greater clarity on the many interconnected parts of the processes involved in offending behaviour. This includes identifying the crime opportunity and the environmental features that support the success of illegal activities (Clarke & Newman, 2009; Cornish, 1994; Farrell & Pease, 2014; Tremblay et al., 2001). CSA can also identify the activities of interconnected participants engaged in criminal activity and their roles in the script (Cornish, 1994; Cornish & Clarke, 2013; Felson et al., 2016; Haelterman, 2016; Piquero & Tibbetts, 2002).

In this regard, CSA suggests there is a logic to the sequence of steps relating to the criminal activity, implying that those involved in the process are conscious of (or at least consider) the risks of being caught (Cornish & Clarke, 2003; Felson, 1986; Lattimore & Witte, 1986). CSA involves principles of Rational Choice Perspective, as offenders
consider the effort involved and the rewards. What they expect to gain from their involvement is part of a moral calculus that an offender will likely consider (Bouffard et al., 2000; Clarke & Felson, 1993; Cornish & Clarke, 1986; Haan, 2003).

Potential offenders can be considered to operate as rational agents, choosing the actions to perform in response to incentives, while seeking to minimise errors when performing these actions and trying to maximise their gains from their involvement in the criminal activity (Brantingham & Brantingham, 1993; Cornish & Clarke, 2003; Felson & Clarke, 1998; Hamilton-Smith, 2002). However, these agents’ rationality is bounded by their available resources (e.g., knowledge, money, skills, experience, weapons, and other components that facilitate their involvement). Consequently, CSA offers a valuable way to build a picture of the decision-making process of offenders by helping to uncover the influencing factors that may cause a particular behaviour or decision to occur, and the role that individuals play in the activities of a criminal group (Bruinsma & Bernasco, 2004; Clarke & Newman, 2009; Ekblom & Gill, 2016; Tompson & Chainey, 2011).

Crime scripts can thus be used to understand the complex schemas and activities that offenders develop. Accordingly, CSA has been used to improve the collection and examination of data to better understand criminal activity (Beauregard et al., 2007; Gilmour, 2014; Morselli & Roy, 2008; Tompson & Chainey, 2011). Moreover, CSA can improve how police and prosecutors respond to crime by identifying the best opportunities for detection and prevention strategies. Lastly, CSA can help identify the factors that may encourage and create opportunities for illegal activities (Chiu et al., 2011; Levi & Maguire, 2004; Newman & Clarke, 2013).
Criminal activities such as cargo theft occur at specific locations and times, as evidenced by the findings from previous chapters. Such concentrations can reveal important spatiotemporal characteristics of the criminal activity and the behaviour of those involved in the criminal activity (Ashby, 2016; Farrell & Pease, 2014; Lacoste & Tremblay, 2003; Leclerc, 2016). CSA is a valuable technique for identifying the activities that take place across the CCP. In so doing, it potentially generates intelligence about the geographic patterns of criminal activity and the spatial decision-making of offenders (Beauregard et al., 2007; Lord et al., 2017). Until recently, however, the geographic aspects of crime locations that play a role in the CCP have not routinely featured in CSA (Alonso Berbotto & Chainey, 2021; Beauregard et al., 2007). The empirical examination in this chapter aims to address this gap in the CSA literature.

### 6.3. Data & Methods to populate the crime script

Populating a crime script involves identifying the main activities within the CCP, the environmental backcloth (outlined in Chapter 2) that influences the decisions made by offenders, and the social and economic conditions that generate opportunities to commit crimes. It encourages the researcher creating the crime script to “think thief” – thinking as the offender may have done (Ekblom, 2001; Lasky et al., 2017; Wortley & Mazerolle, 2008) – to recognise the stages and actions of the CCP. Those actions draw from information relating to the criminal activity, such as the modus operandi used in previous crimes, the equipment used by the offenders (cars, tools or weapons), and the roles required for specific activities performed.
The information required to populate a crime script about organised crime activity can be scarce and difficult to obtain, mainly because of the desire to collect sufficiently specific data about the criminal activity and the often-clandestine nature of organised crime group behaviours. Furthermore, many security agencies do not have consistent protocols for populating their systems with information and intelligence about offenders’ actions. The lack of this information and intelligence can make generating a sufficiently detailed crime script difficult. An alternative approach is to examine open sources of intelligence about the crime with document or content analysis (Hutchings & Holt, 2015; LeCompte, 2000; Tompson & Chainey, 2011; Zanella, 2013) - an approach described in the next section.

6.3.1. Using Open Sources of Intelligence in crime script analysis

Gathering sufficient data to develop a crime script may require consulting several different sources of information. When official information is scarce, or its access is restricted, open sources of intelligence (OSINT) may offer a valuable alternative source of information. When adopting an OSINT-based data collection strategy, it is essential to point out that a considerable number of open sources are available, and not all of them may be reliable. Therefore, an OSINT approach to data collection requires careful consideration.

OSINT has been used in research on many subjects, including risks to national defence (NATO, 2001; US Joint Force Development, 2016), biosecurity (Lyon et al., 2013), the relationship between government decisions, academic research and journalism (Arcos, 2019; Johnson, 2019; Westcott, 2019), personal data protection (Shere, 2020), and

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67 These documents could be any information in the public realm, for example, newspapers, electronic news on web pages, magazines, journal articles, etc.
geospatial intelligence (Thakur et al., 2015). Alonso Berbotto and Chainey (2021) used OSINT to examine the theft of oil from pipelines by organised criminal groups in Mexico, identifying that these sources provided sufficiently, and in some cases, highly detailed information to characterise the modus operandi, key actors, and decision-making involved in this criminal activity. To generate intelligence of sufficient quality, Chainey and Alonso Berbotto (2021) developed a multi-stage method that specified how to search for relevant data, quality assure its content, code the data and populate it into a crime script.

To develop a crime script for cargo theft in Mexico, I followed the method introduced by Chainey and Alonso Berbotto (2021). The first stage involved using a keyword search\(^{68}\) in Google to identify relevant information sources, including information from academic journals, government reports and media news about cargo theft. The second stage involved document analysis in refining the selected information by authenticity, credibility, representativeness, and meaning\(^{69}\). The third stage involved populating the crime script using a coding process “to organise the data within each act based on whether the data referred to a scene, the cast, or a condition” (Chainey and Alonso Berbotto, 2021, p. 11).

Finally, the approach suggested by Saldaña (2009), and recommended by Chainey and Alonso Berbotto (2021, p. 5) was “a coding cycle using axial coding\(^{70}\)” that involved examining and reviewing the gathered data to determine if data could be synthesised.

\(^{68}\) Chainey and Alonso Berbotto (2021) used 36 keyword combinations in English and 34 keyword combinations in Spanish.

\(^{69}\) Chainey and Alonso Berbotto (2021, p.9) mention that “To meet this criterion, only documents published in peer-reviewed publications, by official sources, in renowned newspapers and magazines, or by respectable think tanks and consultancies were included”.

\(^{70}\) Axial coding is considered a second phase of comparative research methods to analyse qualitative data. Based on a more theoretical approach, axial coding is an approach to synthesise and coherently organise the collected data based on hierarchically structured categories and subcategories that add nuance and dimension to emergent concepts and their potential relationship to other framework elements. Reviewed on (last accessed on 17 October 2021):
6.3.2. Document analysis

Document analysis (DA) is a qualitative research method developed to ensure the quality of documents gathered from secondary sources. Bowen (2009, p. 27) defines document analysis as a “systematic procedure for reviewing or evaluating documents—both printed and electronic (computer-based and Internet-transmitted) material”. Applying this method implies reviewing, examining, and interpreting the collected documents’ data (Given, 2008; Gross, 2018).

DA has been used to understand the dynamics of criminal activities such as online crime in internet gambling (McMullan & Rege, 2010), forensic intelligence against organised crime (De Alcaraz-Fossoul & Roberts, 2017), and forums of stakeholders to co-design crime prevention policies (Camacho Duarte et al., 2011). DA is beneficial for examining criminal activities for which officially recorded data sources can be scarce. In the case of the current research, information about the CCP associated with cargo thefts on highways is lacking in police recorded systems in Mexico. DA of OSINT was considered to offer a viable means for examining criminal activity associated with cargo thefts.

A practical application of DA requires the use of a coding system to record the content that is considered to be most relevant within these documents. If the DA is implemented correctly, the result of the coding process and the information extracted from the gathered documents offer a reliable database of information to be analysed (Altheide, 2000; Karppinen & Moe, 2019). In addition, part of the document analysis process involves verification, using triangulation, to cross-check the content extracted from documents to

avoid potential bias. Triangulating the findings can lead to a better interpretation of the data and validation of the findings (Bowen, 2009; Gross, 2018). This research used document analysis to ensure that the documents gathered via OSINT provided reliable information about cargo theft on Mexican highways. The following subsection provides details about how the crime script was populated.

6.3.3. Populating the script using OSINT and DA

Following the method of Chainey and Alonso Berbotto (2021), creating content for the crime script of cargo theft on Mexican highways involved a four-stage process.

1. Creating a potential crime script.

2. Gathering information using an OSINT method.

3. Generating a coding process to populate the script.

4. Using a second coding process to identify the effect of the geographic characteristics.

The process began using Borrion’s (2013, p. 4) criteria to create a potential script by hypothesising about the key acts involved in the cargo theft CCP. The identification of those key acts served as a guide to generate a performed script with the primary sequence of actions displayed by cargo thieves. Within each act, a record of the activities next needed to be created. Following the method proposed by Tompson and Chainey (2011), this involved creating four scene classifications for each key act (preparation, pre-activity, activity, and post-activity). Next, the cast involved in each act, or roles performed were identified (e.g., offenders and the conditions in which they operated). Next, a series of questions were proposed about the required activities, roles and skills, resources, costs, and decision-making that offenders were likely to perform. Table 6.1 lists the questions used to guide data collection about criminal activity.
<table>
<thead>
<tr>
<th>Steps</th>
<th>Considerations for the Document Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Act</td>
<td>Identification of the key stages, what are the minimal acts to commit this kind of robbery?</td>
</tr>
<tr>
<td>Scenes</td>
<td>What opportunities and conditions could the criminals identify to commit their illegal activities? Are highway cargo thefts affected by/related to other crimes?</td>
</tr>
<tr>
<td>Pre-activity</td>
<td>What logistical steps need to be conducted before the activity occurs? What is the role of the geographic space?</td>
</tr>
<tr>
<td>Activity</td>
<td>What logistical steps need to be conducted before the activity occurs? How do potential cargo thieves define these steps to commit the crime? What is the role of the geographic space?</td>
</tr>
<tr>
<td>Post-activity</td>
<td>To successfully finish the process, what are the following activities after committing to the previous scene or stage? Do the locations change?</td>
</tr>
<tr>
<td>Cast</td>
<td>What is the role of the leading offender (or group of offenders), and is it possible to identify their activities as the lead offender? Who are the support offenders? Is it possible to identify the sociodemographic characteristics of the offender(s)? Is it possible to identify the connections between offenders? What is the relationship between the actors? What skills do the offenders have? Is the same for each stage? How do the offenders identify the skills when different skills are required? What is the minimal number of people required to commit the cargo theft? How many people are included in the process? Is it always the same group? What information is required for the criminal group to commit the crime? Do they have &quot;privileged&quot; access to the information? Are the offenders related to legitimate actors (police, judges, entrepreneurs, etc.)? If they are related, do they interact when doing business?</td>
</tr>
<tr>
<td>Conditions</td>
<td>What tools/equipment are required? Do the tools/equipment change between stages? What kind of skills are needed? Are offenders familiar with the location? What know-how and information are required? Are the economic rewards of the activity good enough to commit cargo thefts? Are the economic costs of the activity higher than the rewards? Is the risk related to being caught high? Does the environmental backdrop impact as a crime facilitator? (i.e., secondary roads can act as escape routes, or isolated places can facilitate the cargo theft)</td>
</tr>
<tr>
<td>Offending conditions</td>
<td>Who is responsible for tackling this type of crime? In the case of more than one responsible party, what is their coordination? Is this activity regulated by the government or any other public security agency?</td>
</tr>
<tr>
<td>Prerequisites</td>
<td>What legislation regulates the movement of merchandise by trucks? Who enforces it? Are the roles of other players, such as insurers or chambers of commerce, relevant?</td>
</tr>
<tr>
<td>Facilitators</td>
<td></td>
</tr>
</tbody>
</table>
After generating an initial template to populate the crime script, the second stage of the process was to gather the data using the OSINT method described in section 6.3.1 using online sources. Hence, Google Search and Google Scholar were used to identify information relating to cargo theft on Mexican highways. This initial search used the keywords *cargo theft* and *highway robberies* in English and Spanish\(^{71}\).

In addition to the original terms, synonyms were used to expand the search, including theft on highways, cargo truck thefts, and violent highways in both English and Spanish (for a complete list of keywords and keyword combinations, see Table 6.2). All open sources identified were initially considered, including media reports and investigative journalism reports from Mexican and international newspapers, reports from reliable websites\(^{72}\), and documents from Mexican government agencies. The Google Scholar search revealed several academic journal articles, working papers from logistics and cargo consultancies, and documents from specialist think tanks.

**Table 6.2. Keywords and combinations of words (in English and Spanish) that were used in stage one of the crime script data identification process**

<table>
<thead>
<tr>
<th>English</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) “highway robberies”</td>
</tr>
<tr>
<td>2) “cargo theft”</td>
</tr>
<tr>
<td>3) “supply chain”</td>
</tr>
<tr>
<td>4) “burglaries”</td>
</tr>
<tr>
<td>5) “inter-state robberies”</td>
</tr>
<tr>
<td>6) “highway armed robbers”</td>
</tr>
<tr>
<td>7) “robbers and fraudsters”</td>
</tr>
<tr>
<td>8) “fake accidents”</td>
</tr>
<tr>
<td>9) “cargo theft on highways”</td>
</tr>
<tr>
<td>10) “squads operating on the road”</td>
</tr>
<tr>
<td>11) “highway smugglers”</td>
</tr>
</tbody>
</table>

\(^{71}\) At the beginning of the search, only English words were used, resulting in the identification of fewer than 50 documents to be analysed. The keyword search was repeated in Spanish to identify more sources and potential documents to include.

\(^{72}\) The reliability of these websites is based on the security and verification of the news they offer (e.g., recognised news agencies).
<table>
<thead>
<tr>
<th></th>
<th>English</th>
<th>Spanish</th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td>“highway robbers”</td>
<td>“robo en carreteras”</td>
</tr>
<tr>
<td>2)</td>
<td>“hijack trucks”</td>
<td>“robo de autotransporte”</td>
</tr>
<tr>
<td>3)</td>
<td>“gangs robberies on highways”</td>
<td>“robo de autotransporte federal”</td>
</tr>
<tr>
<td>4)</td>
<td>“in-transit cargo trucks”</td>
<td>“robo de transporte”</td>
</tr>
<tr>
<td>5)</td>
<td>“armed hijackings”</td>
<td>“robo de transporte de carga”</td>
</tr>
<tr>
<td>6)</td>
<td>“logistics firms thefts”</td>
<td>“robo de carga”</td>
</tr>
<tr>
<td>7)</td>
<td>“cargo trucks parked in insecure locations”</td>
<td>“robo de unidades de transporte”</td>
</tr>
<tr>
<td>8)</td>
<td>“risk of cargo loss”</td>
<td>“robo de transporte en cualquiera de sus modalidades”</td>
</tr>
<tr>
<td>9)</td>
<td>“Mexican cargo freight industry”</td>
<td>“robo transportistas”</td>
</tr>
<tr>
<td>10</td>
<td>“blockades on train tracks”</td>
<td>“asalto a transportistas”</td>
</tr>
<tr>
<td>11</td>
<td>“rise in cargo theft”</td>
<td>“atracos al transporte de carga”</td>
</tr>
<tr>
<td>12</td>
<td>“shipping container theft”</td>
<td>“robos al transporte federal”</td>
</tr>
<tr>
<td>13</td>
<td>“fake police”</td>
<td>“robos al transporte de carga”</td>
</tr>
<tr>
<td>14</td>
<td>“armed hijackings”</td>
<td>“robos al transporte terrestre de carga”</td>
</tr>
<tr>
<td>15</td>
<td>“logistic firms thefts”</td>
<td>“robos al autotransporte de carga”</td>
</tr>
<tr>
<td>16</td>
<td>“violent highways”</td>
<td>“trailer”</td>
</tr>
<tr>
<td>17</td>
<td>“highways with more crimes”</td>
<td>“bandas del crimen organizado”</td>
</tr>
<tr>
<td>18</td>
<td>“theft on highways”</td>
<td>“pérdidas económicas del robo de autotransporte”</td>
</tr>
<tr>
<td>19</td>
<td>“cargo truck thefts”</td>
<td>“atracos en carretera”</td>
</tr>
<tr>
<td>20</td>
<td>“losses cargo theft”</td>
<td>“robo de mercancías en carreteras”</td>
</tr>
<tr>
<td>21</td>
<td>“violent highways”</td>
<td>“robo en autopistas”</td>
</tr>
<tr>
<td>22</td>
<td>“robbery of cargo trucks”</td>
<td>“robo en autopistas”</td>
</tr>
<tr>
<td>23</td>
<td>“blocking cargo theft”</td>
<td>“triángulo rojo”</td>
</tr>
</tbody>
</table>
The second step of the OSINT method applied Document Analysis (DA) to quality assure the information identified in the previous step. Following the work of Bowen (2009) and Gloss (2018), the first part of the DA was to refine the sample of documents collected to those that were relevant, and representative for the study. This process removes documents judged unnecessary, or that do not offer additional information to those collected from other sources.

Document relevance was defined by the temporal period and geographic area. This restricted the selection of documents related to Mexico and those generated between January 2016 and June 2020. As cargo theft has increased in Mexico in recent years, many news stories, media reports and other documents referred to this criminal activity. As a result of the keyword search, and despite the restrictions imposed on the search, more than 250 information sources were identified and stored. In terms of representativeness, only two documents per author were used, as Gross (2018) suggested and as applied by Chainey and Alonso Berbotto (2021).
The second part of the DA involved quality assuring the documents. Following the work of Nock & Scott (1991), this required selecting documents in terms of their authenticity, credibility, representativeness, and meaning. This required applying the following steps:

- **Authenticity**: the selection of documents was restricted to those that originated from well-respected newspapers or journalists, official sources (e.g., governmental, or non-governmental organisations), peer-reviewed journals, think tanks and consultancies.
- **Credibility**: reviewing the documents for any potential bias or lack of details.
- **Representativeness**: documents that provided sufficient detail and evidence about the location and time when the crime was committed.
- **Meaning**: the selection of documents related to the commission of cargo theft and included details about the offenders' modus operandi, tools, and activities.

After applying these four criteria, the final sample consisted of 120 documents to analyse for populating the crime script.

The third stage of the OSINT method involved a coding process in populating the acts, scenes, cast, and conditions that form the cargo theft CCP on Mexican highways. Codes were created to identify and organise the data (e.g., by the actions and activities performed by the cargo thieves) under each act. Codes were similarly created to refer the information to their corresponding scene (e.g., preparation, pre-activity, the activity, or post-activity), cast or condition. These data were coded to ‘cast’ if the document referred to a person, organisation, or institution. If data was identified as related to a facilitator of the CCP, this data was coded to ‘condition’. This coding process is illustrated in Figure 6.1, which shows that information relating to a cast member involved in Act 2 would be coded as A2_C. The data was organised in an Excel file including the described codes.
Figure 6.1. The initial coding process to link the information sources with the components of the crime script
Source: Chainey and Alonso Berbotto, 2021, p. 11
The fourth stage of the OSINT method involved a second round of coding. Following Saldaña’s (2009) work, an axial coding process was employed to examine the content of specific categories and subcategories of data collected during the previous coding process to determine associations between coded data points. As Saldaña (2009, p. 218) defines: “The goal is to strategically reassemble data that were “split” or “fractured” during the initial coding process”. In the context of the current research, this axial coding process was performed to review and re-analyse the data collected to ensure it was populated into the correct act, scene, or condition. As a result of this axial coding process, some information was relocated to other parts of the crime script.

Once the script was populated, the next step involved reviewing the content of the crime script following theoretical principles to assure the script's consistency, parsimony, and potential usability (Borrion, 2013). This review assessed the crime script’s content using principles from the rational choice perspective, routine activity approach, and crime pattern theory. This aimed to validate if the acts, activities and decision-making processes considered in the crime script were consistent with the theoretical concepts.

One of the novel proposals of this research was to introduce an additional step that involved coding crime script content about whether it referred to data, information or intelligence about geographic characteristics, such as details about locations or geographic conditions referred to in the documents collected. This extra coding involved reviewing each item of data in the crime script. This was coded with a geographic coding flag if it referred to any geographic characteristics associated with the criminal activity. For example, an item of data identified to relate to the first act and pre-activity and had geographic details was coded as A1_SPr_GI.
The result of these processes (using OSINT, document analysis and the coding process) was the creation of a crime script about cargo theft on highways in Mexico, emphasising how the geographic characteristics impact offender decision-making.

6.4. Results - Crime Script of Cargo Theft on Mexican Highways

This section presents the results of the crime script analysis. First, a brief description of the identified cargo theft CCP is provided, with the six acts that were identified. A description of each act follows, explaining their respective activities and cast and conditions. The information in the sections that follow is based on data extracted from the documents that were selected. In places, specific reference is made to certain sources of data. Details about all documents that were sourced are provided in Annex 9.3.

6.4.1. Description of the cargo theft commission process

Figure 6.2. shows the acts identified as part of the crime script of cargo theft on Mexican highways involves six acts that comprise the commission of cargo thefts on highways:

![Diagram](image)

Figure 6.2. Cargo theft crime commission process

Table 6.3. shows a description of the six acts identified as part of the CCP.

---

73 The data presented in the tables featured in Section 6.4 were gathered from reliable sources, which are elaborated upon in Chapter. The sources of each document used to populate the tables in this chapter have been enumerated in Annexe 9.3 to facilitate easy reference. By consulting the annexe, one can ascertain the origin of any specific document used as reference in the tables.
<table>
<thead>
<tr>
<th>Act</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Planning the Robbery</strong></td>
<td>Offenders convened to plan the cargo theft, allocated roles, decided on required equipment, and identified potential buyers for stolen cargo/merchandise.</td>
</tr>
<tr>
<td><strong>Transportation to the Highway</strong></td>
<td>Offenders gathered before the robbery and drove to the chosen highway segment.</td>
</tr>
<tr>
<td><strong>The Robbery</strong></td>
<td>Offenders proceeded to a highway section, selected a suitable cargo truck, forced the driver to stop, and either offloaded items or took the entire truck with its cargo.</td>
</tr>
<tr>
<td><strong>Transportation After the Robbery</strong></td>
<td>After the robbery, the offenders drove from the highway to a storage location.</td>
</tr>
<tr>
<td><strong>Storage of the Stolen Cargo</strong></td>
<td>Offenders unloaded the merchandise from their vehicle or the stolen cargo truck, storing it at a suitable facility, such as a warehouse.</td>
</tr>
<tr>
<td><strong>Disposal of the Stolen Merchandise</strong></td>
<td>The stolen cargo was sold to one or multiple buyers.</td>
</tr>
</tbody>
</table>

Each act was organised into four parts (following the template described in subsection 6.3.3) for creating a crime script: scene classifications (involving preparation, pre-activity, activity, and post-activity), the cast, the equipment used, and the geographic conditions associated with the act. The entire content of the crime script is presented in Annexe 9.4. Figure 6.2 summarises the crime script, organised by acts, activities, equipment, the cast, and geographic conditions. In the following subsections, each act is described in full based on the information collected and reviewed in the methods section.
### Crime Script of Cargo Theft on Mexican Highways – acts, activities, tools, cast and geographic conditions

**Activities**
- Look for specific segments.
- Recruit co-offenders with suitable skills.
- Define the segments based on geographic conditions.
- Determine how they will act, time, tools and possible escape routes.

**Tools**
- Money, weapons, suitable vehicle, communication devices, GPS blockers, gloves, bolt cutter, storage containers

**Cast**
- Lead Offender
- Co-Offenders
- Maintenance highway workers
- Police officers
- Buyers and business partners
- Owner of the storage facility
- Employee of transport firm
- Other participants

**Geographic conditions**
- Geographical conditions determine how they will act and their escape routes. Also, where meetings are carried out, places are familiar and closer to the selected segments.

**Activities**
- Identify the best route to the segment
- Attend a previous meeting in a hiding spot to avoid the police
- Drive to a segment of the highway
- Drive close to the truck to attack

**Tools**
- Weapons, suitable vehicles, GPS blockers, and communication devices.

**Cast**
- Stolen merchandise

**Geographic conditions**
- Offenders move from their bases/anchor points to where the cargo theft will be committed, knowing the lack of guardianship.

**Activities**
- Offenders drive close to the truck.
- Force the driver to stop (could use weapons and hijack the driver)
- Take control of the truck

**Tools**
- Weapons, suitable vehicles, GPS blockers, and communication devices.

**Cast**
- Offenders

**Geographic conditions**
- Located in uninhabited areas, close to secondary roads connected with small towns. Sometimes, areas with bad network communication and sinuous roads.

**Activities**
- Offenders have previously identified the escape route by secondary roads
- Get inside the cargo-truck
- After committing the robbery, they have the truck and drive to the storage place
- Offenders are on their way to the storage place

**Tools**
- Weapons, suitable vehicles, GPS blockers, and communication devices.

**Cast**
- Offenders

**Geographic conditions**
- Secondary roads that are not part of the National Guard jurisdiction.

**Activities**
- Offenders previously identified a storage place close to the highway with the conditions? to hide the truck
- Arrive at the warehouse and disposal de merchandise
- Prepare the stolen merchandise to be disposed of.

**Tools**
- Money, weapons/guns, suitable storage containers, gloves, bolt cutters, truck dismantling tools, and communication devices.

**Cast**
- Storage management

**Geographic conditions**
- Close to markets but far from the storage place to avoid the police recognising their illegal activities.

---

**Figure 6.3.** Summary of the crime script of cargo theft on Mexican highways

Source: Own elaboration based on (Alonso Berbotto & Chainey, 2021, p. 8)
## 6.4.2. Planning the Robbery

### 6.4.2.1. Activities

Table 6.4. describes each phase of the activities involved in this act.

### Table 6.4. Phases of activities of planning the robbery

<table>
<thead>
<tr>
<th>Phase</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparation</td>
<td>- Scholars such as Agnew (2020), De Oña et al. (2013), Justus et al. (2018), McCutcheon et al. (2016) have documented that offenders were likely to be familiar with the geographic characteristics of the highways where they planned to commit a theft. This includes knowledge of the terrain, availability of hiding places, and hours and days of the week with fewer police patrolling.</td>
</tr>
<tr>
<td></td>
<td>- Offenders were likely to be aware of the geographic conditions making certain micro-places vulnerable to theft (Boone et al., 2016; Ekwall, 2012a; Palmer &amp; Richardson, 2009). An example of this was observed in the two segments with more cargo theft incidents nationwide. Both segments were in the State of Puebla but in totally different geographic areas. One was in an uninhabited area close to small towns connected via secondary roads, making it easy for offenders to steal cargo and transport it to a nearby town. The other was in a mountainous area with a poorly (or non-existent) communication network, making it difficult for law enforcement to respond to cargo theft in this area. Offenders exploited this by</td>
</tr>
</tbody>
</table>
targeting slower-moving trucks without a good GPS signal. Figure 6.4. shows these segments.

- As part of the preparation, the lead offender identified that the financial investment for the robbery could be quickly recovered by selling the stolen merchandise and the mechanical parts of the cargo truck in legal and illegal markets.

- The offenders likely investigated the most common merchandise their business partners demanded (BSI et al., 2022; Burges, 2013; Coughlin, 2012). Demand varied depending on the area, impacting target selection74.

- The lead offender also sought suitable business partners to sell the stolen merchandise (Burges, 2013; Palmer & Richardson, 2009; Sebyan Black & Fennelly, 2021).

- Offenders looked for guns, tools, and cars required to commit cargo theft (Burges, 2013; Justus et al., 2018; TAPA, 2017).

- The lead offender searched for a suitable storage location for the stolen goods and the equipment.

- Offenders considered using different vehicles if their intention was solely to steal the merchandise or the entire cargo truck:

1) First scenario: A sedan or a small pickup truck to avoid attracting police attention, and the other, a larger pickup truck, to transport the

74 For the Mexican case, specialised consultancies have documented that in different areas of the country, cargo thieves tend to rob different types of merchandise—for example, pharmaceutical and chemical products in the West. Groceries and textiles are in the Central Area (Analytica, 2017; Observatorio Nacional Ciudadano, 2014; Sensiguard, 2019).
stolen merchandise (Ekwall et al., 2016a; Friedman & Mitchell, 2003; Justus et al., 2018).

2) Second scenario, where the objective was to steal the cargo truck itself, offenders were likely to utilise sedans or modest vehicles (SENSITECH, 2022a). In that case, the cargo was driven to the storage location inside the cargo truck.

| Pre-activity | - Preceding the planning meeting, offenders acquired the necessary equipment for the theft (e.g., guns, GPS signal blockers, and tools)\(^{75}\).  
- Offenders gathered information by bribing or extorting former or current employees of transportation and logistics firms about truck security systems and the merchandise scheduled for transportation (Manuj & Mentzer, 2008; Mayhew, 2001; Queiroz, 2012).  
- Before the meeting, the offenders conducted on-site visits to the intended location of the theft to assess its suitability\(^{76}\). |
| Activity | - The planning meeting involved all group members, including the lead offender and their support counterparts.  
- The offenders selected the most suitable location and time to commit the theft. They agreed on the actions for the robbery and post-robbery, as well as roles for each group member, including |

\(^{75}\) Information about equipment can be consulted in the following links (last reviewed 12 July 2023):  

\(^{76}\) With information from a former boss of the Mexican Federal Police in charge of patrolling the highways:  
potential co-offenders in supportive roles like lookouts, bribed police officers, or logistic firm workers.

- Scholars such as Burges (2013), Lantz & Ruback (2017), Mayhew (2001), and specialised consultancies such as BSI (2022), SENSITECH (2020), TAPA (2021) have documented the co-offending role of lookouts in cargo theft CCP. These individuals were familiar with the location where offenders planned to act, providing strategic information\(^77\).

- The lead offender, support offenders, lookouts, bribed police officers, maintenance workers, and firm logistic employee(s) agreed on logistics of the crime\(^78\).

| Post-activity | - The offenders collected the equipment and ensured their vehicles were ready and loaded with the required tools. - The lead offender negotiated with business partners for the disposal of the stolen cargo/merchandise. Including grocery and electronic retailers, auto parts shops, and drug stores (Analytica, 2017; De la Torre Romero et al., 2014; Mayhew, 2001). |


Figure 6.4. Segments with more incidences  
Source: Latinus_us. [https://youtu.be/qBs4DDisgs0](https://youtu.be/qBs4DDisgs0) (min 3.12)

It is important to note that these segments were identified in Chapter Five as the two segments with more incidences across the National and Standardised Highway Networks. The analysis of these segments is extended in Chapter Seven.
### Cast

Table 6.5. shows the role and responsibilities of each group member involved in this act.

<table>
<thead>
<tr>
<th>Role</th>
<th>Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lead offender</strong></td>
<td>- Determined segments and times for the robbery.</td>
</tr>
<tr>
<td></td>
<td>- Extorted or bribed police officers.</td>
</tr>
<tr>
<td></td>
<td>- Hired other co-offenders.</td>
</tr>
<tr>
<td></td>
<td>- Negotiated with business partners (including deals with other criminal organisations for weapons).</td>
</tr>
<tr>
<td><strong>Support offenders</strong></td>
<td>- Collaborated on defining specific segments for the robbery.</td>
</tr>
<tr>
<td></td>
<td>- Obtained information about merchandise and truck routes.</td>
</tr>
<tr>
<td></td>
<td>- Searched for escape routes.</td>
</tr>
<tr>
<td></td>
<td>- Bought or stolen technological devices needed to block truck tracking systems (SENSITECH, 2022c; TAPA, 2021).</td>
</tr>
<tr>
<td></td>
<td>- Made arrangements for storage facilities.</td>
</tr>
<tr>
<td><strong>Lookouts</strong></td>
<td>- Notified on the day of the robbery to be ready to support the offenders.</td>
</tr>
</tbody>
</table>
| **Former/current logistics firm employee(s)** | - Provide essential information about cargo-theft schedules, routes, and merchandise carried
| **Police officers**               | - Bribed officers are notified about the segments they should avoid patrolling<sup>80</sup>.                                                          |


<sup>80</sup> Viridiana López Valencia, member of the Ministry for Public Security of Estado de Mexico (the state with the highest reports of cargo theft across Mexico), mentions: “Criminals have access to confidential information from companies, then, they identify the route and the type of cargo that cargo trucks carry.” [https://www.milenio.com/politica/comunidad/asi-roban-al-transporte-de-carga-en-carreteras-del-edomex](https://www.milenio.com/politica/comunidad/asi-roban-al-transporte-de-carga-en-carreteras-del-edomex)

<sup>80</sup> Transport firms in Mexico have reported that the cargo thieves’ modus operandi implies calls to municipal police officers, who were bribed and worked like lookouts:
Storage facility owner  - Agreed on payment for using the facility as a warehouse.

Business partners  - Agreed about the type of merchandise that they required.
- Agreed on how it will be disposed of, and how the payment will be made\(^81\).

Members of other criminal groups  - Agreed to sell guns, and occasionally brought protection to the offenders if the robbery was related to drugs (Aguirre Quezada, 2018; Analytica, 2017; Bleszynska, 2021; Jones & Sullivan, 2019).

6.4.2.3. Equipment

The equipment required for these criminal activities was readily accessible and could be easily acquired. In most cases, these items did not necessitate licenses or special permits for purchase. The lead offender obtained the guns and encrypted phones from illegal markets. Table 6.6. shows the equipment identified as part of the planning activity.

Table 6.6. Equipment – Transportation to the highway

<table>
<thead>
<tr>
<th>Equipment</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Guns</td>
</tr>
<tr>
<td></td>
<td>- Gloves</td>
</tr>
<tr>
<td></td>
<td>- Walkie talkies</td>
</tr>
<tr>
<td></td>
<td>- Burned or encrypted phones</td>
</tr>
<tr>
<td></td>
<td>- GPS blocker</td>
</tr>
<tr>
<td></td>
<td>- Bolt cutter</td>
</tr>
<tr>
<td></td>
<td>- Mexican transport associations have identified two different types of vehicles. Figure 6.5. shows an example of vehicles that offenders used in the CCP(^82)</td>
</tr>
</tbody>
</table>

---

\(^{81}\) Mexican cargo transport associations have documented that stolen merchandise is sold near markets and wholesale centres. They mention that cargo thieves and their business partners are likely to prefer cash payments to avoid fiscal regulations. [https://lasillarota.com/nacion/2023/2/5/nadie-habla-de-lo-que-arriesgamos-robo-transporte-de-carga-aumenta-36-en-mexico-413026.html](https://lasillarota.com/nacion/2023/2/5/nadie-habla-de-lo-que-arriesgamos-robo-transporte-de-carga-aumenta-36-en-mexico-413026.html)

Sedans, the most common being Nissan Tsuru and Versa, Volkswagen Jetta, Chevrolet Aveo.

Pickup trucks such as Ford F150, Ranger; Chrysler Ram series.

Figure 6.5. Example of vehicles used by cargo thieves

6.4.2.4. Geographic conditions
As part of the planning stage, the potential offenders searched for specific geographic conditions that can facilitate the cargo theft CCP. For instance, offenders were likely to identify locations with less communication network coverage, which can facilitate committing cargo theft (BSI and TT Club, 2021; Sensiguard, 2019; SENSITECH, 2020). Another example was their likelihood to choose locations with faster escape routes, including those close to secondary roads.

6.4.3. Transportation to the highway
6.4.3.1. Activities
Table 6.7. describes each phase of the activities involved in this act.
Table 6.7. Phases of activities of transportation to the highway

<table>
<thead>
<tr>
<th>Phase</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Preparation</strong></td>
</tr>
<tr>
<td></td>
<td>- Offenders would typically prepare two vehicles for the operation. One would be a modest sedan (e.g., Nissan Tsuru, Versa, Volkswagen Jetta, or Chevrolet Aveo) to avoid drawing attention. The second would most likely be a pickup truck (e.g., Ford F150, Chrysler Ram, or similar) to transport stolen merchandise. - An alternative scenario involved the use of only the sedan when hijacking the cargo truck.</td>
</tr>
<tr>
<td></td>
<td><strong>Pre-activity</strong></td>
</tr>
<tr>
<td></td>
<td>- Offenders assembled at a prearranged meeting point before heading to the highway. - The lead offender contacted the lookouts to stay informed about any potential issues, such as patrolling activity. They would also notify bribed or extorted police officers and receive real-time updates on police locations⁸³. - Support offenders ensure all required equipment (guns, GPS blockers, and other tools) is loaded into the designated vehicles for the robbery. - The vehicles may include the sedan and pickup truck for transporting stolen merchandise or solely the sedan for hijacking the cargo truck.</td>
</tr>
<tr>
<td></td>
<td><strong>Activity</strong></td>
</tr>
<tr>
<td></td>
<td>- Offenders convened at a designated location and drive to a specific highway segment where they previously identified a cargo truck transporting valuable goods.</td>
</tr>
</tbody>
</table>
While en route, the lead offender communicates with lookouts to stay informed about police patrolling activity in the area. Support offenders ensured they are not being followed. Once the target cargo truck is identified, the offenders drive alongside it until they reach the chosen highway segment for the robbery, fully prepared to commit the theft.

Post-activity

- The driving offender verifies that they are not being followed before initiating the robbery.
- The lead offender contacts lookouts to confirm the absence of nearby police patrols.
- Lead and support offenders prepare guns, GPS blockers, or any other necessary technology to take control of the cargo truck (Analytica, 2017; Sensiguard, 2019; SENSITECH, 2020).

6.4.3.2. Cast

Table 6.8. shows the role and responsibilities of each group member involved in this act.

<table>
<thead>
<tr>
<th>Role</th>
<th>Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead offender</td>
<td>- Drove and coordinated the pursuit of the cargo truck.</td>
</tr>
</tbody>
</table>
| Support offenders | - One was aware that no one was following them and was ready to drive the cargo truck once the other offenders began the attack.  
                     - Another support offender was ready to take control of the attacked cargo truck and deal with the legitimate cargo truck driver. |
| Lookouts        | - Shared strategic information about the conditions of the highway and any patrolling in the area. |

**Legitimate driver of the cargo truck**
- Drove the cargo truck that was attacked.

**Extorted/bribed police officers**
- Changed their patrolling routes to avoid the selected segments of the highway where the offenders planned to act\(^\text{85}\).

### 6.4.3.3. Equipment

Table 6.9. shows equipment identified as part of this act.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Transportation to the highway</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Guns to shoot or intimidate the driver or to use against law enforcement officers</td>
<td></td>
</tr>
<tr>
<td>- Knives are likely to be used to intimidate the driver.</td>
<td></td>
</tr>
<tr>
<td>- Gloves</td>
<td></td>
</tr>
<tr>
<td>- Walkie talkies</td>
<td></td>
</tr>
<tr>
<td>- Burned or encrypted phones</td>
<td></td>
</tr>
<tr>
<td>- GPS blocker</td>
<td></td>
</tr>
<tr>
<td>- Bolt cutter</td>
<td></td>
</tr>
<tr>
<td>- Vehicles:</td>
<td></td>
</tr>
<tr>
<td>- Sedan or modest vehicles to drive without attracting the attention of the police.</td>
<td></td>
</tr>
<tr>
<td>- Pickup truck or another suitable vehicle to load and move the stolen merchandise.</td>
<td></td>
</tr>
</tbody>
</table>

### 6.4.3.4. Geographic conditions

Scholars that had studied highway robberies have suggested that offenders are familiar with their escape routes (McCutcheon et al., 2016; TAPA, 2021; Weisel et al., 2006). Offenders perceived they had identified the most suitable segments to commit a cargo

theft because of their comprehensive knowledge of the geographic context of those locations (uninhabited areas, daylight, lack of network communications). Consequently, I propose that the location where offenders planned to commit the cargo theft and the route to get there were defined by a deep understanding of the geographic conditions in these areas, especially for the driving offenders.

6.4.4. Robbery

6.4.4.1. Activities

*Preparation*

As part of the preparation to commit the robbery, the lead offender was likely aware if the police were patrolling the highway segments where the offenders planned to act\(^\text{86}\). Support offenders checked if the equipment were ready to begin the robbery and attack the truck.

*Pre-activity*

When the offenders were alongside the cargo truck, they followed it until they arrived at the selected segment\(^\text{87}\). Once there, offenders began the process of forcing the cargo truck to stop. Then, offenders were likely to shoot the truck or use their vehicles to block

\(^{86}\) Evidence on this claim can be reviewed here: [https://www.milenio.com/politica/comunidad/asi-roban-al-transporte-de-carga-en-carreteras-deledomex](https://www.milenio.com/politica/comunidad/asi-roban-al-transporte-de-carga-en-carreteras-deledomex)

\(^{87}\) Drivers interviewed by the Mexican Association of Private Security Companies and Satellite Industry (AMESIS) mentioned that cargo thieves follow them, use arms, and force them to stop their cargo trucks. [https://lasillarota.com/nacion/2023/2/5/nadie-habla-de-lo-que-arriesgamos-robo-transporte-de-carga-aumenta-36-en-mexico-413026.html](https://lasillarota.com/nacion/2023/2/5/nadie-habla-de-lo-que-arriesgamos-robo-transporte-de-carga-aumenta-36-en-mexico-413026.html)
its way\textsuperscript{88}. Based on the information consulted in the DA process, newspapers and transport associations have documented that cargo truck drivers reported that\textsuperscript{89}:

“Cargo thieves follow the vehicle (cargo truck) from its point of departure to an isolated location on the highway (the segment selected). Upon reaching the vehicle, the offenders cut off its circulation and proceeded to carry out the robbery. Then, armed individuals fire shots to achieve the vehicle’s stop.”

\textit{Activity}

Once the offenders blocked and stopped the cargo truck, they attacked and pushed the legitimate driver out of the truck. One of the offenders took control of the truck, and it was ready to drive. Meanwhile, the other offender used a device to block the truck’s GPS or communication system signal. Blocking the communication of the cargo truck reduces the possibility that the driver can communicate the situation to the police or the legal owner of the truck, thus providing enough time to finish the robbery\textsuperscript{90}. Figure 6.6. shows an example of the description provided by the logistics and transport companies of how offenders are likely to use jammers or GPS blockers\textsuperscript{91}:

\footnotesize
\begin{itemize}
  \item \textsuperscript{88} In nearly 70\% of cases, offenders use firearms to threaten drivers. Most thefts are perpetrated by forcing trucks to stop on open highways. https://www.torchlight.ai/full-report-mexico-companies-calls-for-action-on-highway-cargo-theft/
  \item \textsuperscript{89} Source: https://www.ejecentral.com.mx/cinco-caminos-prioritarios-para-combatir-robos-pf/
  \item https://zetter.com.mx/como-operan-las-bandas-de-robo-a-transporte-de-carga-en-carretera/
  \item https://lockbox.lockton.com/m/2703444fc4bd8030/original/robo-a-transportistas.pdf
  \item \textsuperscript{90} Reports of the Mexican Transportation Chamber (CANACAR) mention that the use of jammer devices has increased to the point that the Mexican government created a law to avoid its use. Called “anti-jammer law”, it derived from a reform to articles 190 bis of the LFTR and 168 of the Penal Code. https://www.eleconomista.com.mx/empresas/Ley-anti-jammer-que-prohibe-los-bloqueadores-de-video-voz-y-datos-entra-en-vigor-este-sabado-20200124-0053.html
  \item https://rntfnd.org/2020/10/30/gps-jammers-used-in-85-of-cargo-truck-thefts-mexico-has-taken-action/
\end{itemize}

\normalsize
“Once the criminals block the truck's route, they board it and activate the jammer since most trucks are equipped with a GPS. The criminals use these inhibitors to disrupt the signal of the truck's tracking system and divert it from the intended route.”

Figure 6.6. Example of a Jammer/GPS blocker

After offenders took control of the cargo truck, two ways they proceeded were identified:

1. Offenders transferred the merchandise from the cargo truck to the vehicle they used to transport the stolen merchandise. In this approach, at least three group members were involved: two for transferring the merchandise from the truck to the vehicle, and the other drove the vehicle to the storage place. In an interview, a former National Guard Commissioner mentioned:

   “Once they have stopped the cargo truck, they force the driver to step down, and one of the group members takes his place. They proceed to unload the merchandise and transfer it to another vehicle. In some cases, the offenders drive a few kilometres to a location where they can unload it at their leisure92.”

2. In this approach, I identified that offenders were likely to steal the cargo truck. In this case, one offender drove the truck to the storage facility; meanwhile, the other offenders followed it driving the designated vehicle. Figure 6.7. shows a statement provided for a legitimate cargo truck driver that has been victim of cargo thieves93:

---

https://logitrack.mx/por-que-los-robos-al-transporte-de-carga-son-exitosos-y-como-protegerte/

93 Source: https://lasillarota.com/nacion/2023/2/5/nadie-habla-de-lo-que-arriesgamos-robo-transporte-de-carga-aumenta-36-en-mexico-413026.html
“Typically, the offenders threaten us with firearms and force us to surrender the truck. They then take the vehicle to a location where they will unload the merchandise.”

Figure 6.7. Legitimate cargo truck driver declaration

Figure 6.8. shows three different robberies. Figure 6.9. shows the act of the robbery.\textsuperscript{94}

\textsuperscript{94} Imagen Noticias, “Así operan los asaltantes en la carretera México-Querétaro”  
https://www.youtube.com/watch?v=HdPFO7SraRE  
Milenio, “Cámaras captan robo a tráiler en carretera de Querétaro”  
https://www.youtube.com/watch?v=nbi3_D6HAh0  
Milenio, “En Veracruz, la carretera transístmica se convirtió en una trampa mortal para comerciantes”  
https://www.youtube.com/watch?v=CtRLBjtUEbU
Figure 6.8. Example of three robberies on different highways of the country
Figure 6.9. Example activity of Robbery

- Three offenders
- Guns
- GPS blocker
- Phones
Offenders were likely to be aware that the truck driver will try to communicate the robbery to the police or the logistics firm. To avoid any communication, a support offender used their guns to threaten the driver into cooperating with the group to avoid any reaction from the driver. After obtaining the merchandise, the offenders were likely to act as follows:

- If the offenders did not take the cargo truck, they covered the eyes of the driver, put the driver inside one of their vehicles, and, after a few kilometres of driving to the storage place, offenders usually dropped the driver in an abandoned area to prevent the driver recognising the route to the storage place95: In one case the driver stated: “that past 2 a.m. when they made a stop near the place where I was attacked. They threw me out of the van I was being taken in, and I ran to hide.”

Figure 6.10. shows an example of how offenders force the driver inside of a white pickup that they are using as part of the cargo theft commission.

---

95 Sources: https://transporte.mx/siguen-robos-en-la-leon-salamanca-ahora-una-grua-que-transportaba-montacargas/
• If the offenders hijacked the cargo truck, and the legitimate driver remained in the truck (offenders covered the eyes of the driver), the offenders would most usually drop off the driver a few kilometres away in an abandoned place. A legitimate cargo truck driver that suffered a theft documented his experience as follows\textsuperscript{96}:

“I was handcuffed and beaten while they drove to a warehouse. I was chained up in the truck, and two guys sat over me. I heard them call to police elements there who appeared to be colluding with the criminal group.”

\textit{Post-activity}

After the robbery, the offenders began their journey to the storage place. The offender driving the vehicle would be the one who often looked out for potential difficulties (e.g., a police officer). The offenders were likely to call their co-offenders to find out about the situation near the warehouse, and that these co-offenders were preparing the warehouse to store the stolen merchandise. The leader would call the lookouts to ensure that no one knows about the robbery or if patrols were en route near the robbery place. Figure 6.11. illustrates an example of cargo thieves during the post-activity stage. The figure shows how they took control of the cargo truck, put the GPS blocker/anti-jammer, and started to drive (while the other offenders were in another car).

\textsuperscript{96} Source: News channel, NMás. \url{https://www.youtube.com/watch?v=r_B1YyqBXB8}
The documents reviewed stated that the logistics firms would continually monitor their cargo trucks. In cases when the firms lost the GPS signal of the cargo truck (or the truck changed its original route), the logistics firm would try to communicate with the driver, but if unsuccessful, the company would call the police to report the truck was missing\(^97\). An example is provided by a “Traffic Manager” who worked in a logistic firm called “Innovación Lógika”\(^98\):

“The GPS indicates when the cargo truck stops in an unauthorised area or suddenly takes a different route. The monitoring department of the company calls the driver to inquire about what is happening. If there is no response, they know that something is wrong, their first course of action is to contact the nearest authorities to the location.”

\(^{97}\) Associations of logistics firms, such as the Mexican Association of Private Security Companies (AMESP), Mexican Association of Private Security Companies and Satellite Industry (AMESIS), and the National Association of Vehicle Tracking and Protection Companies (ANERV), have similar protocols to attend cargo theft: [https://transporte.mx/empresas-perfeccionan-protocolos-ante-los-robos-de-carga/](https://transporte.mx/empresas-perfeccionan-protocolos-ante-los-robos-de-carga/)
[https://www.ubicalo.com.mx/blog/como-prevenir-el-robo-de-camiones-4-acciones-que-puedes-tomar/](https://www.ubicalo.com.mx/blog/como-prevenir-el-robo-de-camiones-4-acciones-que-puedes-tomar/)

\(^{98}\) Source: [https://www.tyt.com.mx/nota/protocolos-de-seguridad-buenas-practicas-ante-emergencias](https://www.tyt.com.mx/nota/protocolos-de-seguridad-buenas-practicas-ante-emergencias)
Another example was reported by the President of the National Association of Vehicle Tracking and Protection Companies (ANERPV)99

"We have success stories of recovering vehicles within eight or 10 minutes, but certain conditions need to be met. These include the vehicle continuing to share its location, coordination between the monitoring centres and the person who reported the theft, and the personnel at the C4 or C5100 knowing how to correctly interpret GPS coordinates. With these elements in place, the success rate for vehicle and cargo recovery is high."

6.4.4.2. Cast

Table 6.10. shows the role and responsibilities of each group member involved in this act.

<table>
<thead>
<tr>
<th>Role</th>
<th>Responsibilities</th>
</tr>
</thead>
</table>
| **Lead offender** | - Communicated with co-offenders. Forced the cargo truck driver to stop (e.g., blocking their way or shooting at the truck).  
                    - Intimidated the driver using a gun (or knives).  
                    - Called the lookouts to ensure that no one was close. |
| **Support offenders** | - Collaborated with the lead offender to block the way of the cargo truck and, if necessary, shoot to force the driver to stop. |


100 A C4 or C5 urban surveillance system is a comprehensive platform through which a city's security agencies monitor a perimeter or sector in real-time through technological integrations. The acronym C4 stands for Command, Control, Communication, and Computing. C4 centres focus on municipal-level surveillance, while a C5 does so for an entire entity or region. Source: [https://www.securitycom.mx/blog/lineamientos-sistema-de-seguridad-ciudadana-c4-c5](https://www.securitycom.mx/blog/lineamientos-sistema-de-seguridad-ciudadana-c4-c5). These centres are like the Fusion Centers in the United States of America. Source: [https://www.dhs.gov/fusion-centers](https://www.dhs.gov/fusion-centers)
- Once the driver stopped, they jumped in the cargo truck and placed the communication-blocking devices, ensuring the driver did not communicate the robbery.
- Other support offenders transferred the merchandise from the truck to their vehicle (if offenders hijacked the truck, the merchandise was retained in the cargo truck).

<table>
<thead>
<tr>
<th>Role</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lookouts</td>
<td>- Monitored the area close to the activities.</td>
</tr>
<tr>
<td>Legitimate driver of the cargo truck</td>
<td>- Once the offenders intercepted them, stopped the truck and gave control of it to the support offenders to avoid any physical injury.</td>
</tr>
</tbody>
</table>
| Logistic or transportation firm | - After detecting the truck was stopped or changed the original route, called to the legitimate driver to know the situation.  
- If there are not answer, the firm called to the National Guard. |

6.4.3. Equipment

The equipment used in this act was same as the equipment described in 6.4.3.3

6.4.4. Geographic conditions

It was likely that the robbery was committed near previously identified escape routes. The offenders decided to act at that specific segment because they knew they could move quickly to their storage facility without crossing main roads, usually populated with vehicles. The offenders were more likely to act in places proximal to locations where they store the stolen merchandise. An example of the role of geographic conditions is in those places with limited or no telecommunication network. The offenders took advantage of the lack of service to have enough time to commit the crime before the driver
communicated the robbery to the police or the logistics firm. LOGITRACK, a Mexican firm specialised in tracking cargo trucks stated\textsuperscript{101}:

"Often, criminals are already familiar with the areas where authorities will take longer to arrive. The criminals have a clear understanding of low-coverage zones as well as areas controlled by organised crime, where authorities are unlikely to enter due to high risks. If the criminal manages to take control of the vehicle, the chances are high that it will soon be completely out of reach for recovery, especially if they veer off the main roads."

In cases where the geographic conditions did not affect the communication network, the offenders blocked the signal, as previously mentioned. Then, the geographic characteristics of the selected places played a relevant role in the offenders' decisions.

6.4.5. Transportation after the robbery

6.4.5.1. Activities

\textit{Preparation}

Similar to the location of the robbery, the warehouse/storage location was not randomly selected. From the documents reviewed, I identified that storage locations were in places that were familiar to offenders. Figure 6.12. presents the declarations of a cargo thief called “El Ñango” in an interview for a Mexican news channel.

\footnotesize\textsuperscript{101}Source: \url{https://logitrack.mx/por-que-los-robos-al-transporte-de-carga-son-exitosos-y-como-protegerte/}
The support offender who drove the pickup truck that moved the stolen merchandise previously did reconnaissance to determine the most efficient routes to the storage place. The lead offender approved the route or requested changes based on their experience.

**Pre-activity**

The support offenders would typically watched over the cargo truck just after the robbery and before starting the journey to the storage place. If the truck was stolen, a support offender was ready to drive it. In a second scenario, if the cargo truck was abandoned where the crime was committed, the support offenders inspected it to ensure they did not leave any incriminating evidence. Figure 6.13. exhibits an image from a report showing an abandoned cargo truck near the theft. The subtitle in Spanish says: “cargo truck recovered by the police of Querétaro in the same highway where the theft was committed”: 

“My team (10 people) and I used to attack in an area familiar to us. Usually, the robberies were consumed in no more than 3 minutes. We used to drive to a spot near the area where the theft was committed to interchange the merchandise.”
Meanwhile, the lead offender called the lookouts asking for a report about the patrolling activity near the crime location. Several newspapers have documented that the role of the "lookouts" is to watch out for checkpoints on the highway so that their accomplices can act and rob the truck drivers passing through that area\textsuperscript{102}. A newspaper in Puebla documented the case of lookouts that were detected by the police near a highway segment. The lookouts were at the top of a hill, and from there, they used to call the cargo thieves if policing activity was happening near the segment\textsuperscript{103}. In the meantime, the support offenders checked if the GPS blocker was working to ensure that the logistics firm and the police had not noted the robbery. The remaining offenders were inside the vehicles and ready to depart to the storage place.

\textsuperscript{102} Sources: \url{https://lasillarota.com/guanajuato/reportajes/2023/2/10/carnada-de-trailerос-crimen-organizado-acecha-la-carretera-57-tramo-san-diego-de-la-union-414011.html} \hspace{1em} \url{https://www.elsoldepuebla.com.mx/local/estado/le-cortan-las-alas-al-halcon-capturan-a-vigilante-de-la-banda-los-socios-en-tehuacan-puebla-5531126.html}

\textsuperscript{103} Source: \url{https://www.pressreader.com/mexico/el-sol-de-puebla/20200104/282531545329039}
**Activity**

The offenders would then drive by the designated route to the storage facility. If the offenders did not steal the cargo truck, one offender would usually drive the pickup truck with the stolen merchandise, and another would drive the sedan, following and guarding the pickup truck. If the offenders hijacked the truck, one offender drove the stolen cargo truck, and a second drove the other vehicle brought to the robbery scene. The lead offender would usually call the support offenders in the storage place by walkie-talkies or phones to communicate that they were on their way. All the offenders continuously monitored that the GPS blocker was working to avoid patrols following them. The lead offender would also contact the lookouts to ensure no patrolling activity was nearby. Figure 6.14. illustrates an example of this activity.
Figure 6.14. Transportation after robbery
Source: Milenio, https://www.youtube.com/watch?v=nbi3_D6HAh0 (min 1.10)
Post-activity

If the offenders took the driver of the cargo truck with them, they quickly stopped to release the driver a few kilometres after the robbery. This stop was likely to be far enough from the storage facility to avoid giving the police any clues about its location. The offenders would strive to be quick to minimise attention. The lead offender was in close contact with the lookouts to ensure no patrols were following them. Finally, the offenders would arrive to the storage location. Figure 6.15. shows a section from an interview with a driver who had been assaulted.

Figure 6.15. Releasing the driver
Source: Latinus_us, https://www.youtube.com/watch?v=qBs4DDisgs0 (min 5.09)

6.4.5.2. Cast

Table 6.11. shows the role and responsibilities of each group member involved in this act.
Table 6.11. Cast of Act – Transportation after the robbery

<table>
<thead>
<tr>
<th>Role</th>
<th>Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead offender</td>
<td>- Coordinated the operation.</td>
</tr>
<tr>
<td></td>
<td>- Usually drove the sedan that was following and watching the cargo truck.</td>
</tr>
<tr>
<td></td>
<td>- Called the lookouts for reports about the patrols.</td>
</tr>
<tr>
<td>Support offenders</td>
<td>- Checked that the GPS blocker was working.</td>
</tr>
<tr>
<td></td>
<td>- Ensured that no one was following them.</td>
</tr>
<tr>
<td></td>
<td>- Ensured that the legitimate driver did not communicate with the police or the logistics firm.</td>
</tr>
<tr>
<td>Driver support offender</td>
<td>drove the pickup truck with the stolen merchandise or the cargo truck (if it was stolen too).</td>
</tr>
<tr>
<td>Lookouts</td>
<td>- Watched the area and communicated any suspicious activity to the leader.</td>
</tr>
<tr>
<td>Legitimate driver of the cargo truck</td>
<td>- Waited to be released to report the robbery.</td>
</tr>
</tbody>
</table>

6.4.5.3. Equipment

- The equipment used in this act was the same as the equipment described in 6.4.3.3.

6.4.5.4. Geographic conditions

The broader geographic characteristics of the location of the robbery played a significant role in influencing post-robbery spatial behaviour. The offenders’ escape routes were likely to be part of their awareness space. The familiarity that they had with secondary roads or alternative routes was a key component to ensuring a successful transport of merchandise to the storage facility. Several documents stated the influence that secondary roads have on the CCP. Figure 6.16. shows an example of exits to minor roads, the subtitles mention that “Driving by one of the most dangerous highways in the country, there are a considerable number of exits that conduct to irregular secondary roads to the highways”.

246
6.4.6. Storage

6.4.6.1. Activities

*Preparation*

The potential offenders were likely to search a warehouse that could be used as a storage facility. Additionally, those offenders previously identified the fastest and alternative routes between the robbery and storage location. The potential warehouse must be big enough to hide the cargo truck in case it is stolen. A newspaper gathered in the OSINT process\(^\text{104}\) wrote about the Police of the state of Puebla identifying a warehouse with the mentioned characteristics, and that was close to one of the segments with more incidents. Figure 6.17. shows the warehouse identified and dismantled by the police.

\(^{104}\) Source: [https://transporte.mx/encuentran-camiones-robados-en-bodega-de-amozoc/](https://transporte.mx/encuentran-camiones-robados-en-bodega-de-amozoc/)
Furthermore, I identified that offenders were likely to search for a warehouse within their awareness spaces and ensure it was relatively close to the robbery location. For instance, the police in Estado de Mexico found a warehouse and described it as:

"Officers from the Tecámac Civil Guard located a warehouse that was allegedly being used to dismantle stolen vehicles and store merchandise from robberies. Inside, they found the cab of a cargo truck that had been reported stolen with violence a few days earlier. They also discovered multiple tires with rims of different brands and sizes, gasoline tanks from various vehicles, car parts, and tools used for vehicle dismantling. Additionally, a large quantity of tortilla chip boxes and boxes of medications, seemingly stolen, were also found."\(^{105}\)

\(^{105}\) Source: https://www.elsoldetoluca.com.mx/policica/localizan-una-bodega-donde-se-desarmaban-vehiculos-robados-8962238.html
The lead offender would most often conduct a business deal with the owners of the storage facility. The gathered OSINT information documented that restaurants, car repair centres and parking locations were some of the most common storage facilities because they had enough space to hide all the vehicles used in the CCP. These centres could be adapted to store the stolen merchandise. Once the storage facility is determined, the lead offender may hire a person with mechanical knowledge to dismantle the cargo truck if the offenders decide to steal that, too. Figure 6.18. illustrates an example of the type of warehouses used by the offenders. This is a restaurant that cargo thieves adapted as a warehouse to store the merchandise and dismantle the cargo trucks. This type of location played a relevant role in one particular case that is expanded on in the following Chapter.

Figure 6.18. Example of cargo thieves’ warehouse
**Pre-activity**

Offenders were found to adapt the warehouse with all the equipment they needed to transfer the stolen cargo/merchandise (including equipment to dismantle the cargo truck if it was stolen). Before arriving at the warehouse, the lead offender would call the support offenders at the storage facility to prepare the equipment to get the merchandise off the vehicle they used to transport it (or to be ready to dismantle the cargo truck). Figure 6.19. shows an example of a warehouse and the equipment used by the offenders. Additionally, the lead offender would call the lookouts to ensure no patrol activity near the location. Support offenders would also look out to ensure that no one was following them.

“The police found a silver tanker truck, as well as two power generators, a cutting machine, an air compressor, a lawnmower, a heat extractor, dollies, and a handcart.” Reforma.

Figure 6.19. Example of equipment in warehouses
Source: Mario Álvarez, Reforma Newspaper

Activity

Once the offenders arrived at the storage place, the leader would meet with the offenders in charge of the warehouse to confirm that the required equipment was ready. The support offenders transferred the stolen cargo/merchandise from the pickup truck to the specific containers adapted for this activity. If the cargo truck was stolen, the support offenders broke the locks to offload the merchandise after parking the truck. They dismantled the truck and separated the parts that they planned to sell. The following quote was extracted from a Mexican newspaper that offers an example of this activity:\textsuperscript{107}:

“Offenders dismantle the vehicles in a matter of hours and then offer them for sale. The parts that are most commonly stolen include side mirrors, front and rear headlights, tires, and taillights. The theft of batteries has also seen an increase in recent years, along with hoods, bumpers, and fuel tanks. While headlights of a certain brand may have a certain price, in the black market, they are sold for almost half that amount.”

Post-activity

After the offenders offloaded all the stolen cargo/merchandise (or the cargo truck parts) to the containers, the lead offender would call the business partners to inform them that the merchandise was ready to be transferred and to negotiate the merchandise price if any change occurred. The leader and their business partners agreed on the place, day and time of the meeting to exchange the stolen merchandise and determined how the payment would be made. For example, “El Ñango” (mentioned in the prior act) stated that

\textsuperscript{107} Source: https://transporte.mx/crece-mercado-negro-de-autopartes-para-camiones/
he previously agreed with the buyer where and when to sell the stolen merchandise. Another document mentioned that cargo thieves were likely to sell stolen merchandise to informal retailers; they agreed on specific locations to change the merchandise.

### 6.4.6.2. Cast

Table 6.12. shows the role and responsibilities of each group member involved in this act.

<table>
<thead>
<tr>
<th>Role</th>
<th>Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lead offender</strong></td>
<td>- Met the offender in charge of the storage place.</td>
</tr>
<tr>
<td></td>
<td>- Helped to offload the merchandise out of the cargo truck.</td>
</tr>
<tr>
<td></td>
<td>- Called the lookouts to check if the police were close.</td>
</tr>
<tr>
<td></td>
<td>- Agreed with the business partners regarding disposal of the merchandise.</td>
</tr>
<tr>
<td><strong>Support offenders</strong></td>
<td>- Parked the vehicle or the cargo truck.</td>
</tr>
<tr>
<td></td>
<td>- Broke the truck’s lock.</td>
</tr>
<tr>
<td></td>
<td>- Transferred the merchandise to specific containers in the warehouse.</td>
</tr>
<tr>
<td></td>
<td>- The mechanically-minded offender destroyed the GPS.</td>
</tr>
<tr>
<td></td>
<td>- Looked for tools to start dismantling the cargo truck.</td>
</tr>
<tr>
<td></td>
<td>- Disposed of the parts in the containers in the warehouse.</td>
</tr>
<tr>
<td><strong>Lookouts</strong></td>
<td>- Monitored the area near the storage facility to inform of any policing activity.</td>
</tr>
<tr>
<td><strong>Business partners</strong></td>
<td>- Agreed with the lead offender on the meeting place and how they would pay for the cargo/merchandise.</td>
</tr>
<tr>
<td><strong>Legitimate driver of the cargo truck</strong></td>
<td>- Reported the robbery.</td>
</tr>
</tbody>
</table>

---

108 Source: [https://www.youtube.com/watch?v=r_B1YyqBXB8](https://www.youtube.com/watch?v=r_B1YyqBXB8) (min 3.13)

Logistic/transportation firms
- Were aware of the robbery.
- Looked for the truck.
- Reported the robbery to the police.

Police agencies
- Once they knew about the robbery (or through routine patrolling activities, came across the stolen truck), started the search for the truck and/or merchandise.

6.4.6.3. Equipment

The equipment used in this act was the same as the described in 6.4.3.3, albeit with the addition of heavy duty trolley or similar tools to move the merchandise in the warehouse.

6.4.6.4. Geographic conditions

The location of the storage place can highly influence the robbery’s location, especially because offenders must act quickly after the cargo theft. For that reason, the warehouse location was likely to be preferred near to where cargo theft was planned to occur. As offenders were likely to be familiar with places where storage facilities were located, they are likely to know the fastest routes to them. This experience assists in concealing the stolen merchandise or cargo truck and remaining undetected. Many gathered documents mentioned that the warehouse was commonly located in small towns near the highway.

In the OSINT process, I identified that the Offenders were likely to use or rent legal auto shops or car garages as storage places (especially if the owner was colluded with or is part of the group)\textsuperscript{110}. Moreover, offenders tended to prefer warehouses near where the

\textsuperscript{110} These notes shed light on the role of parking lots and auto parts shops.
1) Members of the National Guard located a property used as a public parking lot in a municipality in Guanajuato, where they seized 35 trucks. Some of the trucks were loaded with stolen goods and had been reported as stolen. Source: [https://www.debate.com.mx/estados/GN-halla-bodega-llena-de-camiones-refrigeradores-y-mercancias-robadas-20191110-0204.html](https://www.debate.com.mx/estados/GN-halla-bodega-llena-de-camiones-refrigeradores-y-mercancias-robadas-20191110-0204.html)
merchandise would be transferred to the business partners. These warehouses were usually close to legal markets where the stolen merchandise was resold. This strategic location helped when disposing of the merchandise because the offenders can quickly move it to their business partners.

Figure 6.20. shows the location of three legal markets identified where stolen merchandise was sold\textsuperscript{111}. These legal markets were located near to two segments with the most cargo theft incidents nationwide.

\begin{figure}
\centering
\includegraphics[width=\textwidth]{market_location.png}
\caption{Markets identified as places where people sell stolen merchandise. Source: Periódico Central de Puebla}
\end{figure}

\textsuperscript{2)} “Six members of a cargo theft gang, led by a robber known as "El Muñeco", were captured by state police in an auto part shop located next to the federal highway” Source: https://transporte.mx/detenfan-a-6-desheuesadores-de-camiones-en-veracruz/

\textsuperscript{111} Offenders attack highways that cross Cuautlancingo and the metropolitan area of Puebla. The stolen goods are usually resold at Puebla's “Central de Abastos” - wholesale market - (the largest grocery distribution centre). The distance between the city of Cuautlancingo and the “Central de Abastos” is approximately 12.5 to 20 kilometres. The segments mentioned in this reportage are used as input for the analysis presented in the following chapter. https://www.periodicocentral.mx/pagina-negras/delincuencia/estos-son-los-puntos-de-venta-de-mercancia-robada-que-gn-identifico-en-puebla/24823/
6.4.7. Disposal

6.4.7.1. Activities

Table 6.13. describes each phase of the activities involved in this act.

Table 6.13. Phases of activities of transportation to the highway

<table>
<thead>
<tr>
<th>Stage</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparation</td>
<td>- Offenders conducted prior research on the prices of planned stolen products.</td>
</tr>
<tr>
<td></td>
<td>- The lead offender negotiated with potential business partners.</td>
</tr>
<tr>
<td></td>
<td>- Negotiated or bribed local market authority.</td>
</tr>
<tr>
<td></td>
<td>- Business partners included legal retailers, mechanics, or criminal organisations.</td>
</tr>
<tr>
<td></td>
<td>For example, the note &quot;Legally Established Markets Where Stolen Goods are Sold in Puebla with total Impunity&quot; from “El Universal”(^{112}) mentioned: “According to investigations carried by the authorities, retailers obtained the merchandise from robberies of cargo trucks on highways and trains.”</td>
</tr>
<tr>
<td>Pre-activity</td>
<td>- The lead offender arranged a meeting with business partner.</td>
</tr>
<tr>
<td></td>
<td>- Support offenders loaded stolen merchandise.</td>
</tr>
<tr>
<td></td>
<td>- Lookouts checked for police activity.</td>
</tr>
<tr>
<td>Activity</td>
<td>- Lead offender met business partners for the exchange on the rendezvous point.</td>
</tr>
<tr>
<td></td>
<td>- Transaction involved untraceable cash or goods (in the case of drug precursors).</td>
</tr>
</tbody>
</table>

- Offenders are likely to exchange the stolen products for guns or other drugs (for resell or personal use) as part of the payment (Beittel, 2022; Ignacio & Vieira, 2018; Salzano & Hartman, 1997).

- Support offenders watched for police and communicated with lookouts.

<table>
<thead>
<tr>
<th>Post-activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Based on the gathered information, I suggest that offenders returned to a storage location to divide profits.</td>
</tr>
<tr>
<td>- Offenders are likely to keep some stolen merchandise for personal use or paying co-offenders.</td>
</tr>
<tr>
<td>- The lead offender will likely use the profits to negotiate/bribe/extort more police officers(^{113}), employees of logistics and transportation firms(^{114}), as well as lookouts to gather more information for future robberies.</td>
</tr>
<tr>
<td>- Started planning the next robbery based on past success and geographical conditions. Findings suggested that offenders looked for specific segments that were part of their awareness space with specific conditions that facilitated cargo theft(^{115}).</td>
</tr>
</tbody>
</table>


\(^{114}\) Another way these criminal groups obtain privileged information is by infiltrating company personnel. An employee aware of the merchandise’s movement and value is likely to become involved. This employee can be the driver, warehouse manager, or administrative staff member. Source: [https://www.elcontribuyente.mx/2017/04/asi-operan-los-criminales-que-asaltan-trailer-transportistas-de-carga-en-la-zona-de-puebla-acusan-colusion-con-autoridades](https://www.elcontribuyente.mx/2017/04/asi-operan-los-criminales-que-asaltan-trailer-transportistas-de-carga-en-la-zona-de-puebla-acusan-colusion-con-autoridades)

6.4.7.2. Cast

Table 6.14. shows the role and responsibilities of each group member involved in this act.


<table>
<thead>
<tr>
<th>Role</th>
<th>Responsibilities</th>
</tr>
</thead>
</table>
| **Lead offender**           | - After storing the stolen merchandise, arranged the exchange with business partners.  
                              | - Received payment from business partners.                                        
                              | - Paid all group members and external co-offenders (lookouts, bribed officers, and transport firms’ employees). 
                              | - Started planning the next robbery.                                              |
| **Support offender 1**      | - Escorted the lead offender to the meeting with business partners.                |
| **Support offenders**       | - Helped load the vehicle used for transporting stolen merchandise.                
                              | - Waited at the storage place for their payment.                                   |
| **Business partners**       | - Paid for the stolen merchandise/truck parts.                                    |
| **Offenders from other OCG**| - Paid for specific merchandise (e.g., guns, drug precursors).                    |
| **Lookouts**                | - Monitored policing activities near the warehouse and received payment.          |
| **Market regulators**       | - Were bribed to permit selling stolen merchandise in legal markets.              |
| **Bribed/extorted police officers** | - Received payments for informing the lead offender about policing activities at CCP locations. |
| **Bribed/extorted logistic firm (former) employees** | - Received payments for informing the lead offender about the schedule and type of merchandise the cargo trucks moved. |

6.4.7.3. Equipment

The equipment used in this act is same as the equipment described in 6.4.6.3
6.4.7.4. Geographic conditions

The meetings between the offenders and the buyers were likely to be in places not far from the warehouse but not customarily crowded. For instance, a newspaper reported:

“All the stolen cargo by these criminal groups is usually unloaded with the help of accomplices from these groups (co-offenders) and sent in sections and routes away from federal highways to evade the National Guard. It is disposed at rendezvous points near where the stolen merchandise is sold.”¹¹⁶¹¹⁷.

As the offenders were familiar with those places and took advantage of that knowledge, they were likely to know fastest routes to the meeting point or escape routes if necessary. If the stolen merchandise is a drug precursor or another product sold to CGOs or DTOs, the geographic characteristics of the places where the meeting was held played a relevant role. These meetings were hypothesised to occur in isolated places such as rural roads or abandoned farms, and hence far from policing activities. Offenders knew these places are not well-known by the police and offer more protection to avoid police patrolling¹¹⁸.

Finally, geographic conditions also played a significant role when offenders began to plan the next robbery. Offenders were likely to prefer familiar locations because their knowledge of those places. However, they could search new highway segments with geographic characteristics that can facilitate the cargo theft CCP and their escape.

¹¹⁶ The note documented three cases in the state of Puebla. Source: https://www.periodicocentral.mx/pagina-negra-s/delincuencia/estos-son-los-puntos-de-venta-de-mercancía-robada-que-gn-identifico-en-puebla/24823/
¹¹⁷ In some cases, the meetings are carried out in crowded places. Especially if the local police are bribed as the following note of selling illegal merchandise in Mexico City: https://www.cbsnews.com/news/productos-robados/
6.5. Discussion about the CSA on cargo theft

The crime script in this chapter outlines six stages, covering the planning of the crimes to merchandise disposal and sale. It also underscores the offenders’ acute familiarity with the Mexican highway system and the varied geographical conditions of nearby areas. For example, although some high-incidence segments were in industrial regions, crimes often occurred in uninhabited areas, disconnected from urban environments. These regions typically linked to secondary roads leading to small towns, where offenders have established connections, including their residences. Offenders’ awareness of these geographical conditions facilitated their effective exploitation.

The OSINT method identified actors, their roles, and activities in the cargo theft CCP. The gathered documents were analysed to identify relations within the criminal group and external co-offenders. The coding process inferred how potential offenders decide whether the financial cost and effort of committing the crime were compensated by the potential earnings from selling the stolen merchandise as suggested by Rational Choice Perspective (Brantingham & Brantingham, 1993a; Cornish & Clarke, 1989, 2013).

Another finding relevant to RCP related to the offenders’ perceived costs of committing cargo theft. The consulted documents indicated that cargo theft’s physical and financial costs were less than other criminal activities. For example, cargo theft might incur risks to offenders because of the firearms used and the financial outlay for technological equipment. However, this is considered less costly than being involved in other criminal activities such as drug trafficking or human trafficking.
The findings in this Chapter suggest that co-offending in cargo theft often involves a division of labour and specialisation among group members. Each member may hold specific roles and responsibilities, such as scouting for potential targets, tracking shipments, disabling security systems, intercepting vehicles, or handling stolen goods. Moreover, by selecting suitable co-offenders, the criminal group can enhance efficiency, reduce risks, and pool their resources. Through sharing information, skills, and resources, co-offenders aim to maximise the group’s success while minimising the chances of detection and apprehension (Fisher, 2021; Lammers, 2018; Tremblay, 1993). In this way, a criminal group may target larger and more valuable shipments, overcome security measures, and exploit vulnerabilities in transportation systems.

Another relevant finding is that criminal groups with specialised co-offenders can extend their reach more effectively into other geographic areas. As observed in the planning of the robbery, the lead offender is likely to recruit or establish alliances with local individuals who have a good understanding of the target region. These local co-offenders can provide privileged information about security patterns, delivery schedules, and other relevant aspects for planning thefts (Andresen & Felson, 2012; Charette & Papachristos, 2017; Malm et al., 2011).

Turning to the demand for stolen merchandise, according to Clarke (1999), certain products can be considered CRAVED products (concealable, removable, available, valuable, enjoyable, and disposable). In the context of cargo theft, items such as high-value truck parts, including engines, transmissions, or electronic components, can meet the CRAVED criteria of being valuable and removable. These parts are often sought after by criminals due to their high resale value and the relative ease with which they can be
stolen and sold in legal or illegal markets. Then, these parts can be quickly sold or
disposed of without attracting attention (Aguirre Quezada, 2018; ANTP, 2021; INEGI,
2020; Observatorio Nacional Ciudadano, 2014; Ramírez-Álvarez, 2021). Additionally, the
enjoyability factor comes into play, where offenders may target goods that are personally
desirable or have a high demand in illicit markets.

Furthermore, the absence of regulation and oversight in Mexico’s auto-part industry
allows offenders to expand their operations by selling stolen goods at lower prices. This
finding highlights the absence of effective “super-controllers”. This concept introduced by
Sampson, Eck and Durham (2010) refers to individuals or entities who have a significant
influence over the behaviour of others, and who can use this influence to prevent crime.
In the context of cargo theft, a "super-controller" could be a regulatory body or agency
with comprehensive authority in preventing and combatting such theft. In Mexico, the
findings in this chapter suggest that these super-controllers are ineffective in
implementing policies and coordinating institutional efforts. The lack of coordination
among law enforcement agencies, logistics firms, transportation associations, and private
security firms can facilitate the work of potential offenders. Therefore, prioritising the
establishment of more efficient super-controllers should be a priority to counteract the
cargo theft incidence. Examples of super-controllers will be discussed in Chapter Eight.

The script revealed the influence of geographic conditions throughout various stages of
the cargo theft commission process. The findings indicate that offenders chose their cargo
theft locations based on their in-depth knowledge of the geography. Offenders consider
these conditions in the planning stage, where they map out ideal routes for intercepting
their target cargo trucks. Modus operandi also adapts to location-specific geography, with
strategies fine-tuned to exploit the unique geographic aspects of the intended crime scene. For example, GPS blockers might be crucial to hinder real-time theft reporting. Consequently, I propose that the specific segments where offenders plan to commit the cargo theft and the route to get there were previously defined by a deep understanding of the geographic conditions in these areas.

Geographic conditions also influence the choice of highway segments near escape routes, offenders are likely to be familiar with their escape routes (McCutcheon et al., 2016; TAPA, 2021; Weisel et al., 2006). Moreover, there was evidence that offenders are likely to be aware of the geographical features of secondary roads near the crime location and feel at ease driving on them. Hence, offenders were likely to drive by these routes because using that knowledge can help them reduce their risks of being apprehended. Figure 6.2 illustrates examples of two types of secondary roads, showing a junction to a secondary road that is close to one of the segments with many cargo thefts. This road connects to small towns where parking lots or car repair centres were likely to be used to hide (and dismantle) cargo trucks. This example illustrates how the CSA can provide useful insights about how the location of certain business can influence the geographic decision-making of cargo thieves.
The choice of locations for the storage of stolen items also appeared to be influenced by geographic factors. These include factors such as needing to be close to the cargo theft location (tallying with principles of least effort) while also minimising the risk of being followed by police patrols. The sale of stolen merchandise to business partners also needed to consider geographic conditions, with the rendezvous points often situated near the offenders' warehouses but away from police activities, and often in uninhabited or secluded areas.
Certain key locations are a natural feature of an offender’s spatial mobility, such as where they live and places they frequent. These locations are significant in the offender’s “criminal activity space” (Rengert & Wasilchick, 2000). In the case of criminal groups, individual members may have different homes, but the places where they meet may act as other key locations. A finding from the current study was the identification of these types of locations that are likely to be used by the offenders. To describe these locations, I propose the term "facilitating locations" to refer to specific places commonly used as meeting points by offenders along the CCP. Examples of these places are the venues where offenders hold their meetings. These places also, are locations where offenders are likely to converge when performing activities associated with cargo theft. These facilitating locations are a concept that is developed further in the final empirical study in the current research.

As part of the GIM, the objective of using CSA was to answer the following questions.

1. What geographic conditions do offenders consider when involved in the commission of cargo theft on highways?
2. What specific skills are required to commit cargo theft?
3. How does the environmental background of the locations where offenders intend to impact the design of the cargo theft commission process?

Concerning the first question, the analysis concludes that the offenders leverage their understanding of the surrounding geographic environment to minimise risks and maximise their chances of success. Offenders strategically plan their thefts based on familiarity with selected locations and knowledge of optimal routes. The effect of geographical characteristics was observed in adapting their modus operandi to exploit
specific geographic characteristics. Furthermore, the results from the current study found that offenders identify suitable highway segments near escape routes and select storage and rendezvous locations.

Concerning the second question, the skills required by an offender may include:

1. Geographical knowledge: Offenders must be familiar with the geographic features of the targeted locations, such as road networks and escape routes.

2. Understanding of communication infrastructure: Offenders were likely to know areas with limited or no communication networks to prevent real-time reporting of cargo theft incidents.

3. Technical expertise: A group member may require technical skills in managing GPS blockers or devices that disable cargo trucks’ tracking or communication systems.

4. Criminal networking and coordination: for organised criminal groups, offenders may require establishing connections with other members, sharing information, contacting business partners, organising rendezvous points and defining anchor facilitating locations.

Finally, regarding the third question, the geographic, sociodemographic, and economic characteristics of micro-places with more cargo thefts shape the offenders’ decision-making and strategies. In addition to the geographical conditions, the current study highlights the impact of economic and social variables such as the ease of selling stolen goods, the demand for stolen merchandise, and the lack of regulation and monitoring of stolen products by industrial sectors, such as the auto-part industry. Therefore, the
environmental background of locations where offenders plan to commit cargo theft appears to influence the cargo theft crimes commission process.

6.6. Limitations

CSA, despite its growing use in explaining offenders’ decision-making processes, has faced technical limitations concerning script content, structure, and reliability. Script content can be limited by the quantity and quality of information available (Dehghanniri & Borrion, 2017; Leclerc & Wortley, 2013; Viollaz et al., 2018). Limited data on cargo theft and its geographical factors can affect script development because official sources can be scarce and some data may not be publicly available. To address this limitation, an OSINT method and a document analysis approach were necessary to gather sufficient and reliable information to populate the script.

The OSINT method entailed gathering data on predetermined individuals and their roles in each phase of cargo theft. Documents were examined to uncover relationships within the criminal group and external co-offenders. Geographic influences were assessed using a RCP approach. This process provided insights into how potential offenders weigh the costs against the gains from stolen merchandise sales, informed by co-offending principles detailed in Chapter 2. Given more data availability, identified actions and relationships within the criminal group and co-offenders may be subject to change. Future research, including interviews with police officers reporting cargo thefts, could offer a more comprehensive picture. Analysing the content of this type of qualitative data could enrich the script.
Another limitation faced in the analysis in this chapter related to the theoretical framework used to explain the offenders’ decision-making process. To date, CSA scholars have utilised Rational Choice Perspective (RCP) or co-offending theories to describe offenders’ actions, activities, and relations (Cornish, 1994; Leclerc, 2016; Lord et al., 2017; Tremblay et al., 2001; Zanella, 2013). Both theoretical approaches have attracted criticism which relates to focusing exclusively on the offenders’ perspective to the detriment of considering other relevant actors in the CCP, such as the victims, the law enforcement agencies, as well as their co-offenders (Bouchard & Morselli, 2014; Ekblom & Gill, 2016; Leclerc, 2014). This can lead to a skewed understanding of CCP and its impact on the actors involved.

Consistent with qualitative methods more broadly, CSA offers limited replicability (Borrion et al., 2020; Chainey & Alonso Berbotto, 2021; Ekblom & Gill, 2016). However, this is not a weakness per se since qualitative research does not strive for replicability; instead, qualitative research aims to derive meaning from deep, reflexive analysis. Hence the analysis presented herein is idiosyncratic yet follows as a systematic process as possible to adhere to standards of rigour seen in quantitative methods.

Despite the limitations that may affect the explanatory power of the proposed crime script of cargo thefts on Mexican highways, this chapter’s analysis adopted available principles and guidelines proposed by Borrion (2013), Chainey and Alonso Berbotto (2021), and Tompson and Chainey (2011) to ensure that the presented script is “scientifically robust, useful and usable” (Borrion, 2013, p.1). In addition to being the first crime script on cargo theft , this script is novel because it includes the role of geographic conditions in the CCP.
6.7. Conclusions

CSA is a technique born out of crime science. The crime science perspective has previously added to better inform many other aspects of crime such as improvements in the techniques used for the analysis of crime. This perspective has assisted in the direction of primary data collection and the mining of data (e.g., court documents and OSINT). Furthermore, it has supported improvements in policing and criminal investigation (e.g., improved use of forensic data to support criminal convictions) and more recently in artificial intelligence applications. In the current study, the crime science perspective helped to develop a new narrative about the problem of cargo theft.

In this research, I used CSA as an investigative technique to understand the decision-making process of cargo thieves. CSA and crime science principles can enrich the study of offenders behaviour by providing systematic frameworks for understanding their criminal dynamics. Then, by unfolding the offenders’ actions it was possible to analyse whether the geographic and sociodemographic conditions of locations where cargo theft was committed significantly affect the offenders’ decision-making process.

In conclusion, the cargo theft CCP analysis presented in this Chapter reveals the significant impact of geographical and environmental factors on the planning, the robbery and the disposal of stolen merchandise. Moreover, these geographical conditions influence offenders' decision-making and strategies at each crime stage. As with any other criminal group, cargo thieves are likely to have key locations that are associated with their activities, in this case, “anchor facilitating locations” that are part of their CCP.
The proposed CSA addressed the specific skills required by potential offenders, targeted the environmental background' vulnerabilities, and identified the likely use of anchor facilitating locations. However, the CSA did not identify the actual locations where offenders are likely to have their operational bases. In the final empirical study, I propose a novel method to help identify these locations.
Chapter 7

Using Geographic Profiling Analysis to generate geographic intelligence on criminal groups

7.1. Introduction

What do the spatial elements of crime tell us about the offender’s actions and hunting patterns? (Rossmo, 2000, p. 207). The current research aims to generate geographic intelligence on how offenders’ behaviour is influenced by the geographical characteristics of the places where they conduct illegal activities. The spatial behaviour of cargo thieves on Mexican highways has been examined in previous chapters, identifying where illegal activities occur and the decision-making that influences location choices. However, so far, this thesis has not examined the specific patterns in offenders’ criminal behaviour within their activity spaces. In this chapter, I address this by analysing cargo thieves’ spatial and criminal hunting behaviour and, by doing so, generate insights about their offending activity.

The third part of the proposed Geographic Intelligence Model (GIM) involves using the theoretical principles of Geographic Profiling Analysis (GPA) (Rossmo, 1995; 2000). These principles help to better understand the influence of the environmental backcloth on offenders’ target selection and their search and attack behaviours. GPA is an investigative technique that analyses the locations of a crime series to determine the most probable area of the offender’s residence or some other location from which the offender anchors their activities (Chainey, 2021; Rossmo, 2000, 2022) While law enforcement
agencies have used GPA to identify an offender’s home base or anchor points, it has primarily been used to analyse a series of crimes committed by individual offenders rather than crimes committed by organised criminal groups. In the current research, I extend the use of GPA to criminal groups.

GPA has principally been used in law enforcement to inform investigative strategies. In the current research, the use of GPA principles to criminal group activities is to generate geographic intelligence about these activities. As an investigative technique, GPA requires Linkage Analysis to corroborate the relation of a crime series to a single offender (Chainey, 2021; Rossmo, 1999). However, I will not conduct a linkage analysis in the manner in which it is used for single offender serial crime but instead will draw from patterns observed from the activities of criminal groups to identify offending activities that are likely to be connected. For the purposes of introducing this novel application of GPA I plan to analyse criminal group members’ activities in specific areas of Mexico, albeit in areas where cargo theft has been observed to highly concentrate. By doing so, my aim is to identify locations that act as key locations associated with the offenders involved in cargo theft in these areas.

In this chapter, I characterise the offending activity of individuals within criminal groups to infer specific locations that are spatial nodes. Identifying these nodes provides insights into how criminal groups operate and the locations from which they anchor their activities.

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119 Rossmo (2000, p. 260) defines Linkage Analysis as “The comparison of crimes to determine whether they were committed by the same offender(s). Linkages can be established through physical evidence, eyewitnesses, or behavioural similarities such as modus operandi (M.O.) and signature.”
In this manner, the main objective of this Chapter is to answer the following research questions:

1. How do geographical conditions influence the offenders’ spatial behaviour and their offending activities in their area of operation?

2. Can Geographic Profiling Analysis be used to infer the anchor points of criminal groups?

The following section explains GPA and its theoretical basis. The third section describes its application as part of the proposed Geographic Intelligence Model for criminal groups using data on cargo thefts on highways in Mexico. Section four presents the results. Sections five discusses the results. Section Six describes the challenges of using GPA in the analysis of criminal groups.

7.2. Theoretical Principles of Geographic Profiling Analysis

This section includes three parts. The first part explains several key principles associated with offenders’ spatial behaviour, including how the least-effort principle influences an offender’s spatial mobility and how offenders anchor their spatial activities from certain key locations. The second part describes how offenders conduct the search for suitable targets (their offending hunting behaviour). The third part describes how the theoretical principles of co-offending apply to the application of GPA on criminal groups.
7.2.1. Spatial behaviour

7.2.1.1. Least-effort principle

The least-effort principle proposed by Zipf (1949) suggests that individuals aim to achieve their goals while minimising effort. This principle is particularly relevant to explain offenders’ decision-making processes regarding whether to commit a crime. Individuals who perceive criminal behaviour as an efficient way to achieve their goals are more likely to engage in criminal activity (Andresen et al., 2014; Bernasco & Block, 2011; Felson, 1987; Townsley & Sidebottom, 2010). This principle can also explain why certain crimes are more common in certain areas. Potential offenders who identify areas with more opportunities to commit a crime will require less effort to carry out their criminal activities.

As suggested by Chainey (2021), the least effort principle is a fundamental concept in geographic profiling. It highlights the spatial constraints on an offender’s awareness space and how these constraints influence offenders’ choice of crime location. The further an offender travels to commit a crime, the greater the effort involved. Moreover, increasing the distance to travel to commit a crime may lead the offender into unfamiliar geographical areas, increasing the risk of encountering unforeseen trials. The least effort principle, therefore, suggests that limitations are placed on the spatial extent that offenders are willing to travel to commit a crime.

7.2.1.2. Activity spaces – Anchor points

GPA assumes that offenders tend to commit crimes within their specific "activity space", a geographic area influenced by their daily routines and behavioural patterns (Bernasco, 2010a; Rossmo & Velarde, 2008; Rossmo, 2000). The concept of activity space relates
to the paths and routes connecting different areas, constituting an integral aspect of the Brantinghams' "crime site selection" model and aligning with the notions of awareness spaces and mental maps (Brantingham & Brantingham, 1984; Clark, 1990; Goodall, 1987). An individual's activity space encompasses their habitual locations, such as their residence and workplace, and often visited destinations, such as those for leisure and entertainment (Jakle et al., 1976; Rossmo & Summers, 2021; Rossmo, 2000). Thus, activity space is a critical framework for understanding offenders’ spatial decision-making behaviours.

GPA involves identifying offenders’ "anchor points". An anchor point is a geographic location that holds significant importance to an offender and can serve as a central location from which they conduct their criminal activities (Bernasco & Block, 2011; Couclelis et al., 1987; Rossmo, 2000). An anchor point is likely to be a specific location within the offenders' activity space, such as their residence, workplace or another location from which they base their criminal operations (Brantingham & Brantingham, 1991; Couclelis et al., 1987; Rengert et al., 2000; Rengert & Lockwood, 2009). For a criminal group, each group member is likely to have anchor points. In some cases, the anchor points for certain members of the group may be the same, such as they may live together (or very close to each other) or carry out a large number of their criminal activities from the same location (e.g., a common meeting point for members of the criminal group) (Bouchard & Malm, 2016; Fisher, 2021; Lasky et al., 2017; Van Daele & Beken, 2011). Identifying these anchor locations can provide valuable geographical intelligence about the criminal group. The following topic examines the movement of potential offenders and how this influences the location of their potential anchor points.
7.2.1.3. Journey to Crime

A relevant concept related to the least effort principle is the Journey to Crime (JTC), which is a movement pattern that offenders follow when committing a crime. It is influenced by several factors, such as the least-effort principle, the offender's familiarity with the area, the presence and patterning of suitable targets, and the perceived risks and rewards of committing a crime in a specific location (Bottoms & Wiles, 2002; Brantingham & Brantingham, 1981; Rossmo et al., 2012). Several studies have shown that the number of crimes an offender commits decreases as the distance increases from where they commence their journey to crime (Block & Bernasco, 2009; Rengert et al., 1999; Smith et al., 2009). Collectively, these studies have shown that offenders tend to travel short distances to commit a crime. For example, Rossmo’s aggregation of over 50 JTC studies showed that offenders travelled a median distance of just over one mile from their home to where they committed a crime (Rossmo, 2000).

One of the key limitations of JTC research is that researchers rarely know where an offender starts their journey. This is because most research on the JTC is based on data that do not typically include information about the exact offender's anchor location and more generally considers the offenders’ awareness space rather than specific locations from where they commence their JTC (Nieto et al., 2022; Rengert & Wasilchick, 2000; Ruiter, 2017). As a result, researchers are often forced to make assumptions about where the offender started their journey, which can introduce bias into their findings.

In addition to the limited knowledge of where an offender begins their journey, examining the variability of research findings on the JTC is important. The existing literature presents a wide range of findings and interpretations. The diversity of criminal behaviours and
contexts makes it challenging to establish a universal framework for studying the journey to crime (Rengert, 2004; Rengert et al., 1999; Townsley & Sidebottom, 2010). Different types of crimes, such as burglary, robbery, or drug trafficking, involve distinct motivations, planning processes, and spatial dynamics. As a result, findings from studies focused on one specific type of crime may not necessarily generalise to other criminal activities (Bichler et al., 2011; Harries & LeBeau, 2007; Smith et al., 2009).

Although the evidence suggests offenders prefer to travel short distances, most of these studies have focused on single offenders. Hitherto, few studies have focused on the distances travelled by criminal groups and how co-offenders may influence the decision to travel greater distances to commit crimes. Research that has examined the geographic mobility of co-offenders, albeit those that are travelling “itinerant crime groups” in Belgium, Van Daele & Vander Beken (2010) suggest that 20.1 km is the mean distance for crimes committed by two or more people of these type of offenders (Van Daele & Vander Beken, 2010). Regarding “multiple offenders”, those that were observed to have committed ten or more offences, the mean distance offenders travelled was 22.8 km. These findings led Van Daele & Vander Beken (2010) to suggest that members of criminal groups were more likely to travel further than single offenders, but that the decay of activities with respect to an increase in distance still applied to these criminal groups.

120 In their study, the authors use the Belgian police database containing all serious property crimes in Belgium from 2002-2006. They define itinerant groups as “group offenders; systematic/multiple offenders; of Eastern European origin; and operating from outside Belgium or from one of Belgium’s main cities”. A potential concern of this study is derived from the difficulties in geocoding the information, the researchers use “the Lambert coordinates of the centre of each municipality were used to localise residences and crime places. Euclidian distances between the home base and crime site were then calculated.” (Van Daele & Vander Beken, 2010, p. 341). They recognise the potential bias and establish, “Unfortunately, this biases the results too. Intra-regional crime trips, which do occur often, cannot be estimated very accurately. As a consequence, the method used is only appropriate for analysing mobile offending” (p. 342).
The least effort principle, the location of anchor points, and the journey to crime influence the offenders’ spatial mobility. To commit a crime, offenders must also identify when and where potential targets are located. This requires offenders to consider how they must search for and then attack their potential targets.

7.2.2. Offenders’ Targeting and Hunting Behaviours

7.2.2.1. Targeting Patterns

Offenders’ targeting methods refer to their strategies to select and focus on potential victims (Rossmo, 1993, 1996; Ruiter, 2017). Research suggests offenders develop their targeting methods through a multistage process that starts with choosing a suitable place to find their potential victims (Canter & Larkin, 1993; Rossmo, 1996; Synnott et al., 2019). Their targeting methods and the place to commit a crime are influenced by offenders’ preferences and situational factors, such as the offender’s familiarity with the area, their knowledge of the victim’s routine, and the availability of potential victims (Bennett & Wright, 1984; Bernasco & Nieuwbeerta, 2005; Pyle et al., 1974; Tilley et al., 2015).

GPA considers the targeting methods an offender may use by analysing crime patterns and identifying similarities in the characteristics of the targets that the offender selects. However, this can be more complex in cases involving criminal groups because more than one person is involved in the CCP. In such cases, identifying the targeting methods of members with key roles in the CCP, such as the group leader, can help to identify the criminal group’s targeting method.

Identifying the group’s targeting patterns is a starting point for determining the activity space and anchor points of a member of a criminal group. When analysing the targeting
patterns of each offender collectively, this may identify locations where these offenders converge. These convergence locations may be places that are important to the spatial operations of the group. In the first instance, I consider how the distribution of targets influences the spatial mobility of offenders.

7.2.2.2. Target Backcloth

Section 2.3 described the concept of the *environmental backcloth*, which encompasses the physical and social attributes of locations where crime occurs, such as demographics, infrastructure, resources, and services (Brantingham & Brantingham, 1981, 1991; Johnson et al., 2009). The environmental backcloth helps to determine the likelihood of crime in a particular area and can influence the actions of criminals and potential victims. Empirical studies in Chapters 4, 5 and 6 also emphasised the importance of examining the characteristics of the surrounding area and the environmental backcloth of locations that experience higher crime rates. However, further clarification is needed regarding the significance of these features in the offenders’ targeting and hunting process. To do so, we can draw from the concept of *target backcloth* that is used in geographic profiling analysis to consider why offenders decide to commit crimes at specific places.

According to Rossmo (2000, p. 146), the target backcloth is equivalent to the concept of spatial opportunity structure (Brantingham & Brantingham, 1995). The Brantinghams suggest that crime is not randomly distributed but is instead influenced by the spatial opportunities available to offenders\textsuperscript{121}. In this sense, the target backcloth refers to the temporal and geographic distribution of suitable targets (Chainey, 2021; Rossmo, 2000).

\textsuperscript{121} The spatial opportunities can be physical, such as the lack of security measures. For example, dark pavement with no streetlights is a physical opportunity for crime. Another spatial opportunity is the social
The environmental conditions that enable the identification of suitable targets are inherent in the physical landscape of a specific geographic area. These features can facilitate the commission of a crime in such locations, including abandoned buildings or connections with highways. Temporal factors also play a crucial role, such as daylight or the year’s season (Bottoms, 2014; Brantingham & Brantingham, 1993a; Ratcliffe, 2010; Van Soomeran, 1989).

The analysis of the target backcloth is a component of geographic profiling that interprets the offender's knowledge of the area. Moreover, the availability of suitable targets and the surrounding geographical and temporal conditions may facilitate the crime. Once offenders have identified suitable areas to attack, they must consider how to hunt for these targets.

7.2.2.3. Hunting Process

Offenders use various strategies and techniques to identify, search, and attack potential targets. Collectively, this is referred to as their “hunting behaviour” (Rossmo, 1993; 1995, 2000). Hunting behaviour involves surveillance, exploration, and target selection, which vary depending on the type of crime. Analysing hunting methods provides insights into offenders’ motivations and targeting patterns when committing crimes in specific places.

An offender’s hunting behaviour can be examined regarding how the offender searches for a suitable victim and the method of attack they use. With regards to search behaviour, Rossmo proposes four methods that offenders use:

opportunities that can increase crime risk. For example, a crowded train station with many potential victims is a social opportunity for crime.
1. Hunter: An offender who intentionally seeks out a target, using their residence as a starting point for their search.

2. Commuter (poacher): An offender who intentionally initiates a search for a target, conducting it from a location other than their residence. This involves the offender travelling (commuting) to another geographical area from which they commence their search for a target.

3. Troller: An offender who encounters a potential victim opportunistically while engaged in non-predatory activities.

4. Trapper: An offender who occupies a position or holds a job that entails interactions with potential victims; or attracts victims into a controlled environment through fraudulent means.

With regards to how the offender attacks their target, Rossmo proposed three victim attack methods:

1. Raptor: An offender who assaults a victim upon initial contact.

2. Stalker: An offender who initiates contact with a victim and follows them before committing an attack.

3. Ambusher: An offender who attracts a victim to a location under their control, such as a residence or workplace, and subsequently attacks the victim.

Rossmo introduced these search and attack typologies to better understand the hunting behaviours used by serial offenders of serious violence. However, I propose that these principles can also be applied to criminal groups. Identifying each group member’s spatial behaviour and hunting behaviour can potentially provide insights into how the group collectively performs criminal acts.
Criminal groups are likely to use multiple search and attack methods to commit their crimes. They can gather information from various sources and expand their spatial boundaries based on each member’s knowledge, experience, and capabilities (Alarid et al., 2009; Bruinsma & Bernasco, 2004; van Koppen et al., 2010). By pooling that information together, criminal groups can formulate strategies involving multiple search and attack methods, allowing them to pursue their illicit objectives effectively. Offenders are likely to adapt their search and attack method in function of the type of crime they are involved. Even, they can change their methods depending on the CCP's stage they are performing.

What happens after committing a crime is also important when considering offender spatial mobility. Lu (2003; 2006) identified that in the case of robbery, specific economic units\textsuperscript{122} can play an important role after committing a crime, such as commercial parking lots and warehouses in downtown areas close to major roads. Transportation from the scene of a cargo theft, and the storage and disposal of stolen items are all important stages of the cargo theft crime commission (as identified in the CSA in Chapter Six). Therefore, the locations where offenders travel after the theft of cargo are also important to consider when analysing the spatial mobility of offenders. In the CSA, I identified specific locations – introduced as facilitating locations – where offenders are likely to anchor their activities as part of the cargo theft CCP. These facilitating locations, some of which may operate as anchor points for group members, are explained later in this research as a core part of applying geographic profiling principles to criminal groups.

\textsuperscript{122} In this research, the “Economic Units” concept represents businesses, firms, enterprises, and points of interest that the offenders can use as part of their crime commission process. A more detailed description of this concept is provided in Section 7.3.1.3.
7.2.3. Examining the places where offenders act

Although facilitating locations are a term I introduce in the current research, the idea that there are locations that are important to offenders is not a new topic. Prior research by Tamara Madensen and others has introduced the concept of *crime place networks*, building on the concepts of target backcloth and how offenders hunt for their targets. The concept of a crime place network refers to how crimes should not be considered as isolated events but instead should be considered within a broader spatial context that involves several other places (Barnum et al., 2017; Bernasco, 2010b; Eck et al., 2023; Madensen, 2017). These other places include (Hammer & Madensen, 2017, p. 5):

2. Convergent Settings: public places where offenders routinely meet.
3. Comfort Spaces: private meeting, staging, and supplying locations.
4. Corrupting Spots: places that encourage criminal activity in other locations.

Place-based Investigations of Violent Offender Territories (P.I.V.O.T.) exemplifies this crime place network concept (Hammer & Madensen, 2017). Introduced initially in Cincinnati, P.I.V.O.T. involved examining the places where violent offenders operated. The P.I.V.O.T. approach aims to identify specific sites (such as unregulated parking spaces, with a lack of place management, unsecured structures, illegal vending activities, etc.) that are part of the CCP.

Identifying the places where criminal activities overlap (offenders’ convergence settings) can aid in understanding the locations where offenders anchor their activities. Also, identifying offenders’ convergence settings can generate insights to identify places common to different criminal group members and are part of the CCP. Mapping and
analysing the relationships between these places can offer insights into the dynamics and patterns of criminal activity (Caplan et al., 2011; Clouse & Madensen, 2020).

7.2.4. GPA in the Context of Co-offenders and Groups

To effectively apply GPA principles to organised criminal groups, it may be necessary to identify key actors with a more significant presence in the group’s criminal activities and analyse these activities using GPA, co-offending, and decision-making principles. Chapter Two introduced the theoretical principles of co-offending to enhance the understanding of organised criminal groups. This involved examining the decision-making processes of individuals who join organised criminal groups and the subsequent cooperation between co-offenders assigned specific roles in target identification (Englefield & Ariel, 2017; Malm et al., 2011; van Mastrigt & Carrington, 2019). Furthermore, assigning specific roles within the group’s illegal activities, such as the role of overseeing the attack, is an important consideration when examining co-offending (Copes et al., 2012; Lantz & Ruback, 2017b; Malm & Bichler, 2011). Although these principles were previously described, Chapter 2 did not explain how co-offenders may collaborate when deciding on a potential target and their hunting process.

The CSA presented insights into the role of co-offenders, which helps to identify the assessments of key members and the facilitating locations that are part of the CCP. By doing so, it is possible to infer certain facilitating locations that key members share with other co-offenders, and the role of those locations in the target and hunting process. These locations may also be locations where other group members are anchored, and so collectively, may be important locations where the group’s activities converge.
By integrating GPA and co-offending principles within the context of organised criminal groups, a more comprehensive and nuanced analysis of the locations where the group anchor their activities can be conducted. The following section presents the data and methods to generate the proposed GPA on criminal groups.

7.3. Data and Methods to elaborate a GPA

This section details the data used to generate the proposed GPA. It outlines the analytical methods employed to process and interpret the selected data, including statistical techniques and computational algorithms for generating geographic profiles. The section also highlights the strengths and limitations of each technique. By detailing the data and methods used, it offers an in-depth account of the GIM method for investigating the spatial and temporal aspects of offenders’ hunting and spatial behaviours.

7.3.1. Cargo theft information in the Context of GPA

Developing a GPA necessitates managing information and searching for patterns that can relate a series of crimes to a potential offender (Rossmo, 2000). Generating a GPA requires geocoded data, information about when the crime was committed, the target backcloth, and the offenders’ hunting methods. This section details the data extracted from the INAI database and the crime script as part of this exercise.

To apply GPA principles to cargo theft on Mexican highways, I adapted the questions proposed by Rossmo (2000, p.216) to gather the information required. These questions were,
1. Site selection — How were the cargo theft locations accessed? What else is in their general area? How might the cargo thieves have known of these locations?

2. Time — When did the cargo theft occur (i.e., time, weekday, date)? What are the time lags between cargo thefts?

3. Target backcloth — What is the geographic arrangement and availability of the target group?

4. Hunting — What hunting method did the cargo thieves use? Why were these sites chosen and not other possible locations? What was the cargo thieves’ probable mode of transportation?

5. Locations — What are the locations connected to the cargo theft series? Where are they? What are the distances and travel times between them? Can they be considered as “facilitating locations”?

The following subsections outline the answers to these questions.

7.3.1.1. Highway segments to apply GPA – the spatial component

To answer the first question regarding the selected micro-places to commit cargo theft, I used the data described in Section 5.3.3. That database includes the geographic coordinates and the hour when cargo thefts were committed, which are necessary variables to generate a GPA.

Table 7.1 shows the three segments selected to apply GPA principles. These segments had the highest incidence of cargo theft on the SHN\(^{123}\).

\(^{123}\) The standardised segments were preferred over the National Highway Network (NHN) because the SHN has lines with similar lengths that more homogenously catch the geocoded points (crimes). The joining between the crimes and the SHN segments offers a complete account of the crimes committed along the
Table 7.1. Segments with more cargo theft in Mexico (SHN segments)

<table>
<thead>
<tr>
<th>ID Segment</th>
<th>Code Highway</th>
<th>Name Highway</th>
<th>Length</th>
<th>Cargo thefts</th>
</tr>
</thead>
<tbody>
<tr>
<td>NHN_14666</td>
<td>150D</td>
<td>Puebla-Córdoba</td>
<td>9,530.76 m</td>
<td>55</td>
</tr>
<tr>
<td>NHN_15206</td>
<td>150D</td>
<td>Puebla-Córdoba</td>
<td>7,280.44 m</td>
<td>53</td>
</tr>
<tr>
<td>NHN_9101</td>
<td>45</td>
<td>Querétaro-León</td>
<td>9,511.80 m</td>
<td>28</td>
</tr>
</tbody>
</table>

These segments registered more than five crimes, which meets the minimum requirement to conduct a GPA (Rossmo, 2000). The INAI database also provides the cargo theft’s specific time (day of the week and hour). This information can help to ascertain the offenders’ spatial and hunting behaviour.

Figure 7.1. presents a map with the identified segments and the states where the segments are located. For the spatial analysis of each segment, I present a map indicating where the cargo theft was committed. Also, each map includes a layer with information from Google Maps to identify the environmental backcloth of those locations.

The second part of the spatial analysis involved a more detailed description of the micro-places where cargo theft was committed. Using pictures from Google Maps, I describe specific locations along the segments. In doing so, I attempt to identify the facilitating locations that may be related to the cargo theft commission process.

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network and a better representation of the distribution of crimes than using the original NHN. Similar segments also help to better characterise the surrounding conditions in those locations.
Figure 7.1. Cargo thefts by identified segments and states to apply GPA
7.3.1.2. Temporal component

The first part of the temporal analysis involves charts regarding the monthly evolution of cargo theft. This analysis is to identify if the cargo thefts committed within a certain period are likely to be that of a single criminal group. The three segments under analysis are those with the highest incidence at the national level, which assumes the existence of specific conditions that attract offenders to these areas. If these conditions remain unchanged, and no cargo thefts are occurring in these segments for over two months, I suggest that the criminal group operating in that area may no longer be active. For example, if one cargo theft was reported in June 2016, and the following cargo thefts were reported in April and June 2017, I did not include the first theft.

While the temporal analysis is restricted to a specific timeframe, it is important to acknowledge a noteworthy possibility: isolated theft incidents may serve as triggers for subsequent cargo thefts. These isolated thefts, which may arise from disruptions in transportation routes, economic fluctuations, or other contextual factors, could trigger a chain reaction leading to an increase cargo theft events in a subsequent period. As identifying a significant relation between those potential contextual factors and offenders’ spatial behaviour is out of the scope of this thesis, further research should explore the mechanisms through which these isolated events could influence cargo theft concentration, thereby shedding light on offenders’ behaviour.

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124 The reference of two months is based on visual inspection of the three segments with more incidences. For example, in periods of high incidence, if a series of thefts was reported in January, at least one more occurred within two months. In contrast, during low-incidence periods, more than two months passed without any reports.
Figure 7.2. presents the monthly evolution of cargo thefts committed in segment SHN_9101 (in Guanajuato). Then, Figures 7.3. and 7.4. show the evolution of cargo thefts in segments SHN_14666 and SHN_15206, both in Puebla. The results are as follows.

Figure 7.2. shows that cargo thefts in 2017 and 2018 are likely unrelated to other thefts in the study period. Therefore, I restricted the data to when most thefts occurred. The temporal analysis will present information from March 2019 to September 2020.

While Figure 7.3. shows the cargo theft monthly evolution in segment SHN_14666. This segment shows a significant concentration in 2019 and 2020. Consequently, I decided to use the data from those two years to generate the temporal analysis.
Figure 7.3. Cargo thefts in segment SHN_14666 in Puebla State by month, 2017 to 2020

Figure 7.4. shows the cargo theft monthly evolution in segment SHN_15206. This segment showed a specific cargo theft concentration in 2019. Therefore, I only consider the thefts committed in this year and omit the others from the analysis.

Figure 7.4. Cargo thefts in segment SHN_15206 in Puebla State by month, 2017 to 2020
Once the temporal information was delimited for each segment, the second part of the temporal analysis involved generating data clock graphs. These charts aim to visualise the distribution of crimes by day of the week and police operational shift (similar to section 5.4.1). This information can provide insights into the offenders’ routine, such as their preferred hour or day of the week to commit crimes. By including the time dimension and understanding the temporal patterns, it is possible to create offender profiles and identify their spatial-temporal relationships as part of a criminal group (Rossmo, 2000).

7.3.1.3. Economic units to infer facilitating locations

The OSINT and DA process presented in Chapter 6 revealed that locations such as cafes or restaurants could act as facilitating locations. Offenders are likely to use these locations to meet before travelling to the identified segments. Furthermore, it was documented that car parts stores or car-repair centres can be utilised as warehouses or rendezvous points to dispose of stolen merchandise or cargo truck parts. These potential facilitating locations can be used to identify places where specific members anchor their activities. Therefore, I propose to use them as part of the GIM to infer the group’s anchor locations.

Once the potential facilitating locations were determined in the CSA, the first part involved gathering information concerning the economic units identified as facilitating locations. To do so, I sourced a database from INEGI’s National Statistical Directory of Economic Units (DENUE)\textsuperscript{125}. This database includes detailed information about the type of economic activity, location, number of employees, and name, among other details, of all the units.

\textsuperscript{125} For more details and visualisation of the DENUE, visit \url{http://en.www.inegi.org.mx/app/mapa/denue/}
across Mexico. To narrow the focus to the facilitating locations, I extracted data on only restaurants, cafes, car repair centres, auto part shops and car parks within a 10-kilometre radius from the selected highway segments. This included the business name and geographic coordinates. Figure 7.5. shows an example of this database.

<table>
<thead>
<tr>
<th>ID</th>
<th>Type</th>
<th>Name</th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>7846527</td>
<td>Groceries store</td>
<td>ABARROTES EL TEXANO</td>
<td>20.506636</td>
<td>-100.7964342</td>
</tr>
<tr>
<td>8772133</td>
<td>Restaurant</td>
<td>LA UNITA</td>
<td>20.531317</td>
<td>-100.8045344</td>
</tr>
<tr>
<td>9149415</td>
<td>Car repair centre</td>
<td>TALLER MECANICO</td>
<td>20.57050742</td>
<td>-100.742178</td>
</tr>
<tr>
<td>7846320</td>
<td>Auto parts shop</td>
<td>VENTA DE AUTOS</td>
<td>20.53874604</td>
<td>-100.8071802</td>
</tr>
</tbody>
</table>

Figure 7.5. Example of data extracted from DENUE

7.3.1.4. Information from the CSA

Identifying certain activities of specific members helps elucidate the criminal group’s activities as the sum of individuals’ actions. From the proposed CSA in Chapter 6, I extracted relevant information to answer the following questions:

- **Target backcloth** — What is the geographic arrangement and availability of the target group? Is it the same in each crime site?
- **Hunting** — What hunting method did the cargo thieves use? Why were these sites chosen and not other possible locations? What was the cargo thieves’ probable mode of transportation?

Based on the CSA results, it is possible to infer that the spatial behaviour of certain group members (for example, the lead offender) can be tracked to specific places (the facilitating locations). Moreover, it is possible to infer the offenders’ potential travel routes to the micro-place where they commit cargo theft. Consequently, by using that information, I
apply geographic profiling and journey to crime principles to infer the places where they anchor their activities.

To identify the hunting process of cargo thieves, I adapted Rossmo’s *Criminal Predator Hunting Typology* (Rossmo, 2000, p. 143). The CSA provides enough details to identify the hunting process and determine whether cargo thieves hunt as hunters, commuters, trollers, or trappers, and if they attack as raptors, stalkers or ambushers. Section 7.4.3 presents the results of this analysis.

### 7.3.2. Methods to develop a GPA of cargo theft on Mexican highways

Rossmo (1993, p. 9) suggests using Criminal Geographic Targeting (CGT) as a model of offender hunting behaviour to develop a GPA. CGT involves analysing spatial information linked to a series of crimes to determine the most likely areas where the offender might be located. CGT can be implemented using Rigel\(^{126}\), which includes the CGT algorithm. However, I did not use this software. Instead, I applied GPA theoretical principles to infer the criminal group’s anchor points when Rigel or other software is unavailable\(^{127}\). The following section describes two alternative methods of spatial analysis techniques that can be used in geographic profiling. The second subsection details the *Coterminous Locations method* introduced in this thesis.

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\(^{126}\) For a more detailed review section, see “10.4.4 The Rigel Computer System” from Rossmo (2000). And ECRI’s webpage: [https://ecricanada.com/products/igel-analyst/](https://ecricanada.com/products/igel-analyst/) (last reviewed 11 April 2023)

\(^{127}\) The price of a Rigel license is too cost-prohibitive to purchase within the scope of this PhD research. This may also be the case for other researchers and law enforcement agencies.
7.3.2.1 Spatial mean and Journey to Crime Circles

The spatial mean has commonly been used in geographic profiling research (Chainey, 2021; Chainey & Ratcliffe, 2005; Levine, 2008; Taylor, 1977). The spatial mean, also known as the centroid or centre of gravity method, measures the central tendency of a sample of spatial point data by identifying the centroid/spatial mean from the geocoded crime locations (LeBeau, 1987, 2017; Rossmo, 1995b; Stephenson, 1980). Examples of its use are provided by LeBeau (1987), applying to a serial rapist in San Diego, California. Daniell (2008) shows an application of this technique to a series of sexual assaults in Bath, England. Both cases aim to identify potential areas where offenders act and the influence of certain urban factors related to their activities.

In geographic profiling analysis, journey to crime circles is another technique used. This approach entails calculating the estimated distance an offender travels to commit a crime, creating circles around each offence location, and examining where these circles intersect. The radius of the circles is not universally defined and is typically determined based on previous research on similar crimes to infer the offenders' activity space. Daniell (2008), in her study on reported sexual assaults in Bath, England, used circles with a radius of 0.5 miles drawn around each assault location. This radius was determined by referring to Rossmo's (2000) research on offenders involved in sexual assault cases. Daniell (2008) aimed to identify the area where most circles overlap, suggesting that offenders are more likely to have an anchor point within this area. Figure 7.6. shows an example of this technique.
7.3.2.2 GIM Coterminous Anchor Locations Method

The abovementioned methods were developed to profile single offenders. Here, I introduce a method called *Geographic Intelligence Coterminous Anchor Locations (CAL)* to develop a GPA on criminal groups.

The Cambridge Dictionary defines “coterminous” as having or meeting at a shared border or limit\(^\text{128}\). For example, two areas sharing the exact boundaries or borders, two time periods that coincide exactly, and two ideas or concepts that are closely related or share many of the same characteristics. In that sense, identifying areas where a criminal group

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\(^{128}\) Details: [https://dictionary.cambridge.org/dictionary/english/coterminous](https://dictionary.cambridge.org/dictionary/english/coterminous) (last reviewed 11 April 2023)
member shares their activities with another member can be described as a coterminous location. Figure 7.7 shows an example of this coterminous geographical areas concept.

In addition to the GPA's spatial and temporal component, the CAL method involves four steps. The first step considers inferring the cargo thieves' journey to crime. To date, there has been no known study that has measured the journey to crime distance performed by cargo thieves. However, studies focusing on vehicle theft in the UK, such as those of Tonkin et al. (2009) and Wiles & Costello (2000), showed that vehicle thieves usually travel between 3.5 to 19 kilometres from their homes to where they commit a theft. Furthermore, Vandeviver et al. (2015) suggest that the JTC distance tends to increase when offenders commit crimes in areas near motorways and dense road networks. Then, considering the above-mentioned results, I propose that cargo thieves are likely to travel between 5 to 20 kilometres from their potential anchor locations to the segment where they commit cargo theft. Therefore, I suggest generating circles of 5 and 10-kilometre
radii from the centroid of the segment in analysis. Figure 7.8. shows an example of this proposal.

![Diagram](image)

**Figure 7.8. Potential cargo thieves’ journey to crime**

The second component includes the economic units representing the facilitating locations identified in the CSA (similar to the crime place network). The CAL method uses these locations to analyse the offenders’ spatial and hunting behaviour. These facilitating locations are likely to play an essential role in their CCP. The CSA revealed that at least one group member frequents those locations. Then, it may be possible that these facilitating locations are coterminous to group members.

As part of this second step, I added the economic units within the circles. The addition of these economic units is to infer potential cargo thieves’ anchor locations. Figure 7.9. shows an example.
The CAL method’s third component introduces the **surrounding area of influence**. This concept is related to the impact of geographical conditions on the CCP. In the case of cargo theft, the results of the previous empirical analyses suggest that the geographical conditions of micro-places tend to have a major impact on the cargo theft CCP.

The surrounding area of influence in this example involves the secondary roads. Scholars suggest that highways connected to secondary roads are more likely to suffer vehicle or cargo theft (Chainey & Guerrero Rojas, 2019; Lu, 2006; McCutcheon et al., 2016). The CSA documented that cargo thieves use secondary roads to move the stolen goods to small towns where their warehouses are likely located. Using the National Highway Network information\(^{129}\), I included all the secondary roads within the circles because they can be part of the JTC\(^{130}\). Figure 7.10. shows an example of this process.

\(^{129}\) The National Highway Network (NHN) comprises all the highways across Mexico (including state and municipality roads) which are considered secondary roads for elaborating the GPA on criminal groups.

\(^{130}\) The cut of the secondary roads was made using the algorithm “clip” contained in the vectorial and geoprocessing tools of QGIS 3.16.
The fourth and last step of the CAL method involves the identification of *GIM clusters*. The convergence of the green lines and yellow circles within the buffers of the potential journey to crime indicates where cargo thieves may have their operational bases. This is the outcome of including clusters with economic activity that potentially contain the cargo thieves’ facilitating locations identified in the CSA. Also, the green lines depict the connections to secondary roads and their surrounding areas. Figure 7.11. shows an example of these GIM clusters.
For this research, the GIM circular buffer areas consider towns with facilitating locations connected to the highway segment. The CAL method is a novel application of geographic profiling because it is specifically designed for the spatial mobility of criminal groups. The following section presents the results from using this method.

### 7.4. Geographic Profiling of cargo thieves in Mexico

This section presents the results of applying the principles of geographic profiling to the analysis of criminal groups, using the example of cargo thefts on Mexican highways. The first subsection presents descriptive spatial and temporal analysis, which includes a geographic and sociodemographic context of the identified segments. The second part of the subsection describes the cargo thieves’ target backcloth and the hunting process.

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131 Based on the information obtained using the OSINT method described in Chapter 6, this section presents the results obtained after filtering to focus on the states and identified regions. The descriptive geographic, sociodemographic, and economic variables were initially analysed.
Finally, a map for each segment, with the results of applying the Geographic Intelligence Coterminous Anchor Locations (CAL) method identifying specific geographical areas with cargo thieves' likely base of operations, is presented.

7.4.1. GPA spatial and temporal analysis

7.4.1.1 Spatial distribution

Three maps were generated for each segment analysed. The first map shows where the cargo thefts were committed along the segment. Although this map includes all the thefts, in some cases, as the National Guard report the cargo thefts in the same location, the map only shows those with different geographic coordinates. The second and third maps describe the surrounding conditions in those places to identify the target backcloth.

Figure 7.12. shows the spatial distribution of cargo thefts committed in segment SHN_9101 during the study period. Although the National Guard reported 28 cargo thefts, these occurred at only nine locations along this segment.
Segment SHN_9101 is in a region primarily focusing on the automotive, agro-industrial, and logistics industries (Analytica, 2017; INEGI, 2021; SENSITECH, 2020). This highway presents a constant flow of commodities related to those industries, increasing the number of cargo trucks along the route and providing opportunities for cargo theft. Also, in this area, organised criminal groups engage in activities such as drug and guns trafficking, extortion, and illegal oil extraction (Beittel, 2022; BSI and TT Club, 2021; CANACAR, 2021; Justice in Mexico, 2021).

Figure 7.13. shows a micro-place within the segment. It has connections to secondary roads and other major highways of the country. There are also economic units such as parking spots, warehouses, and car repair centres. All these conditions and facilitating locations were previously identified in the CSA to be likely used by cargo thieves.
Figure 7.13. Facilitating locations and surrounding conditions in segment SHN_9101

Figure 7.14. provides another example. The state of Guanajuato has many firms related to the automotive industry. Industrial parks are also located along the highways in this area. These parks offer spaces that can be used as warehouses. Also, the presence of auto parts shops, which are not regulated, can facilitate cargo thieves’ activities.

Figure 7.14. Facilitating locations and surrounding conditions in segment SHN_9101
Segment SHN_14666 is part of the highway that connects the Mexico City metropolitan area and the country’s centre with major ports of the Gulf of Mexico. Consequently, a high volume of cargo trucks cross this state (Puebla is ranked sixth in Mexico for the volume of traffic on highways\textsuperscript{132}). Figure 7.15. shows the distribution of cargo thefts committed along segment SHN_14666.

![Figure 7.15. Cargo thefts in segment SHN _14666 in Puebla State](image)

With 57 cargo thefts reported, this segment had the country’s highest number of incidents. However, the National Guard only reported four geographical coordinates along this segment. The spatial analysis and the information gathered in Chapter Six showed that this segment crosses an industrial region that houses many logistics and automobile industries.

\textsuperscript{132} The Mexican Ministry in charge of communications and transport (highways included) produces an annual report on the highways with more traffic across the country. Based on that information, Veracruz, Guanajuato, Nuevo Léon, Querétaro, Jalisco, Estado de México, and Puebla are the states with more traffic of cargo trucks in Mexico. (Last consulted 12 June 2023). [https://www.sct.gob.mx/fileadmin/DireccionessGrales/DGST/Vehiculos_Kilometro/V-Km_DV2023-ENT.pdf](https://www.sct.gob.mx/fileadmin/DireccionessGrales/DGST/Vehiculos_Kilometro/V-Km_DV2023-ENT.pdf)
Figure 7.16 shows one of the identified micro-places with the most cargo thefts. There are junctions to secondary roads and other highways that connect with the country’s south. The area this segment crosses is also known for a high presence of organised criminal groups engaged in activities such as the illegal extraction of oil (Ignacio & Vieira, 2018; Jones & Sullivan, 2019; Navarro, 2017).

Figure 7.16. Facilitating location and surrounding conditions in segment SHN_14666

Figure 7.17 depicts another part of the segment, featuring connections to other highways that lead to other cities. Adjacent to the highway, there are designated parking areas where cargo truck drivers often stop to rest. The CSA documented that these spots are likely to be exploited by cargo thieves during the commission of cargo theft. Furthermore, auto parts shops and warehouses in this area can facilitate cargo theft.

Figure 7.17. Facilitating location and surrounding conditions in segment SHN_14666
By accounting for 55 cargo thefts, segment SHN_15206 has the second-highest incidence in the country. As previously reported, the map only shows the thefts with different coordinates (for this segment, the National Guard only reported three geographical coordinates). Figure 7.18. shows the distribution of those cargo thefts.

This segment is situated in a mountainous area. This implies that drivers tend to travel at slower speeds when navigating steep hills. As described in Chapter Six, several news articles reported that cargo thieves tend to exploit these geographical conditions to commit thefts. As part of the cargo theft CCP, cargo thieves are aware of the deficient telecommunications network in this area. For example, several GPS tracker failures make it difficult for truck drivers to send their location in real-time\textsuperscript{133}.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{image.png}
\caption{Cargo thefts in segment SHN_15206 in the border of Puebla and Veracruz States}
\end{figure}

\begin{flushleft}
\textsuperscript{133} Studies by institutions as (CANACAR, 2020; INEGI, 2021; Observatorio Nacional Ciudadano, 2014; SENSITECH, 2020) have emphasised the impact that the lack of communication network has on the commission of thefts in this area.
\end{flushleft}
In addition to the lack of a telecommunications network, other geographical factors and economic units are relevant to their CCP. For example, Figure 7.19. shows the presence of restaurants that cargo thieves may frequent to gather information about the cargo truck drivers or may be used as a rendezvous point to dispose of the stolen merchandise.

Figure 7.19. Facilitating location and surrounding conditions in segment SHN_15206

Figure 7.20. shows that this segment is adjoining the junction of a small town with a gas station. This station includes a restaurant and a rest stop for truck drivers. Based on the gathered information for generating the crime script, these facilitating locations may be used by cargo thieves.

Figure 7.20. Facilitating location and surrounding conditions in segment SHN_15206
The previous figures showed that facilitating conditions and locations such as junctions to secondary roads, warehouses, auto parts, and car repair centres are present in almost all the identified micro-places. This is aligned with the findings in Chapters 5 and 6, which suggest the relevance of including these factors to analyse the cargo thieves’ decision-making as part of the GPA.

7.4.1.2 Temporal patterns

The first part of the analysis in section 7.3.1.2 determined the interval when cargo thefts can be connected to a criminal group. For segment SHN_9101, cargo thefts in 2019 and 2020 were considered. Figure 7.21. shows that most cargo thefts were committed on Tuesday and Wednesday. Friday had the third-highest number of reports.

Figure 7.21. Cargo thefts in segment SHN_9101 by day and shift, 2019 and 2020

Figure 7.22. shows the temporal distribution on Segment SHN_14666. It is also restricted to 2019 and 2020. Along highway segment SHN_14666 the highest level of activity was from Thursday to Saturday during the overnight shift, with Saturday presenting the highest incidence.
Figure 7.22. Cargo thefts in segment SHN_14666 in Puebla State, 2019 and 2020

Figure 7.23. shows SHN_15206’s temporal distribution of cargo theft by day and shift.

Sunday’s overnight shift presents the highest concentration of cargo thefts in this segment. However, the shift from 18:00 to 23:59, especially from Thursdays to Saturdays, was also a time period of high incidence. A more detailed discussion of these results is presented in section 7.5.

7.4.2. Spatial and hunting behaviour of cargo thieves on Mexican Highways

The figures in this section include the Auto parts shops, Car repair centres, Parking places and Restaurants within the JTC circles described in section 7.3.2.2. Figure 7.24. shows the distribution of businesses around the segment SHN_9101.
Based on Figure 7.24., within the red circle (5km of radius) is a town with a high concentration of facilitating locations that may be used as anchor points. At the left border of the second circle (10km of radius) is another area with a high concentration of facilitating locations. The areas with the most concentrations are connected to other highways and secondary roads, potentially linked to cargo theft activity.

Figure 7.25. shows many areas with a concentration of businesses within both circles. Compared with the previous figure, no specific economic activity clusters can be directly related to cargo thieves in this area. However, this segment also connects to other highways and roads with the towns around it. The easier and faster connection to the
highway may influence the cargo thieves’ decision-making of anchoring their activities in those towns and potentially their base.

Figure 7.25. Cargo thefts in segment SHN_14666 and DENUE locations

Figure 7.26. presents the circles of segment SHN_15206. As this segment is close to the mountainous area, Figure 7.26. shows a considerable lack of economic activity. There is just one significant cluster that is likely to contain the cargo thieves’ facilitating locations, it being close to the highway and the junction connecting with this segment. This cluster may have the thieves’ facilitating locations and potentially their base.
Turning to the cargo thieves’ hunting process, the cargo thieves are likely to present a commuter and stalker hunting and attack process. Figure 7.27. shows a diagram of the processes.
Figure 7.27. Cargo thieves’ hunting process

Figure 7.27. shows cargo thieves may act as *commuters*. They travel from their anchor locations to other geographic areas to look for a cargo truck victim. They are then likely to behave as *stalkers* because after identifying their cargo truck target, they follow it to the segment where they plan to act. Section 7.5 expands the discussion of these results.

### 7.4.3. Geographic profile - GIM clusters - of cargo thieves on Mexican highways

Applying the CAL method, the theoretical principles of GPA and the results of previous chapters, I present the GIM buffers for the three analysed segments. The GIM buffers include where offenders are likely to anchor their activities. Figure 7.28. shows a map with the results for the segment SHN_9101.
The CAL method suggests that the criminal group is most likely to have its base of operations near a town with the highest concentration of facilitating locations and is connected by secondary roads.
Figure 7.29. presents the results for segment SHN_14666. The analysis identifies several potential areas where the criminal group may operate. Clusters of economic activity and secondary roads connecting with the segments make it difficult to pinpoint a specific location. Nonetheless, the CAL method indicates that cargo thieves could seek to minimise the commuting distance from their anchor location to the highway. Therefore, the green lines and yellow circles closer to the road will likely host the cargo thieves’ operational base.
Figure 7.30. shows data associated with segment SHN_15206. Two areas that meet the model’s conditions can be identified. These areas assume that offenders are looking to make the journey to commit a crime that implies less effort. It is suggested that the area close to the identified segment will likely contain the criminal group’s operational base.
7.5. Discussion on using GPA in criminal groups

In this research, I propose the Coterminous Anchor Locations (CAL) method for applying geographic profiling to criminal groups. The CAL method uses principles of geographic profiling, crime script analysis, and spatial and temporal analyses. Using these approaches, the CAL method aims to identify criminal groups’ potential anchor locations (such as their operational bases) within a studied area.

In addition to GPA principles, the GIM and the CAL method follow a DIKI approach (Ratcliffe, 2016). First, data regarding cargo theft activities were integrated from Mexican sources. Second, information about these activities was generated using spatial analysis techniques to identify spatial micro-places of criminal activity. Furthermore, offenders' activity nodes and pathways associated with the group's criminal operations were identified using qualitative methods. This information generates knowledge regarding individual offenders' spatial behaviour, such as their known anchor points, routes, and areas of operation. In doing so, it generates information about the criminal group's collective geographic activities. By including GPA principles, the GIM generates intelligence into criminal groups' spatial dynamics, enabling the identification of locations that are important to the operational criminal activities of the group.

The identification of the locations where offenders anchor their activities required the use of geographic profiling principles. Geographic Profiling assumes offenders are likely to commit crimes within their activity space, reflecting their daily routine and behavioural (spatial and hunting) patterns (Rossmo, 2000). Then, by identifying the routines of certain members, it is possible to estimate the movement of the group and to infer the locations where they anchor their activities.
Building on the CSA and Lu’s (2003, 2006) results, I suggested the concept of facilitating locations. These locations, and likely economic units that aid in committing crimes, are commonly used by offenders as part of their illegal activities. The CAL method assumes that multiple offenders utilise these locations as part of their daily routines and behavioural patterns, similar to the anchor points described by Rossmo (2000). By capturing the economic units that are considered as facilitating locations within specified distances from the segments, it is possible to estimate the areas where cargo thieves are likely to travel, as depicted in Figure 7.24.

As discussed in the previous chapter, criminal groups may undertake longer journeys to commit crimes than single offenders. This capability is due to the collective knowledge and extensive network of co-offenders within the group (Fisher, 2021; Lu, 2003; van Daele & Vander Beken, 2010; Vandeviver et al., 2015). Moreover, the information gathered in Chapter Six related to the distance between the warehouses identified by the police and the crime locations, suggests that cargo thieves are likely to travel further because the potential earnings are bigger than the risks. Therefore, I suggest that the cargo thieves’ journey to crime is likely to be 10 to 20 kilometres from the segments where they act. This original finding aims to contribute to the knowledge in JTC research.

Another component of the CAL method is the surrounding areas of influence. As highlighted by Hammer and Madensen (2017), crimes are not isolated events but are influenced by the contextual factors present at the crime scenes and the connections between them. The CAL method incorporates the concept of crime place networks, recognising that crimes are not isolated incidents but are influenced by the contextual factors surrounding the crime locations - the surrounding areas of influence. By examining
the geographical conditions and sociodemographic variables in the surrounding areas where crimes occur, the CAL method aims to uncover the target backcloth and understand how these factors shape the spatial and hunting behaviour of specific group members. This analysis provides valuable insights into the activities of the criminal group within the broader network of crime places.

Analogous to the concept of a "Geographic Profile" (Rossmo, 1995; 2000), the CAL method proposes "GIM clusters", which are specific geographical areas where it is more likely the offenders’ anchor points will be located. These clusters result from the convergence of facilitating locations and surrounding areas of influence within the JTC circles. Thus, these "GIM clusters" have potential practical applications within this model.

Figures 7.28., 7.29. and 7.30. provided examples of the GIM, a town close to the segment directly connected by a secondary road. This town contains a cluster of facilitating locations such as car parts shops and car repair centres, which can sometimes act as warehouses or rendezvous points to dispose of the stolen merchandise. These conditions can facilitate the offenders’ journey to crime. Hence, I suggest that for this example, offenders anchor their activities in this town.

In practical terms, the CAL method was tested in three segments with different characteristics. Despite their differences, they share certain conditions and facilitating locations likely to be linked to the cargo theft commission. For example, secondary roads that connect with highways or towns where offenders can anchor their activities. Another example is the economic units near the segments that can act as facilitating locations (such as car-repair centres, warehouses, parking places, etc.). Two of those segments cross by regions where many firms related to the car manufacturing industry are located.
Aligned with the findings of Chapter Six, the figures in subsection 7.4.1.1 showed that warehouses, car parking lots, car parts shops, and junctions to secondary roads are connected to these segments. These facilitating locations, plus the spatial and hunting behaviour identified in subsection 7.4.2, suggest that cargo thieves are likely to have their anchor locations within the JTC circles.

The third segment is in an area where the geographic conditions change quite significantly over a relatively short distance and how these changes can impact the offenders' spatial behaviour. This segment started in a mountainous area with a poor communication network cover and where cargo truck drivers tend to drive slower. Considering that only a few towns near this segment contain the facilitating locations previously identified, the GIM cluster was identified there. This finding suggests that offenders know the routines of the cargo trucks and are trying to minimise the effort of committing a cargo theft by taking advantage of the surrounding geographical conditions. Furthermore, this segment finishes at the junction of the main highway with a secondary road to the only town in that region. Considering the journey to crime and geographic profiling principles, cargo thieves likely have their activity space close to that town. Then the CAL method suggests that their base of operation or a significant anchor point exists.

The temporal analysis shows cargo theft concentrates on specific days and times. This finding suggests that cargo thieves are likely to target their potential victims based on the temporal surrounding conditions, such as the lack of light and guardianship at specific hours of the day. Then, cargo thieves will design their hunting process considering these particular conditions.
Figure 7.27. presented the hunting and attack method based on Rossmo’s (2000) typology. Here, I suggest that cargo thieves tend to hunt as commuters and attack as stalkers. This result is likely to be observed in each segment; cargo thieves are likely to plan the activities of the cargo theft CCP in the facilitating locations identified in the geographical regions by the analysis and then travel to the segments. There, they follow the truck until the designated segment and using the modus operandi reported in Chapter Six, they attack the cargo truck and steal the merchandise.

The CAL method aims to enhance our understanding of criminal groups’ spatial and behavioural patterns, shedding light on their operational bases. However, as a novel approach, this method faces limitations that are considered in the following section. The CAL method implications and an extended discussion of it are presented in Chapter Eight.

7.6. Limitations of applying GPA to criminal groups

Applying geographic profiling principles to criminal groups encounters methodological and theoretical challenges. Although developing a GPA for criminal groups may seem paradoxical because this method was developed for solo offenders, using theoretical principles to complement the CSA findings on the identified micro-places is feasible. Then, the criminal group’s anchor locations can be estimated by analysing the roles and activities of key group members in specific locations.

While GPA principles have been traditionally applied to single offenders, throughout this chapter I have proposed that they can also be effectively adapted to examine multiple offenders within criminal groups. The theoretical underpinnings of GPA, such as the assumption of an offender’s spatial behaviour being influenced by their familiarity and
activity space patterns (Rossmo, 2000), can be extended to understand the collective spatial behaviour of multiple offenders operating within a group. For instance, the principle of distance decay, which posits that offenders are more likely to offend closer to their anchor points (Rossmo, 1995; 2000), can be applied to multiple offenders within a criminal group who may share common anchor points or operational bases.

Using cargo theft offenders as an example, the GIM operationalises theoretical GPA principles to examine the spatial behaviour of multiple offenders as part of the group’s CCP. Rather than relying solely on Rossmo’s (1995; 2000) Criminal Geographic Targeting (CGT), which is tailored for single-offender analysis, the GIM proposes a modified approach that accounts for the collaborative nature of criminal activities. For instance, by analysing group members’ collective movement patterns and identifying coterminous anchor points or strategic locations, the GIM can delineate key areas of a criminal group’s CCP.

Despite considering the geographical context and environmental criminology foundation, several scholars have pointed out the limitations of GPA in the geography of crime studies (Bernasco, 2007; Holmberg & Christianson, 2002; Rossmo, 2022; Snook et al., 2004, 2005). These limitations include incomplete data due to incorrect geocoding, inadequate temporal framing, or a lack of modus operandi descriptions that can compromise spatial and criminal linkage analyses¹³⁴ to associate a series of crimes with a specific group. Although the original database gathered in this research lacked geographic coordinates

¹³⁴ The criminal linkage analysis is a fundamental component of any GPA exercise led by a law enforcement agency. However, as stated in the introduction of this Chapter, the CAL method is not trying to develop a police investigative technique; this research tries to expand the current methods to develop a GPA considering criminal groups.
and modus operandi descriptions, it was possible to infer locations of importance to the criminal groups through the process of geocoding the information described in Chapter Three and the information from CSA. This enabled the criteria proposed by Rossmo (2000, p. 218) to be met, such as identifying at least five crimes related to time and space and the search and attack method.

A significant limitation of the current research was the lack of mathematical calculations to infer criminal group locations. Although multiple mathematical techniques exist to calculate a GPA\textsuperscript{135}, the CAL method needed a mathematical component to solidify its technical assumptions of the journey to crime. The circles containing economic activity information and those calculated from the centroid of identified segments were determined based on considerations from other authors regarding the journey to crime and the relevance of some businesses used as anchor locations in their illegal activities (Ackerman & Rossmo, 2015; Lu, 2006; Roberts & Block, 2015; Tonkin et al., 2009). The CAL method provided valuable insights into the potential locations of criminal group operation bases within the studied area. However, further work is needed to apply more sophisticated mathematical calculations to model the offenders’ journey to crime and determine the boundaries of the surrounding geographic area of influence.

Notwithstanding these limitations, the CAL method identified areas with higher economic activity and closer proximity to major highways as more likely to host criminal group activities. The impact of geographic conditions on illegal group activities was highlighted, with areas in mountainous regions showing lower connectivity and economic activity. The

\textsuperscript{135} For more details about other methods to develop a GPA review, Canter et al., (2000); Curtis-Ham et al., (2022); Levine & Block, (2011); Stamato et al., (2021).
findings provide a foundation for future research and suggest potential areas for law enforcement agencies to target their efforts in combating cargo theft and other criminal activities in the region. However, a linkage analysis is a fundamental component of any GPA exercise that requires further work to expand the current methods of developing a GPA considering criminal groups. The lack of a mathematical component to determine JTC and the area of influence remains pending work of this proposal.

7.7. Conclusions

As part of the proposed Geographic Intelligence Model in criminal groups, an objective of developing a GPA to infer criminal groups’ anchor locations and activity space was to answer the following questions.

- How do the geographical conditions influence the offenders’ spatial behaviour and their offending activities in their area of operation?
- Can Geographic Profiling Analysis be used to infer the anchor points of criminal groups?

Results presented in section 7.4 and their respective discussion showed that specific conditions around the identified micro-places impact the offenders’ spatial behaviour. Under those conditions, offenders adapt their journey to crime, how they determine their targets and their hunting-attack method. In addition, the GIM buffers aim to identify areas that concentrate on facilitating coterminous locations to other group members, helping to infer which locations are used as anchor points for criminal activities.

The CAL method is a novel approach to the geographic profiling of criminal groups, focusing on identifying facilitating locations and the impact of the surrounding geographic
conditions. However, further research is needed to test its effectiveness and reliability to address the limitations presented in the previous section. The following Chapter will conclude this thesis by analysing the results of each Chapter as a whole and using them to suggest practical implications of the GIM.
Chapter Eight

Discussion of the Geographic Intelligence Model

8.1 Introduction

This chapter serves as the culmination of rigorous research and analytical endeavours. Here, I delve into the results from each preceding component of the Geographic Intelligence Model (GIM) on criminal groups. Throughout this research, I have endeavoured to explain the complex interaction between space, time, and criminal behaviour, shedding light on the underlying patterns shaping offenders’ decision-making processes. Employing robust methodologies and combining complementary data sets, four empirical analyses were developed to study cargo theft on Mexican highways. First, I demonstrated the spatial clustering and temporal patterns exhibited by cargo theft. Then, I proposed a crime script, unravelling the decision-making processes and sequential steps involved in the crime commission process. Finally, I presented a novel geographic profiling approach to identify spatial associations between the places where offenders tend to anchor their activities. Together, these empirical analyses offer a comprehensive and multifaceted perspective on cargo theft.

Besides the current introduction, Section 8.2 revisits the main findings of this research. Section 8.3 delves into the research gap this thesis addresses, elucidating its theoretical and practical implications. Section 8.4 discusses the data and methodological limitations. This thesis concludes by discussing how the GIM lays the groundwork for future crime prevention research and new opportunities for countering organised crime.
8.2 Revisiting the findings for each empirical study

This thesis commenced by stating that criminal groups have evolved to become more professional organisations. To analyse this professionalisation, I proposed the GIM, a theoretical and methodological framework to better understand their criminal activities using cargo theft on Mexican highways as an example. For each of the three components of the GIM shown in Figure 8.1, I presented a series of methods and techniques to analyse criminal group activities.

![Geographic Intelligence Model](image)

**Figure 8.1. Diagram of the process to generate geographic intelligence**

The following subsections summarise and expand on the implication of each GIM component’s main findings.

8.2.1. Identifying temporal and spatial concentration as part of the GIM

Chapters Four and Five reported on the results from empirical studies on the temporal and spatial distribution of cargo theft in Mexico. Regarding temporal concentration, it was identified that concentration in certain months, like October, November, and December,
is potentially influenced by high-consumption seasons such as Christmas (Andresen & Malleson, 2013; Burges, 2013; Özberk, 2010). Further analysis revealed specific days and hours with more thefts, like Tuesdays and Thursdays in the morning and Fridays overnight. This potentially indicates offenders’ consideration of guardian absence and vulnerability (Bernasco, 2010b; Ceccato & Uittenbogaard, 2014; Curtis-Ham et al., 2020).

The spatial analysis revealed a significant geographic concentration of cargo thefts. 93% of thefts were recorded to have been committed in only 25% of states and 82% in 4.2% of municipalities, suggesting that specific geographic, economic, and sociodemographic factors likely contribute to opportunities for cargo theft. Spatial analyses, including Moran’s I and Local Indicators of Spatial Association (LISA), confirmed spatial autocorrelation. There were identified six clusters of high theft activity, shedding light on spatial patterns and factors that can create opportunities for committing cargo theft (Ashby & Craglia, 2012; Justus et al., 2018; Kleemans et al., 2012).

The spatial analysis in Chapter Five showed that 25% of all cargo thefts occurred in just 0.006 to 0.037% of the highway segments. This finding revealed that the concentration of crime nationwide was much greater than the concentration of crime that Weisburd (2015) proposed in his law of crime concentration (stating that 25% of crime occurred within 0.4 and 1.6% of micro-places), when studying crime patterns at the city level.

A main limitation I faced through the research process was the data quality to elaborate the proposed statistical and spatial analyses. To improve the future assessment, measurement, and recording of cargo theft, it is crucial to address the issues about data capture by Mexican law enforcement agencies. One proposed solution is implementing a comprehensive and standardised reporting system specifically designed for cargo theft.
incidents. This system should include detailed data fields to capture essential information such as the date, time, location (including GPS coordinates), type of goods stolen, modus operandi, and any identifying characteristics of the perpetrators or vehicles involved.

Additionally, law enforcement agencies can leverage technology to enhance data collection processes. For instance, mobile applications could be developed to enable officers to quickly and accurately record cargo theft incidents directly from the field. These applications could include intuitive interfaces, dropdown menus for standardised data entry, and the ability to attach photos or documents as supporting evidence.

Furthermore, inter-agency collaboration and information-sharing mechanisms should be strengthened to facilitate the exchange of cargo theft data between different law enforcement agencies and relevant stakeholders. This could involve the establishment of a centralised database or platform where cargo theft data from various sources can be aggregated, analysed, and disseminated on time. Training programmes for law enforcement officers can also play a crucial role in improving data capture practices. Officers should receive training on the importance of accurate and detailed reporting and effectively using data collection tools and technologies.

In conclusion, although the data-related issues in Chapters Four and Five, the statistical and spatial analysis findings show that cargo theft was unevenly distributed and concentrated in time and at specific places. These findings emphasise the need to consider geographic conditions when addressing organised crimes like cargo theft and that offenders are likely to consider certain places as being more conducive than other areas to this type of crime.
8.2.2. Identifying criminal groups’ decision-making process

In Chapter Six, a Crime Script Analysis (CSA) examined whether the geographic conditions where offenders plan to commit cargo thefts affect their decision-making process. The CSA uncovered a detailed process of six acts, from planning to selling stolen goods. The results from the CSA indicated that offenders were likely to exhibit a deep understanding of the Mexican highway network and surrounding geography. Notably, despite proximity to industrial regions, most thefts occurred in uninhabited areas connected to secondary roads near small towns, possibly housing offender warehouses.

The crime script provided evidence of how geographic conditions significantly affect various stages of the theft process. Offenders were likely to implement location-based strategies, exploiting features like sinuous roads and poor telecommunication networks to ease interception of their targets. These conditions also impact escape routes and storage site selection, minimising effort and risk. Disposing and selling stolen merchandise to business partners similarly considered the environmental backdrop, with rendezvous points identified as likely to be located near the offenders' warehouses but away from police activities.

The script identified key actors and their roles, shedding light on how lead offenders recruit co-offenders with specific skills for different stages of the theft process. The results suggested that the awareness of the geographic conditions empowers the cargo thieves to exploit those conditions. Section 8.3 delves deeper into these findings and their implications for theory and practice.
8.2.3. Inferring criminal groups’ anchor locations as part of the GIM

Geographic Profiling Analysis (GPA) is a technique that primarily focuses on individual offenders rather than criminal groups (Rossmo, 2000). I proposed the Geographic Intelligence Coterminous Anchor Locations (CAL) method to expand the GPA to criminal groups. This novel approach examines how geographic conditions influence offenders' spatial and hunting behaviours within their CCP.

This four-step CAL process involves identifying offenders' likely travel distances from anchor points. As explained in Subsection 7.3.2.2, based on the studies of Tonkin et al. (2009), Wiles & Costello (2000), and Vandeviver et al. (2015), I proposed that cargo thieves were likely to travel 10 to 20 kilometres from their potential anchor points to the specific segment where they acted. Therefore, I suggested the use of circles with radii of 5 and 10 kilometres from the centroid of the segment under analysis.

The second step of the CAL method involved examining the facilitating locations. Similar to the concept of a crime place network (Clouse & Madensen, 2020; Eck et al., 2023; Hammer & Madensen, 2017)), these facilitating locations are pivotal in the offenders’ criminal activities. They served as convergence settings, meaning they were public places where potential offenders regularly convened, and becoming a potential anchor location.

The third component of the CAL method considered the role of secondary roads and their surrounding areas of influence. Studies suggest that major roads and highway segments connected to secondary roads are more susceptible to vehicle or cargo theft (Chainey & Guerrero Rojas, 2019; Lu, 2006; McCutcheon et al., 2016). Thus, these secondary roads may form part of the offender’s journey.
The fourth step of the CAL method identified the GIM clusters. These clusters were located within the areas identified as part of the cargo thieves’ potential journey to crime. They represent specific geographical areas where facilitating locations, secondary roads, and the surrounding areas of influence converge. Thus, these GIM clusters indicate where cargo thieves were likely to anchor their activities, such as their operational bases.

Based on Rossmo’s (2000) hunting and attack typologies, I suggested cargo thieves hunt as commuters and attack as stalkers. The CSA documented that group members travel to a facilitating location (such as a restaurant or a cafe) and then move to the highway. Once on the highway, cargo thieves identify their target. Then, they act as stalkers, following their target until the selected segment where they commit the cargo theft.

8.2.4. Synthesising the findings of the GIM

The GIM is a theoretical and methodological framework developed to understand criminal groups acting at specific locations. Considering the findings exposed in the previous subsections, the GIM’s main objective is to answer:

- Do the geographic conditions where organised criminal groups choose to commit their illegal activities influence their offence decision-making?

Criminal group operations are unlikely to be randomly distributed in geographic space. Instead, these groups commit crimes in specific places (Bernasco, 2010; Chainey et al., 2019; Curtis-Ham et al., 2020). For instance, the GIM findings for cargo theft on Mexican highways suggest that a few highway segments account for most reported cargo thefts. Furthermore, the identified six spatial clusters of cargo theft activity and the ten highway
segments in the central part of the country suggest that the offenders’ routine activities can explain this concentration, the target attractiveness, and environmental factors in the surrounding places where a cargo theft was committed.

Cargo thefts on Mexican highways tend to involve a six-part crime script involving planning, transportation to the highway, robbery, transportation of stolen merchandise, storage, and disposal. Moreover, offenders are likely to plan the robbery and transportation to the highway using their knowledge of the geographical conditions of the area and the type of merchandise being transported. The robbery occurs, with offenders (in most cases) forcing the driver to stop, sometimes blocking communication technology, and stealing the merchandise. The stolen goods are then transported to a storage location and stored in a warehouse before disposal.

The CAL method was tested in three segments with different characteristics. Despite their differences, they share certain conditions and facilitating locations likely linked to cargo theft commission. Examples include secondary roads connecting to highways or towns where offenders can anchor their activities and businesses near the segments that facilitate locations such as car repair centres, warehouses, or parking places. Applying GPA principles, it was possible to identify GIM clusters (Rossmo’s geographic profile), which include the areas where it is likely the OCGs’ anchor points are located.

Then, based on the Geographic Intelligence Model and the research findings, I suggest that geographic conditions influence the decision-making process of organised criminal groups across their illegal activities. The situational environment, social and economic factors, proximity to storage facilities and markets, and access to co-offenders are crucial in shaping offence decision-making of criminal groups.
8.3. Research gap and implications of the research findings

In an ever-changing landscape shaped by evolving criminal strategies, I introduced the GIM to address a critical research gap concerning the geographic distribution of activities by criminal group members and how they are interconnected. It highlights the inherent spatial and temporal aspects of organised crime groups’ activities and their influence on decision-making in committing crimes. By addressing this gap, the GIM contributes to the dynamic field of Crime Science.

This section outlines the theoretical and practical implications of the GIM findings and the main contributions to crime science from the current research. The implications discussed here provide a foundation for further scholarly investigation, encouraging researchers and practitioners to build upon these insights. Finally, this research strives to promote the development of a robust theoretical framework that can effectively address the complexities of analysing organised criminal groups’ geographical and procedural decision-making.

8.3.1. Implications for theory

The GIM’s main objective is to generate crime intelligence. As Section 2.5 discusses, the concept of intelligence in policing can be elusive. Nonetheless, it is noteworthy that most intelligence definitions converge in guiding efforts towards a better understanding of criminal behaviours and motivations, from which informed decisions can be made and activities prioritised to better investigate and prevent crime (Carter & Carter, 2009; Ratcliffe, 2016; Tilley, 2003). Therefore, the GIM’s results fit this approach and can be considered crime intelligence outputs that advance this field’s theoretical and practical
framework. In particular, crime intelligence outputs that lead to a better understanding of criminal activities and offender behaviours in a geographic context. The following subsections discuss their theoretical implications.

8.3.1.1. Offenders’ decision-making and crime ecosystem

In the Rational Choice Perspective (RCP) context, I aimed to elucidate the reasoning behind how potential offenders perceive the costs associated with organised crime, such as cargo theft. Insights gathered from the OSINT process suggested that cargo theft's physical and financial investments are comparatively lower than other criminal activities (Boone et al., 2016; Ekwall & Lantz, 2015a, 2015b). Even though potential offenders may possess awareness regarding the potential risks tied to criminal acts, they often internalise these risks as part of the criminal cost-benefit calculus (Bowers et al., 2004; Opp, 1997; Rossmo & Summers, 2022).

For instance, individuals involved in cargo theft may recognise the risks of using guns. Nevertheless, as discussed in Chapter Six, cargo thieves tend to consider these risks less significant than the dangers and costs involved in other forms of organised crime, such as drug trafficking or human trafficking. Moreover, several documents stated that the economic gains in cargo theft could be substantial, with a relatively low likelihood of apprehension in countries like Mexico or Brazil (BSI and TT Club, 2021; Justus et al., 2017; SENSITECH, 2020). Joining cargo theft groups may be perceived as a way to make significant financial returns at a minimal physical and monetary cost. Thus, from the offenders’ perspective, this may be considered a rational choice for their illegal actions.
Based on the Routine Activities Approach (RAA), Felson (2006a) proposed that the interaction between offenders, targets, places, handlers, guardians, managers, and super-controllers constitutes the “crime ecosystem”. In that sense, the GIM is a flexible framework that uses qualitative and quantitative methods to identify the interconnections of each component of Felson’s crime ecosystem. To better understand an OCGs crime commission process (CCP), using cargo theft as an example, I use the GIM outcomes to examine the interactions between the entities of OCGs crime ecosystem.

The GIM provided evidence that specific activities of OCGs can be dissected through the concepts of the RAA. Individuals involved in cargo theft (like many other offenders involved in organised crime activities) were likely to identify the routine (schedule) of their victims (cargo truck drivers). In doing this, offenders were likely to develop a more efficient cargo theft CCP that targeted specific places and times without guardianship. Then, identifying the interactions within the crime ecosystem for cargo theft helps to better understand the repetitive nature of these criminal operations. This result highlights the systematic and methodical approach these groups take to pursue their illicit objectives.

A relevant finding related to the crime ecosystem for cargo theft is the impact of the driver’s tiredness as part of the CCP. Driver fatigue is a factor that can facilitate cargo theft at specific times. Studies have shown that drivers are likely to experience diminished driving performance and vigilance during overnight shifts or overlong shifts (Buys, 2009; International Road Transport Union (IRU), 2005; TAPA, 2019). These situations make them more vulnerable to potential threats of cargo theft on the highway (Garde et al., 2020; Miller, 2010; Taylor et al., 2019). The offenders may know their potential victims’ routines, including driving at night or without proper rest, implying decreased alertness.
Moreover, offenders know the lack of guardianship (law enforcement or another informal guardian) at specific times. This combination potentially facilitates cargo theft.

Expanding on the interrelations of the crime ecosystem, the GIM aims to enhance our theoretical understanding of how darkness influences offenders’ decision-making. While prior research on cargo theft has acknowledged the relationship between darkness and this crime (Burges, 2013; Hayes, 2007; Mayhew, 2001), the GIM’s findings, in alignment with Tompson & Bowers (2013) and Reynald (2010) propose two key insights. Firstly, it suggests that darkness does significantly increase the potential for this type of crime. The concealment offered by the cover of night (lack of light) provides potential offenders with a cloak of anonymity, facilitating the approach and targeting of cargo trucks without attracting attention. Furthermore, reduced visibility can impede security measures, such as surveillance cameras and guards, making detecting and preventing theft attempts more challenging. Secondly, darkness can also make victims, in this case, cargo trucks and drivers, more vulnerable to crime. Limited visibility reduces their ability to perceive potential threats and reduces their response capacity, increasing their susceptibility to criminal acts. Thus, the role of darkness in amplifying both criminal opportunities and victim vulnerability is a pivotal element within the crime ecosystem.

Another relevant RAA concept in explaining the crime ecosystem emerges from the super-controllers’ role in understanding organised crimes (Townsley et al., 2016). Their actions can influence the offenders’ decision-making by regulation the places where they plan to act. I will examine the role of super-controllers in subsection 8.3.2.1.
8.3.1.2. Co-offending in the context of the GIM

In addition to better understanding the crime ecosystem of cargo theft (and potential extensions to other organised crimes), investigating the selection and role of co-offenders is a core objective of the GIM. In Chapter Two, co-offending was explained as being a critical aspect of organised crime activity (Ashby, 2016; Gilmour, 2014; Langlois et al., 2022). This includes the importance of examining the relationship between the criminal group and external actors (such as lookouts, bribed police officers, business partners, etc.). A relevant component of the GIM involves analysing the role of specific co-offenders as part of the CCP. In this sense, a key theoretical principle to consider is how the group’s recruiters (usually the leader) seek co-offenders with specific skills.

Research by authors such as Alarid et al. (2009), Bruinsma and Bernasco (2004), Hochstetler (2001), and Malm et al. (2011) have explored how criminal groups look for co-offenders with certain abilities required to commit their illegal activities. In that sense, the findings from Chapter Six further indicate that organised groups (such as cargo thieves) are likely to seek specific co-offenders with specific skills for each stage of the CCP\textsuperscript{136}. Furthermore, the GIM’s theoretical framework helps to better understand the selection of co-offenders and their role assignment. The presence of co-offenders in the presented crime script underscored the social nature of criminal activities and the collaborative nature of cargo theft as an organised crime. Offenders may rely on co-offenders to mitigate risks, enhance efficiency, and share knowledge and expertise (Alonso Berbotto & Chainey, 2021; Chiu et al., 2011; Hancock & Laycock, 2013b; Lord et

\textsuperscript{136} From knowing how to drive trucks, operate firearms, or certain types of technology (such as GPS jammers) to specialised truck mechanics or individuals with negotiation skills to sell stolen merchandise.
By working together, co-offenders can exploit the geographic conditions, leverage their collective skills, and increase the likelihood of a successful theft.

Furthermore, it is crucial to recognise that co-offending activities often exhibit a geographical dimension within the context of organised crime (such as cargo theft). This geographical element encompasses the spatial characteristics shared by routine group behaviours associated with these criminal activities. The geographical aspect of co-offending extends to the spatial patterns that emerge from the collective actions and movements of offenders engaged in routine criminal group activities. These findings from the current research provide a nuanced understanding of the spatial dynamics in co-offending and add valuable insight to our comprehension of cargo theft and other organised crime operations.

**8.3.1.3. Crime concentration at different geographic resolutions**

Turning to the theoretical implications regarding the geographic patterning of crime, the GIM introduces a novel perspective that allows for a more nuanced evaluation of crime concentration and the impact of the surrounding conditions on the CCP\(^\text{137}\). First, at the macro level measurement, I identified six clusters where more cargo thefts were reported. This initial result indicated the presence of certain conditions that can facilitate the cargo theft CCP. Then, the following step involved identifying the specific micro-places and their relations with the surrounding conditions on the identified clusters. These interactions can significantly advance our theoretical understanding of this form of organised crime.

\(^{137}\) This includes analysing the offenders’ awareness space, environmental backcloth, opportunities that make more feasible the CCP, among others.
To identify the micro-places with higher concentration, I replicated Weisburd’s law of crime concentration (2005) using highways to measure the concentration at the national level – including non-urban areas – representing a novel contribution to crime concentration literature. Table 5.10 showed that only 0.006 to 0.037% of the highway network accounted for 25% of all cargo theft incidents. These findings align with those from previous research (e.g., Weisburd 2015 and Wilcox & Eck 2011), which suggested that a few places are responsible for a significant proportion of crimes. Nonetheless, the implications of this study go beyond Weisburd’s original findings, indicating that when crime concentration is examined across an entire country, crime concentration can be even more pronounced than previously considered.

Identifying the six clusters and the specific segments with the most incidences offers a more complete picture of the cargo theft CCP. Moreover, delving into the differences identified at the national level versus the urban context analysed by Weisburd (2015), several factors can contribute to this pronounced concentration. For example:

- **Population density.** Different regions within a country vary in terms of population density. Offenders – like all people – prefer not to travel far when possible, and this explains why non-urban areas do not experience as much crime.

- **Economic activity.** Areas with higher levels of economic activity tend to offer more opportunities to commit crimes. Thus, when examining crime concentration at the national level, these regions contribute disproportionately to the overall concentration.

- **Transportation networks.** Offenders are likely to strategically target specific transportation routes or hubs for their illegal activities. The transportation network can include secondary roads in good condition that are likely to be used by the offenders.
to travel to and from the crime location. As this situation is not homogeneous at the country level, the patterning of crimes changes along the transportation networks.

- Policing and enforcement strategies: Law enforcement resources and strategies may vary nationwide. Some regions may have more robust policing strategies, leading to lower crime rates. Conversely, areas with limited resources or ineffective policing strategies may experience higher crime rates, contributing to the concentration of crimes at the national level. Sometimes, the officers do not adequately record the crimes, which masks the concentration. This is further discussed in section 8.4.

### 8.3.1.4. Micro-places conditions as facilitators of organised crime

The factors mentioned may explain the higher crime concentration at the national level. However, a more detailed analysis of the opportunity structures offered by these places is necessary, in line with research by Bernasco (2007), Kleemans & de Poot (2008), and Tremblay et al. (1994). Examining the environmental background and the opportunities, such as land use, demographics, or economic activity, provides a more precise analysis of the offenders' CCP. Furthermore, this analysis helps determine whether highway segments serve as crime attractors, crime generators, crime enablers, or crime radiators.

In Section 2.4.1.was described that crime attractors are places that generate specific opportunities and attract individuals willing to commit specific crimes. Crime generators are areas with a high flow of potential targets through and to nodal activity points. And, a crime enabler location possesses specific conditions that make them more conducive to criminal behaviour (Brantingham & Brantingham, 1995). Meanwhile, crime radiators are facilities that attract crime to both the inside and the outside of the facility (Bowers, 2014).
Chapters Six and Seven showed that a highway’s characteristics can change significantly within just a few kilometres, and those changes can either facilitate or inhibit this crime. For instance, results in 7.4.1 showed that specific conditions (including the economic activity, secondary roads, lack of light) around the three segments with the highest incidence can be related with the CCP. Considering these factors and as discussed in section 4.5 regarding the clusters with higher incidence, a theoretical implication is that specific highway segments can be considered crime enabler places.

However, not all highway segments fall into this category. Certain facilities near highway segments are likely to attract and concentrate criminal activity. These facilities, including cafes, warehouses, car repair centres, petrol stations, restaurants, and parking lots, are often appealing to cargo thieves due to their storage of valuable goods, lack of security, and location in high-crime areas. Hence, these facilities can be considered "crime radiators" that attract crime internally and contribute to crime in their immediate vicinity.

8.3.1.5. Facilitating locations and Geographic Profiling applied to criminal groups

The concept of crime place networks plays a crucial role in understanding the spatial dynamics of organised crimes. These networks encompass locations and sites that criminal groups or offenders utilise for various stages of their criminal activities (Clouse & Madensen, 2020; Eck et al., 2023; Hammer & Madensen, 2017). For instance, examining the convergence points of potential offenders at facilitating locations like cafes or restaurants to plan their cargo thefts, the role of secondary roads in facilitating getaways to warehouses or secluded areas, and the specific GIM clusters can be seen as integral components of these crime place networks. This provides valuable insights into how
these networks evolve and adapt, shedding light on the strategies employed by offenders in selecting, accessing, and departing from these locations.

Wilcox and Eck (2011: 475) proposed that “many facilities provide criminal opportunity, and it is the contextual clustering of public-use facilities, especially along or near major roads that are related to area’s crime”. Moreover, Rengert & Wasilchick (2000) mentioned that certain locations in the offenders’ routines hold significance in their “criminal activity space”. To contribute to the existing literature, in the CSA, I identified specific facilities that offenders regularly utilise as integral parts of their criminal activity space. To shed further light on their significance throughout the CCP, I introduced a novel term, “facilitating locations”. These venues can include cafes, restaurants, and car parts shops, which offenders often visit during the CCP of cargo theft. This innovative concept helps elucidate the multifaceted nature of these locations in the context of organised criminal operations.

These facilitating locations are presumed to be used for specific members within the CCP. For example, the CSA revealed that certain group members tend to have preliminary meetings in cafes or restaurants near the selected highways before they hunt for and attack their targets. Additionally, other group members are likely to use car repair centres as warehouses in the storage act. Although criminal group members perform numerous activities within the group, there is likely to be commonality in the geographic spaces frequented by these individuals. This commonality in using geographic spaces aligns with the spatial component of co-offending discussed in 8.3.1.2. Therefore, identifying these facilitating locations is valuable when analysing criminal group activity, as these locations are likely to serve as places for the co-offending activities of the group.
When analysing criminal groups, the facilitating locations play a relevant role in identifying their criminal activity space as a group. Individual members may reside in different homes, but the places where they gather can serve as locations where they anchor their activities. This is similar to the concept of convergence settings proposed by Felson (2003), which refers to places where offenders are likely to converge and can hire/contact suitable co-offenders (Andresen & Felson, 2010; Bichler et al., 2014; Kleemans et al., 2012). The facilitating locations and the offenders’ familiarity with the geographical conditions of the places where they plan to act may often be within the offenders' awareness space (Bernasco, 2010a; Chainey & Ratcliffe, 2005; Lammers, 2018). Furthermore, these conditions are likely to shape the offenders’ spatial behaviour (Canter & Larkin, 1993; Rossmo, 2000; Synnott et al., 2019; Tonkin et al., 2009). Then, the facilitating locations, acts, activities, and roles of the cargo theft CCP are crucial to understanding the offenders’ decision-making to commit crimes in a specific area.

8.3.1.6. Geographic Profiling applied to criminal groups

Potentially, the GIM’s most innovative theoretical implication was developing a method to infer specific areas where criminal groups are likely to anchor their activities. Using Geographic Profiling principles, I proposed the CAL method, which incorporates the information of specific members of the group and locations linked to their criminal activities—for instance, the facilitating locations. The CAL method aims to infer the anchor points of criminal groups. While GPA focuses on individual offenders, this method extends this framework to criminal groups. Table 8.1. shows how CAL adds to the current knowledge in GPA.
Table 8.1. CAL additions to the current knowledge in GPA

<table>
<thead>
<tr>
<th>Nature</th>
<th>Geographic Profiling Analysis (GPA)</th>
<th>CAL (Coterminous Anchor Locations) Method</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A well-established method in crime science</td>
<td>An innovative theoretical framework that is a practical branch of GPA and spatial behavioural analysis</td>
</tr>
<tr>
<td>Objective</td>
<td>Profiling individual offender behaviour</td>
<td>Comprehension of criminal groups' spatial and behavioural dynamics within specific micro-places</td>
</tr>
<tr>
<td>Applicability</td>
<td>Primarily applied to individual offenders</td>
<td>Expands the application of geographic profiling analysis to criminal groups, not just individual offenders</td>
</tr>
<tr>
<td>Focus</td>
<td>Emphasises understanding individual spatial behaviour</td>
<td>Focuses on examining how geographic contexts and facilitating locations shape criminal behaviours</td>
</tr>
<tr>
<td>Theoretical Insights</td>
<td>Understanding offender mobility patterns, target and hunting behaviour, anchor locations</td>
<td>Offers theoretical insights on opportunities, risks, and spatial distribution of potential targets and their impact on the CCP within specific locations to complement the existing knowledge in the field</td>
</tr>
<tr>
<td>Spatial Component</td>
<td>Geoprofile identifying delimited areas with a higher probability of containing offenders' anchor locations</td>
<td>Introduces the concept of “GIM clusters” to reveal anchor points based on offenders' routine activities, journey to crime, and facilitating locations</td>
</tr>
<tr>
<td>Co-offending Perspective</td>
<td>Not typically associated with co-offending spatial relationships</td>
<td>Considers the spatial aspects of co-offending and how geographical attributes of anchor locations influence organised criminal groups</td>
</tr>
<tr>
<td>Practical Use</td>
<td>Profiling for law enforcement and investigative purposes</td>
<td>Proposed as a crime intelligence output to interpret geographical and sociodemographic influences on offenders’ decision-making</td>
</tr>
</tbody>
</table>
After examining the GIM’s *crime intelligence outputs* from a theoretical standpoint and exploring how these findings contribute to the broader knowledge in their respective domain, the following section outlines their practical implications.

### 8.3.2. Implications for practice

In Section 2.5, I described the four modes of intelligence (criminal Intelligence, crime intelligence, community intelligence, and contextual intelligence) proposed by Innes et al. (2004, p. 44). This section discusses the GIM’s results as crime intelligence-oriented outputs for each mode. I begin by discussing the role of institutions in tackling organised crime. This is then followed by a discussion of the practical implications of each methodological component of the GIM. In the current research, the GIM has been applied to cargo theft. I then explain how the GIM can be used as a model for examining the criminal activities of OCGs more generally.

#### 8.3.2.1. Super-controllers and a Marked Reduction Approach to tackle organised crime activities

In the quest to mitigate organised crime activities, a critical aspect involves the identification of super-controllers. Introduced by Sampson et al. (2010), super-controllers are individuals or institutions in positions of power and authority to regulate the controllers’ actions to prevent crimes. Then, this concept in the context of cargo theft on Mexican highways can refer to government agencies and private organisations wielding significant regulatory and oversight powers within the transportation, logistics, and auto parts industries in Mexico.
Despite legislative efforts proposed by institutions like the Chamber of Deputies and the National Chamber of Cargo Transport (CANACAR) (CANACAR, 2021; Cámara de Diputados de México, 2021), cargo theft remains a significant challenge for Mexican businesses and law enforcement agencies (Analytica, 2017; Bleszynska, 2021; Observatorio Nacional Ciudadano, 2014). The OSINT analysis revealed that inadequate regulation enabled offenders to expand their activities by offering stolen merchandise and auto parts at lower prices (CANACAR, 2019; INEGI, 2021; Observatorio Nacional Ciudadano, 2014). This finding highlighted the limited effectiveness of preventive measures by the “super-controllers”.

To mitigate these types of organised criminal activities, super-controllers should promote collaboration between law enforcement agencies, the transport industry, and technology companies. This can include promoting and adopting innovative security technologies (such as GPS tracking, alarms, secure locks, and surveillance systems), data analytics and Geographic Information System (GIS) tools. Furthermore, implementing targeted patrolling and private surveillance during days and times when theft is most likely to occur improves the proactive aspect of security measures.

Moreover, the GIM aims to enhance our understanding of organised crime CCP by exploring the role of business partners. This aspect has received limited attention in existing literature on these crimes. The CSA findings indicated that offenders likely employ well-defined methods for sourcing and attacking targets and established networks of business partners for selling stolen goods in both legal and illegal markets. Given these findings, I propose considering a “Market Reduction Approach (MRA)” alongside the super-controllers concept when analysing this form of organised crime.
The MRA involves a comprehensive strategy to disrupt stolen goods markets by increasing the effort and costs of selling stolen items (Sutton, 2013, 1998; Sutton et al., 2001). The CSA highlighted that cargo theft often involves criminal groups profiting from the growing demand for specific merchandise and cargo truck parts in legal and illegal markets. This demand stems from the ease with which stolen goods, particularly highly desirable products (CRAVED), can be sold (Aransiola et al., 2023; De la Torre Romero et al., 2014; Ekwall & Lantz, 2017, 2019). Consequently, offenders can offer stolen merchandise to legitimate business owners within legal markets (Schneider, 2004; Stevenson, 2001; Sutton, 2005). These findings underscore the relevance of considering MRA as a potential countermeasure in combating this criminal activity.

Furthermore, a GIM’s potential practical implication for cargo theft (and thinking for most of the organised crimes) is that the role of the super-controllers is even more relevant when including the MRA approach. An effective way to tackle this kind of crime should include understanding the dynamics of the markets and what products are most demanded by society at specific times and places. Therefore, the super-controllers should design regulations and actions to increase the cost of selling stolen merchandise. Examples of this should include not only policing actions to prevent this crime but also increasing public awareness related to buying stolen merchandise.

8.3.2.2. The GIM as a method to complement intelligence-led policing

The GIM seeks to assess the importance of geographic locations in a criminal group's activities and identify specific geographic anchors linked to them. As a practical concept, the GIM intends to operate as a generalisable methodological framework to analyse
criminal groups’ activities. Thus, in the following three subsections, I describe the potential practical implications of using the GIM so that other researchers can replicate and expand it to analyse other organised crimes.

The GIM’s empirical analyses can be replicable following a Data-Information-Knowledge-Intelligence (DIKI) continuum (Ratcliffe, 2016) approach. To replicate the GIM, future researchers must begin with a robust data collection and analysis system (Data). This encompasses gathering data about criminal activities, locations, trends, and the socio-economic factors that drive OCGs. Subsequently, they must transform this data into structured and meaningful insights (Information) to provide law enforcement agencies, policymakers, and scholars with a clear understanding of the problem. Knowledge emerges as researchers derive actionable strategies from this information, tailoring law enforcement, community-based interventions, and policy reforms to tackle OCGs effectively. Intelligence is achieved when this knowledge is adapted and evolves their approaches to prevent OCGs continuously.

In terms of knowledge (the actionable strategies), the GIM can offer valuable insights and practical implications for Intelligence-Led Policing (ILP) (Carter & Carter, 2009; Ratcliffe, 2002, 2016; Tilley, 2003). Firstly, GIM uses detailed spatial and temporal techniques to identify specific micro-places and temporal bandwidths with higher crime concentration. By doing so, law enforcement agencies can better understand the criminal activity in those places and design targeted and data-driven strategies. For instance, they can schedule patrols, surveillance, and crime prevention initiatives during these identified high-risk periods and locations (Collazos et al., 2021; Ratcliffe et al., 2011; Sherman &
Weisburd, 1995). Moreover, GIM’s results can help strategically deploy resources, enhancing law enforcement operations’ efficiency and effectiveness.

Incorporating various spatial and temporal measures into the analysis is consistent with an intelligence-led approach to policing. Techniques, such as crime mapping and statistical analysis, can provide precise information about crime concentration and its associated factors within organised criminal groups (OCGs). Moreover, these analyses reveal the conditions conducive to criminal activities within micro-places. While this research may have encountered data limitations, the potential for mapping when and where crimes happen is substantial. With comprehensive data, researchers can determine whether micro-places with high crime incidence are isolated hotspots or part of larger high-crime areas. Additionally, insights into the temporal patterns of OCG activities, such as nighttime or daytime operations, can guide law enforcement’s response strategies. This knowledge can empower policymakers to design public policy to focus on micro-places and specific timeframes where OCG crimes are most concentrated.

The GIM’s analytical capabilities align with the objectives of ILP by providing actionable intelligence on where and when criminal activities are most prevalent. This intelligence enables researchers to develop proactive and targeted responses, enhancing public safety and the efficiency of policing efforts.

8.3.2.3. Crime Script Analysis to better understand organised crime

To generate intelligence related to the roles and specific activities in the locations where offenders are likely to act, the GIM involves using CSA to unpack the OCG’s CCP. Chapter Six offered a detailed process to create a CSA, which included “think thief” –
thinking as the offender may have done to make the decision points more explicit (Ekblom, 2001; Lasky et al., 2017; Wortley & Mazerolle, 2008). Here, I delve into the discussion of how a CSA helps identify stages where the CCP can be broken apart and, by doing so, what actions could be proposed to tackle criminal activities.

Following the example provided in Chapter Six, a CSA should include the geographical component to shed light on the decision-making processes of criminal groups. It reveals how geographic conditions influence their actions. For instance, if offenders' choices are influenced by certain geographic features or facilitating locations, measures can be taken to disrupt these patterns. Moreover, a CSA can provide valuable insights into the criminal groups’ modus operandi and escape routes. This information helps to identify each offender’s roles, patterns, and areas they are likely to operate. Law enforcement agencies can use it to target specific locations and conditions to disrupt and deter criminal activities.

Furthermore, a CSA can highlight co-offenders’ roles and how they contribute to the operation’s success, emphasising the collaborative nature of OCG’s crimes (Ekblom, 2011; Gant et al., 2009; McGloin, 2005). Understanding co-offending dynamics within an OCG is crucial for developing effective crime prevention strategies. Identifying the roles and relationships among co-offenders can help law enforcement agencies target key individuals or disrupt criminal networks (Calderoni, 2015; Duijn et al., 2014; Hancock & Laycock, 2013b). By focusing on the social dynamics and interactions among co-offenders, interventions can be designed to disrupt these collaborations, deter potential offenders, and disrupt the criminal opportunities associated with these criminal activities.

In addition to identifying stages, actions, roles, and co-offenders, the CSA offers another critical output to the GIM: locations where offenders converge. Following the concept of
place networks (Clouse & Madensen, 2020; Eck et al., 2023), the CSA identified that certain locations (such as bars, parking lots, and parks) are likely to be shared for certain group members and are part of the OCGs’ criminal activities in specific areas. Moreover, as previously discussed, these locations can be considered crime radiators (Bowers, 2014) and convergence settings (Bichler et al., 2014; Felson, 2003). Then, their identification helps generate tailored proposals to monitor them and tackle OCG’s activities nearby. For example, monitoring activities near car repair centres and auto parts shops can help to identify if offenders are using these venues as part of their CCP.

Incorporating CSA into the GIM offers a valuable toolkit for law enforcement, policymakers, and researchers to effectively understand, combat, and prevent organised crime. CSA helps design strategies that disrupt the activities of specific members at specific times and locations. For instance, this subsection proposed cutting potential relationships between offenders and business partners using an MRA approach. Furthermore, law enforcement agencies can design surveillance by targeting vehicles that follow cargo trucks at specific places and hours.

8.3.2.4. Generalising the CAL method

The GIM expanded the GPA principles to criminal groups to complete the intelligence outputs from identifying micro-places, times, and the OCG’s CCP. The Coterminous Anchor Locations method (CAL) is the most practical and innovative of the methods presented throughout this research. CAL offers a framework for understanding the OCGs’ spatial behaviour and inferring specific areas where their members are likely to anchor their activities.
A relevant output from the CAL is that its application does not rely on specialised software, only using instead the knowledge the researchers will have developed from studying a crime problem. CAL is a 4-step process. Step 1 involves identifying offenders’ potential journey to crime. Step 2 draws the role of facilitating locations. Step 3, the surrounding areas of influence (in this example involves the secondary roads). Step 4 involves inferring the GIM clusters, the geographical area likely to anchor offenders’ activities.

A deeper examination of the micro-places with the highest crime concentration and the GIM clusters can shed light on the underlying factors that make them attractive for OGC. Researchers can use the GIM’s spatial component to analyse if OGC members are likely to be aware of the geographical conditions in places where they plan to act. Moreover, using the CSA, they can unfold their activities and co-offending relations there. Finally, by using CAL, researchers can identify if offenders are likely to use particular search and attack methods that are chosen because of the geographic conditions present at these micro-places. This understanding can serve as a foundation to develop strategies that consider the likelihood that OCG offenders possess knowledge of specific locations’ surrounding conditions, exploit them, and anchor their activities there.

Another practical implication relies on identifying venues that offenders use as anchor points within the GIM clusters. Policymakers and city authorities can consider implementing environmental changes to disrupt criminal operations and dismantle criminal place networks in those places (Clouse & Madensen, 2020; Eck et al., 2023; Hammer & Madensen, 2017). These changes can focus on improving the surrounding conditions around those venues (such as lack of light, sidewalks in bad conditions, venues without adequate regulation regarding their activity, etc.). These measures can
improve society’s perception on public security, and potentially, they will be willing to cooperate if they identify people who are part of a criminal group (Linning et al., 2022; Newton et al., 2014; Oberwittler & Wikström, 2009). Ultimately, the implications of CAL extend to creating safer communities and reducing the impact of organised crime.

8.3.3. Contributions to the field

Countless research has focused on how criminal groups define their illegal activities considering the surrounding conditions of the places where they plan to act (Bruns, 2015; Klima, 2011; Sampson et al., 2010). However, there remains a research gap in understanding the distribution and geographic connection of the activities carried out by criminal group members. In this research, I aim to narrow this gap in understanding.

To add to the current knowledge of OCGs’ activities, such as cargo theft, I identified that these crimes are likely to occur at specific times and places. This indicates the existence of a geographic dimension that plays a crucial role in shaping these activities. Based on the findings of this research, it is plausible that specific strategic facilitating locations are part of the group’s activities, and the geographic characteristics of these locations influence the group’s modus operandi, as shown in the CSA presented in Chapter Six.

The main contribution of this thesis to the field of crime science is developing the CAL method to apply geographic profiling principles that are usually used to analyse solo offenders (Rossmo, 1995b, 1997, 2000) to criminal groups. Hitherto, no research on geographic profiling involves criminal groups. I aimed to cover this gap by developing a method to analyse specific group members’ spatial and hunting behaviour in a delimited area. Using principles of geographic profiling such as the journey to crime, crime patterns,
and routine activities approach, the CAL method infers delimited areas likely to be the criminal group’s operation bases. Then, I claim to contribute to the crime science field by expanding the application of geographic profiling to criminal groups.

Furthermore, several scholars and practitioners mention that crime intelligence can be “strategic” or “tactical” (Brown & Clarke, 2004; Flood & Gaspar, 2009; John & Maguire, 2012; NCIS, 2000). Strategic intelligence refers to intelligence that can be used in law enforcement agencies’ operational activities. The GIM’s crime intelligence outputs can be used to inform the design of these strategies. By understanding how geographic conditions influence the OGC’s decision-making process, another GIM implication is the possibility of enhancing crime prevention and policing strategies. Law enforcement agencies can tailor their efforts to target high-risk areas and identify the facilitating locations more effectively. This knowledge can guide the allocation of resources, such as increased surveillance or patrols, in areas with a higher likelihood of criminal activity.

The research conducted in this study addresses a significant research gap in the understanding of how geographical conditions impact the decision-making and spatial behaviour of organised criminal groups. Prior studies have primarily focused on individual-level analysis or general crime patterns, neglecting the specific geographical factors that influence the activities of members of criminal groups. By bridging this research gap, the current study provides valuable insights into the role of geographic conditions in shaping the group members’ decision-making, including selecting target areas, establishing anchor points, and the transportation routes used for illegal activities. The GIM contributes to a more comprehensive understanding of the complex dynamics between geography and organised crime, filling an important gap in the existing literature.
8.4. Limitations

Although GIM offers robust findings and an innovative methodology, it is essential to acknowledge the limitations of this research. This section addresses the main limitations that should be considered when interpreting and applying the findings in this research. These limitations include data constraints, the specific contextual setting of the research, methodological considerations, and the generalisability of the findings. I also identify areas for future research.

The impact of the GIM is subject to data availability and quality limitations, which need to be considered when interpreting its findings. Chapter Three described the use of two databases for the current research, each with its strengths and limitations. The dataset from the Executive Secretariat of the National System for Public Security (SESNSP) offers a comprehensive view of cargo theft. However, it has limitations due to its aggregation at state and municipality levels, restricting detailed analysis. Relying on administrative crime records introduces potential reporting biases that vary across regions. Similarly, the dataset from INAI has its constraints. Access to complete records within the "Informe Policial Homologado" (IPHs) is restricted due to sensitive information, reducing the sample size and completeness of cargo theft incidents. INAI data only covers incidents attended by National Guard officers, possibly excluding some events.

Accuracy issues in the geographic coordinates recorded by police officers can affect data reliability, impacting GIM’s spatial analyses. Addressing these data limitations is crucial for enhancing the GIM’s utility in preventing organised crime. For example, I georeferenced the 2,473 observations from the INAI’s database, reviewing them many
times to ensure their accuracy. Future researchers should improve data collection methods, address biases, and ensure data relevance.

Another data limitation is the significant variations in segment lengths of the National Highway Network (NHN) (extremely short segments) that might bias concentration estimates downwards (can either exaggerate or underestimate the actual concentration). Notably, it might lead to distortions in interpreting Weisburd’s LCC. To address this potential bias, I developed the Standardised Highway Network (SHN) to generate homogeneous 10km segments (when possible). Then, researchers should exercise caution when applying Weisburd's LCC to datasets with such segment length variations.

A potential limitation in the spatial analyses refers to the Modifiable Areal Unit Problem (MAUP) (Openshaw, 1984). The MAUP denotes the sensitivity of spatial analysis results to the size and shape of the geographic units used (Chainey et al., 2008; Ratcliffe, 2005; Rengert & Lockwood, 2009). The irregular shape and size of municipalities can make it challenging to measure the spatial concentration of crime accurately. Hence, larger shaped areal units might end up with higher concentration levels because there is simply more geographic space for crime to occur. Moreover, in the context of national or regional analysis, if the boundaries are not precisely defined, it becomes harder to accurately measure the concentration of cargo theft within specific areas.

Additionally, aggregate measures (such as municipality level) may oversimplify crime patterns and mask variations within the geographic units, potentially leading to biased outputs. This is known as the ecological fallacy, which scholars have cautioned against in interpreting crime concentration using areal units (Chainey & Ratcliffe, 2005; Hipp, 2007; Hipp & Kim, 2017; Steenbeek & Weisburd, 2016). As a result, the calculated
concentration measure may not accurately represent the proper distribution of crimes within the area in analysis.

The availability and quality of information to populate the CCP represents another GIM limitation. Gathering detailed and comprehensive information on OCG crimes should include specific actions and sequences involved in committing a crime. Ideally, the data sources for creating the crime script should include police reports or victim statements. The lack of this information may provide an incomplete picture of the entire CCP (Borrion, 2013; Ekblom & Gill, 2016; Tompson & Chainey, 2011). For instance, cargo theft is a crime that often goes undetected or unreported, especially if the theft is not discovered immediately or if it involves collusion between offenders and insiders (Ekwall et al., 2016a; SENSITECH, 2022a, 2022c; Urciuoli, 2010). This can result in underreporting or incomplete documentation of cargo theft incidents. As a result, the available information may not capture the full range of offenders’ strategies, techniques, and decision-making processes. The reliance on limited or incomplete information may constrain the CSA’s depth and accuracy.

As previously stated, the CAL method aims to be the most novel contribution to the research. However, it does have some limitations. First, GPA was developed to explain the spatial behaviour of individual serial offenders more than criminal groups. Second, CAL assumes that offenders and criminal group members consistently operate within their activity space and adhere to predictable routines. However, this may not always be the case, as criminal groups may exhibit flexibility in their movement patterns. Offenders are likely to adapt their spatial targeting choices and activities to avoid detection or exploit new opportunities (Bernasco, 2007, 2010b; Bernasco & Nieuwbeerta, 2005).
Furthermore, offenders can identify opportunities even when they have not been personally in those locations. For example, by doing research on the internet or referring to their networks, offenders are likely to expand their knowledge about specific locations with attractive targets and less risk than other places (Barcellos & Zaluar, 2014; Bouchard & Morselli, 2014; Mann & Sutton, 1998; Sierra-Arévalo & Papachristos, 2017). Therefore, relying solely on the routine base of a few group members may overlook important variations in their spatial behaviour and anchor locations.

Another limitation is regarding the facilitating locations. This term is subjective and context-dependent. The selection of economic units as facilitating locations assumes their consistent use by multiple offenders, but this assumption may not always hold. Offenders may adapt their strategies and utilise different locations based on situational factors and structural opportunities, making it challenging to accurately define and capture facilitating locations (Carter & Carter, 2009; Clouse & Madensen, 2020; Cornish & Clarke, 2017).

The concept of the journey to crime lacks specific research focusing on cargo thieves. Applying existing research to other types of offenders may not fully capture the unique travel patterns and distances travelled by cargo thieves (Bichler et al., 2011; O’Leary, 2011; Townsley & Sidebottom, 2010; Van Kopen & Jansen, 1998). The suggested use of circular buffers around highway segments to capture economic units as facilitating locations within specific distances is an approximation that may not fully reflect the actual movement patterns of cargo thieves. While CAL considers the effect of geographical conditions and sociodemographic variables in nearby areas where crimes were committed, it may not account for all contextual factors that could influence offenders’ behaviour and their journey to crime. While useful for understanding spatial and hunting
behaviour, examining the target backcloth may overlook other relevant factors such as social dynamics, situational cues, or temporal variations in offenders’ activities.

Despite the limitations outlined in this section, the CAL method and the GIM provide comprehensive theoretical and methodological frameworks for understanding criminal group activities. Overall, the GIM generates geographic intelligence rooted in a solid theoretical framework and data-driven analysis despite data accuracy, geocoding completeness, temporal framing, and modus operandi description issues. From these limitations, several potential areas for future research are possible that would enhance the GIM. These are discussed in the next section.

8.5. Possible new lines of research

The GIM aims to generate valuable contributions to the existing body of knowledge in crime science through its methodological and theoretical approaches. GIM’s methods aim to identify specific micro-places, understand the criminal groups’ CCP, infer their potential anchor locations, and explain those findings through its extensive theoretical component. However, the described limitations showed that various aspects of this research require further development and are potential topics for future research.

For the specific case of cargo theft, investigating the role of situational factors, such as transportation routes, warehouse locations, or supply chain characteristics, in shaping offenders’ decision-making can be an important avenue of further research. Researchers can uncover spatial and operational contexts that facilitate or deter cargo theft incidents by examining how these factors influence their strategies and activities. This research could contribute to evidence-based strategies for securing supply chains, optimising
transportation routes, and enhancing security measures at vulnerable points along the cargo theft commission process.

When expanding to other organised crimes, an initial new line of research can be conducting longitudinal studies that include data with specific time-oriented and georeferenced variables. This analysis can identify how specific months, days and hours impact offenders’ behaviour (changes in strategies, target selection, hunting, etc.). Longitudinal analysis can provide insights into the adaptability and resilience of criminal groups and the effectiveness of prevention strategies. This research should be complemented with spatial analysis that compares the evolution of spatial patterns and crime concentration across different regions, cities, or countries. Moreover, it can involve analysing geographic features, socio-economic conditions, law enforcement practices in the geographical areas with the most crime prevalence. This comparative spatiotemporal analysis could identify contextual factors contributing to the crime concentration (or displacement) to inform targeted interventions at different geographical scales.

Further research can include developing a gravity model as part of the GIM. This model can calculate the likelihood of cargo theft occurring between two locations. Moreover, it would be possible to identify certain characteristics such as the attractiveness of the cargo being transported, the presence of potential offenders in the area, and the ease of access to the highways. A gravity model can help identifying hotspots or clusters of cargo theft activity along specific highway routes, allowing law enforcement agencies to allocate resources more effectively and implement targeted interventions to deter criminal activity.

To generate intelligence-oriented outputs, the GIM can add Risk Assessment tools as part of its ILP approach. Specifically, to cargo theft, designing risk assessment tools that
evaluate the vulnerability of transportation routes, key actors involved in the CCP, or specific valuable targets (Buys, 2009; Klima et al., 2011; Palmer & Richardson, 2009; Zoutendijk, 2010). When expanding GIM to another type of organised crime, such tools can consider various risk factors and risky assessments. For example, GIM can analyse illegal gold mining in specific places. Then, as part of the risk assessment tools, there would include geographical characteristics of the routes where illegal miners move the extracted mineral, the risk that each potential business partner represents, and the logistics chains involved in this crime.

Building upon the principles of ILP, a promising avenue for new research could focus on developing and evaluating predictive policing models to combat organised crimes (Farrell & Pease, 2014; Mainas, 2012; Ratcliffe, 2016). More sophisticated mathematical models and algorithms should be developed tailored explicitly to organised crime. These models can incorporate travel distances, time of day, road network connectivity, and the interplay between offender behaviour and environmental factors. Moreover, integrating emerging technology—such as big data methods—can help improve organised crime analyses. For example, fine-grained information about previous criminal groups’ behaviour can offer insights into their decision-making processes. This research could even explore the integration of big data analytics and machine learning algorithms to identify travel patterns, detect anomalies, and predict potential crime hotspots.

Regarding the CSA, there are many opportunities to expand its application to better understand OGCs. An example is designing a more efficient method to triangulate information from multiple sources (Bowen, 2009b; Lasky et al., 2017; Skidmore, 2021). This method would focus on text-mining techniques to systematise information gathered
from law enforcement reports, industry databases, and interviews with key stakeholders. By doing so, the information can enhance the richness and accuracy of the CSA.

Another promising avenue of research could involve examining the interplay between crime scripts and situational crime prevention measures. By analysing how specific crime prevention strategies disrupt or modify the CCP, it could be possible to assess their effectiveness in reducing crime and identify potential areas for improvement (Alonso Berbotto & Chainey, 2021; Hopkins & Chivers, 2018; Leclerc, 2014). This research can contribute to evidence-based policy recommendations and the development of targeted interventions that align with the dynamics and characteristics of specific OGCs.

Furthermore, applying social network analysis techniques can help to understand the social structure and connections within criminal groups (Arias, 2006; Burcher & Whelan, 2018b; Kriegler, 2014; Tita & Radil, 2011). This future research can investigate how spatial proximity influences group members’ collaboration, recruitment, and communication patterns. Combining geographic profiling principles, criminal groups and social network analysis, this interdisciplinary approach can advance our understanding of how criminal groups operate in spatial contexts and their relationship with external and internal co-offenders (Khalid et al., 2018; Kriegler, 2014; Malm & Bichler, 2011). Moreover, this approach offers the potential to anticipate the movement and operations of criminal groups based on their network, geographical features, and socio-economic factors.

The GIM’s theoretical and practical framework opens the door to a future where state-of-the-art techniques ally to tackle organised crime. However, it is vital to approach these additions judiciously, acknowledging the ethical considerations (such as the potential bias
of using big data or algorithms that have shown bias targeting specific sociodemographic groups). Expanding the GIM can help to reshape the landscape of organised crime prevention, fortifying our efforts with modern technology and innovative thinking.

8.6. Conclusion

In this thesis, I introduced the "Geographic Intelligence Model (GIM)" on criminal groups. The GIM is a methodological and theoretical framework to better understand organised crime activities. Furthermore, the GIM involves qualitative and qualitative methods to produce crime intelligence products to enhance law enforcement's analytical capabilities in combatting those groups. This empirical approach encompasses three distinct studies:

1. Temporal and spatial analyses to identify specific places and times with the highest crime concentration.
2. Crime Script Analysis to unfold the crime commission process and identify group members’ roles.
3. The CAL method to extend geographic profiling to criminal groups and infer their geographical areas likely to be the criminal group’s operation bases.

The GIM provides a novel approach to examining the geographic distribution of criminal activities and the identification of geographic anchors associated with criminal groups’ activities. Through an analysis of cargo theft on highways in Mexico, I used the GIM to analyse the criminal group’s actions in its commission. By focusing on the geographic patterning of cargo theft, this study identifies specific anchor locations crucial to the functioning of criminal groups engaged in this activity.
The GIM on criminal groups offers valuable insights into the influence of geographic conditions on the criminal activities of organised groups. I proposed a comprehensively understood cargo theft pattern in Mexico through a sequential mixed-methods approach, combining quantitative data analysis and qualitative investigation. The model acknowledges the offender’s decision-making process. Moreover, the significance of the situational environment, social and economic factors, access to co-offenders, and proximity to storage facilities and markets in shaping the commission of cargo theft. By incorporating these elements, law enforcement agencies can enhance their prevention, detection, and intervention strategies, ultimately contributing to a more effective response to organised criminal activities.
### Chapter 9

#### Annexes

9.1. Cargo theft per Mexican state, January 2015 to December 2020

Table 9.1. Cargo theft per Mexican state, January 2015 to December 2020

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Source: Secretariado Ejecutivo del Sistema Nacional de Seguridad Publica (SESNSP)
9.2. Significance maps of LISA and $G_i^*$ statistic 20

Figure 9.1. Significance Level LISA – Queen contiguity – Cargo theft by Mexican municipality

Figure 9.2. Significance Level LISA – Rook contiguity – Cargo theft by Mexican municipality
Figure 9.3. Significance Level $G^*_i$ – Queen contiguity – Cargo theft by Mexican municipality

Figure 9.4. Significance Level $G^*_i$ – Rook contiguity – Cargo theft by Mexican municipality
9.3. Documents gathered to generate the Crime Script

Table 9.2. Coding references CSA

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<td>Facilitators (CF)</td>
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<td>Activity (SAc)</td>
<td>Enforcement (CE)</td>
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<td>A4 = Transportation after robbery</td>
<td>Post-activity (SPs)</td>
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<td></td>
</tr>
<tr>
<td>A5 = Storage</td>
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</tr>
<tr>
<td>A6 = Disposal</td>
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Table 9.3. Documents gathered

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<th>Coding</th>
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Interview logistic firm, cost of CT

Traffic impact

Violence against drivers / hijack

Sell of auto parts

rural / secondary roads

Warehouse

Warehouse

Vehicles used in the CCP

equipment & warehouse

Violence against drivers

Warehouse size

Cast offenders warehouse

Co-offenders role warehouse

equipment & warehouse

Cast offenders warehouse

Warehouse, M.O., co-offenders

rural / secondary roads

Potential buyers in legal markets

Warehouse and equipment

Sell of stolen merchandise in CDMX

co-offenders hired to load stolen merchandise

Law against cargo theft

Logistics firms protocols

Cargo truck recovered

Co-offenders acting on warehouse located on small town

Law against cargo theft
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<td><a href="https://www.reuters.com/investigates/special-report/mexico-violence-0/">https://www.reuters.com/investigates/special-report/mexico-violence-0/</a></td>
<td>DTOs and cargo theft in Mexico</td>
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<td>64</td>
<td>A3</td>
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<td>A3_C</td>
<td><a href="https://www.publicinteligence.net/FBI-CargoThievesGPS.pdf">https://www.publicinteligence.net/FBI-CargoThievesGPS.pdf</a></td>
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<td><a href="https://resources.coyote.com/source/cross-border-mexico-risks">https://resources.coyote.com/source/cross-border-mexico-risks</a></td>
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<td>70</td>
<td>A5 CF</td>
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<td>Equipment &amp; warehouse</td>
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<td>M.O. and Days</td>
<td><a href="https://transporte.mx/mercos-ro-los-dias-que-hay-mas-robos-de-unidades-de-transporte-de-carga/">https://transporte.mx/mercos-ro-los-dias-que-hay-mas-robos-de-unidades-de-transporte-de-carga/</a></td>
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<td>A1 CF</td>
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<td>Type of stolen merchandise</td>
<td><a href="https://www.safeinkmexico.com/camiones-de-robo-de-mercanc%C3%ADa-a-transportistas-en-mexico-durante-2021/">https://www.safeinkmexico.com/camiones-de-robo-de-mercancía-a-transportistas-en-mexico-durante-2021/</a></td>
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<td>81</td>
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<td>A1_SPPr</td>
<td>Bribed police officers</td>
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<td>82</td>
<td>A4 SPs</td>
<td>A4_SPs</td>
<td>Robbery of sedans</td>
<td><a href="https://www.youtube.com/watch?v=0uDr6tLzJ-u">https://www.youtube.com/watch?v=0uDr6tLzJ-u</a></td>
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<td>83</td>
<td>A3 SAc</td>
<td>A3_SAc</td>
<td>Violence against drivers / hijack</td>
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<td>M.O. detailed</td>
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<td>86</td>
<td>A2 CF</td>
<td>A2_CF</td>
<td>Interview legitimate driver</td>
<td><a href="https://www.lectoral.mx/videos/policia/nueva-modalidad-de-asalto-cobran-cables-en-carretera">https://www.lectoral.mx/videos/policia/nueva-modalidad-de-asalto-cobran-cables-en-carretera</a></td>
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<td>A2 SPs</td>
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<td>Vehicles used in the CCP</td>
<td><a href="https://taslajota.com/nacion/2023/3/5/nadie-habla-de-loque-antes-de-robear-trailer-de-carga-aumenta-36-en-mexico.19550.html">https://taslajota.com/nacion/2023/3/5/nadie-habla-de-loque-antes-de-robear-trailer-de-carga-aumenta-36-en-mexico.19550.html</a></td>
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<td>A1 SPp _GI</td>
<td>A1_SPp_GI</td>
<td>Geographic externalities across the country</td>
<td><a href="https://921.com.mx/terrestre/2021/05/10/que-son-las-y-nutimas-completa-robo-autotransporte">https://921.com.mx/terrestre/2021/05/10/que-son-las-y-nutimas-completa-robo-autotransporte</a></td>
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<td>DTOS and cargo theft in Mexico</td>
<td><a href="https://www.econoticias.com.mx/policia/disputas-entre-delincuentes-vuelven-altamente-politizadas-las-carreteras-de-Mexico-2019122-0503.html">https://www.econoticias.com.mx/policia/disputas-entre-delincuentes-vuelven-altamente-politizadas-las-carreteras-de-Mexico-2019122-0503.html</a></td>
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<td>95</td>
<td>A1 SPp G</td>
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<td>DTOS and cargo theft in Mexico</td>
<td><a href="https://transporte.mx/ma-son-los-peric/">https://transporte.mx/ma-son-los-peric/</a></td>
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<td>96</td>
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<td>DTOS and cargo theft in Mexico</td>
<td><a href="https://www.milenio.com/politica/comunidad/asi-roban-al-transporte-de-carga-en-carreteras-del-edomex">https://www.milenio.com/politica/comunidad/asi-roban-al-transporte-de-carga-en-carreteras-del-edomex</a></td>
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<td>97</td>
<td>A5</td>
<td>A5_</td>
<td>Violence against legal driver</td>
<td><a href="https://www.google.com/maps/dr/Park+Industrial+Ciudad_Tijuana+Park">https://www.google.com/maps/dr/Park+Industrial+Ciudad_Tijuana+Park</a>, +Pue.+&amp;hl=es&amp;gl=MX</td>
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sell merchandise

Police recovering cargo trucks

Protocol logistics

Violence against warehouse workers

Interview legitimate driver

Police recovering cargo trucks

Protocol logistics

Warehouses

Logistics firms protocols

Bribed police officers

Interview legitimate driver

Segments with high incidence

Risk assessment

Warehouses

Protocol logistics

Typical warehouses

Typical warehouses

Exported police officers

Looking for potential drivers

Violence against the driver
9.4. Crime Script of cargo theft on Mexican highways

<table>
<thead>
<tr>
<th>Crime Script of Highway Cargo Theft Robbery in Mexico</th>
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</thead>
<tbody>
<tr>
<td><strong>1. Planning</strong></td>
</tr>
<tr>
<td><strong>Preparation</strong></td>
</tr>
<tr>
<td>– Criminal groups involved in this crime are likely to identify segments of the highways and times of the week with less capable guardians and formal social control agents (such as police officers, private security guards, and no CCTV, among others).</td>
</tr>
<tr>
<td>– Offenders are likely to know how to board cargo trucks and use their technological resources (such as GPS blockers, communication devices, etc.) to be more efficient during cargo theft.</td>
</tr>
<tr>
<td>– Lead offender identifies suitable business partners in legal markets to sell them the stolen merchandise.</td>
</tr>
<tr>
<td>– Lead offender may contact other offenders in illegal markets to obtain guns.</td>
</tr>
<tr>
<td>– Offenders are likely to bribe or extort current or former employees of transport firms to get key information about the merchandise and routes of the cargo trucks.</td>
</tr>
<tr>
<td>– Lead offender looks to recruit maintenance highway workers to identify the patterns of patrolling on highways.</td>
</tr>
<tr>
<td>– Offenders seek cars (which, in some cases, could be stolen). They mainly prefer sedans (such as Volkswagen, Jetta or Nissan Versa) because they are the most common in Mexico and do not draw attention from police officers.</td>
</tr>
<tr>
<td>– Lead offender identifies individuals willing to participate in and benefit from cargo theft.</td>
</tr>
<tr>
<td>– Offenders purchase (or steal) technology such as GPS blockers (called “anti-jammers”) to block the tracking systems of the target cargo trucks. These blockers can be found in legal stores or on web pages.</td>
</tr>
<tr>
<td>– Offenders source a suitable warehouse facility to store the equipment they will use to commit the crime. This could be a negotiation or may involve forcing a business or person with these facilities to provide this storage (free of charge or as per some other agreement).</td>
</tr>
<tr>
<td>– Some bigger DTOs have expanded their illegal activities to other crimes. They are likely to make agreements with cargo theft offenders to target and rob specific cargo trucks. These cargo trucks sometimes carry products that DTOs use as drug precursors. Moreover, DTOs involve cargo theft offenders in money-laundering activities (such as selling cargo truck parts in illegal markets or in illegal auto parts shops).</td>
</tr>
<tr>
<td>– Agree with other OCG/DTOs to get guns.</td>
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</tbody>
</table>

| **Cast** |
| – Criminal Group |
| o Lead offender: coordinates all the activities related to the crime commission process. This person oversees the group, manages the money flow and has primary connections with other criminal organisations and buyers in legal markets. |
A small number of support offenders will take responsibility for the following tasks:
- Scope out highways to identify specific segments for targeting robberies; gather information about merchandise carried on trucks and routes taken by cargo trucks; seek vehicles and ensure they are well maintained for committing the cargo theft; seek devices to block the cargo trucks’ tracking system; makes the necessary arrangements to acquire suitable storage facilities.
- Highway maintenance workers: inform about the conditions of the highway and patrolling patterns on specific segments.
- Corrupt police officers: supply essential information about where and when the police will be patrolling.
- Buyers and business partners: pay for the illegal merchandise or agree to sell it on the illegal markets.
- Owner of the storage facility: provides suitable space to store the stolen merchandise. And the cargo truck if it is stolen.
- Seller of a GPS blocker device: legitimately offers the tool to block the tracking system of the cargo truck.

<table>
<thead>
<tr>
<th>Conditions and tools</th>
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<tbody>
<tr>
<td>The heterogeneous and complex geographical context gives an advantage to offenders to act without interference.</td>
</tr>
<tr>
<td>High levels of impunity in the justice system. If offenders are caught, the probability of prosecution is very low.</td>
</tr>
<tr>
<td>Employees of transportation firms have access to privileged information about the routes and type of merchandise that is transported in a specific cargo truck.</td>
</tr>
<tr>
<td>Lead offender has access to financial resources and guns.</td>
</tr>
<tr>
<td>Other members can recruit and intimidate potential co-offenders (lookouts, gun traffickers, etc.).</td>
</tr>
<tr>
<td>Some towns near the highways host car repair centres that can be used as warehouses.</td>
</tr>
<tr>
<td>Perception of low risk and high rewards; criminal group quickly moves the merchandise (and even the parts of the truck), and they do not need to invest significant amounts of money or put their lives at risk as they would in other crimes.</td>
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<table>
<thead>
<tr>
<th>Pre-activity</th>
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<tbody>
<tr>
<td>Buy guns and other weapons from other Organised Crime Groups (OCG).</td>
</tr>
<tr>
<td>Planning the theft of suitable vehicles (preferably sedan type) to use in the crime commission.</td>
</tr>
<tr>
<td>Identifying individual(s) who can drive cargo trucks (preferably, an individual familiar with the geographical characteristics of the area where they will act).</td>
</tr>
<tr>
<td>Bribing or extorting former or current employees of the transportation firms for:</td>
</tr>
<tr>
<td>- Gathering information about the schedule and the merchandise carried by the cargo trucks.</td>
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<tr>
<td>- Obtaining relevant information about the security system of the trucks.</td>
</tr>
<tr>
<td>Identifying times with fewer patrolling activities.</td>
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<tr>
<td>Identifying potential escape routes.</td>
</tr>
<tr>
<td>Buying or stealing GPS blocker devices.</td>
</tr>
</tbody>
</table>
- Buying or stealing walkie-talkies and/or burner phones for offender communication.
- Identifying potential co-offenders (bribing or extorting police officers or highway maintenance workers).
- Preparing the storage location (rent or buy a warehouse).

**Cast**

- Lead offender: decides who will be part of the group, buys the guns from other criminal organisations, and negotiates for the vehicles used in the robbery.
  - Support offenders: Identify possible routes to escape (minimising the risk of being captured); buy or steal devices required to block the tracking of cargo trucks; make the necessary arrangements to fit out the storage facilities.
- Current or former employees of transportation firms can be extorted or can be co-offenders to provide relevant information.
- Police officers can be extorted or can be co-offenders providing relevant information.
- Maintenance highway workers: could be hired or extorted to become a lookout.
- Seller of GPS blocker device: sell (or suffer a robbery of) the GPS blocker.
- Seller (or victim of theft) of walkie-talkies and burner phones: sell (or suffer a robbery of) the communication device.

**Conditions and tools**

- It is easy to buy guns and weapons on illegal markets (weak regulation and control).
- It is easy to acquire a suitable vehicle (whether it is purchased, a vehicle already in the possession of the OCG, sourced from other contacts, or stolen).
- High levels of impunity and corruption allow the criminal group to bribe or extort police officers, highway maintenance workers, and drivers or employees of transportation firms.
- Geographical conditions of where offenders plan to act determine how they act and the possible escape routes.
- Offenders can communicate with other co-offenders by walkie-talkies, burner phones or encrypted phones/apps.
- Lead offender has privileged information from the people (lookouts) monitoring the patrolling near the selected location.
- Lead offender is in contact with co-offenders of the storage facility.

**Activity**

- Based on their familiarity and knowledge of the area, determining the specific segment and time to commit the crime.
- Lookouts monitoring the area advising regarding the dynamic of the patrolling on the selected location.
- Recruiting and negotiating with co-offenders (lookouts, more support offenders). These kinds of criminal groups typically have few members. Cargo theft offenders are not likely to be looking to recruit permanent members. They are likely to recruit co-offenders for specific activities in the crime commission process.
- Extorting/bribing police officers to change their patrolling on the chosen highway segment.
- Obtaining/stealing a suitable vehicle for transporting all offenders.
- Extorting/bribing to obtain information on the merchandise transported through the selected highway segment.
- Planning the robbery (transport to the location, timing, routes to the storage place, bribes, alternative escape routes).
- Negotiating/extorting with the warehouse or household owner that will be used as a storage facility.
- Negotiating with buyers and business partners regarding the disposal of stolen merchandise or cargo truck parts.
- Buying guns and weapons from other OCGs.
- Lead offender, support offenders, drivers, lookouts, bribed/extorted police, maintenance workers, and employee(s) of the firms agree on the logistics (day, meeting point, activities, tools, etc.) of the crime.
- Buying and/or stealing equipment to block the tracking system of the cargo truck.

**Cast**

- Lead offender: determines specific segment and time to commit the robbery; extorts or bribes the police and other co-offenders; negotiates with buyers and business partners; finishes the deal for weapons.
  - Support offenders: collaborate on defining the specific segments for robberies; obtain the information about merchandise carried on trucks and at what time it will pass; define routes to escape (based on the geographical characteristics of the places near the highway and minimising the risk of being captured); buy or steal devices required to block the tracking of trucks; make the necessary arrangements to condition storage facilities.
- Lookouts: are notified about the day of the robbery.
- Former or current firm transportation employee(s): gives key information about the cargo truck’s merchandise and departure time.
- Police officers: are notified about the segments of the highway that they will avoid patrolling.
- Highway maintenance workers or other lookouts are notified about the day of the robbery.
- Storage facility owner finishes the deal to give access to the facility or permit the use of its land or warehouse.
- Buyers and business partners agree on the payment and when the stolen merchandise is ready for disposal.
- Members of other criminal groups: sell guns (also can protect the offenders if the robbery is related to drugs).

**Conditions and tools**

- Criminal groups can easily obtain guns and weapons, which increases the possibility of extorting or bribing other potential offenders.
- Lack of confidence in law enforcement agencies and the justice system increase the perception of a low risk of being captured. Some people could be attracted to be part of criminal groups or negotiate with them.
- Equipment required for the robbery is commonly available and easy to get (some of them do not need a licence or special permits to buy them)
  - Guns; gloves; walkie-talkies or burned or encrypted phones; GPS blocker; Bolt cutter.
- There is no reliable regulation of the legality of the origin of merchandise in legal markets.
- People are willing to pay low prices. To them, do not matter if those products are illegal or stolen.

### Post – Activity
- All the cast members agreed on the meeting point, day and time before the robbery.
- Necessary tools and information to commit the robbery are obtained.
- The vehicle is ready to depart. It is loaded with the required equipment.

### Cast
- **Lead offender:** coordinates everything and is ready to call the buyers to ensure the deal.
- **Support offenders:** load the tools on the vehicle.
- **Driver offender:** reviews the plan to escape and assures readiness.
- **Lookouts:** are waiting for the call of the leader to start monitoring.
- **Former or current firm transportation employee(s):** are sending key information to the offenders (about what truck and when it will pass for the selected segment).
- **Police officers:** send information to the lead offender about their dynamic of patrolling.
- **Maintenance highway workers:** are waiting for the call of the leader to start monitoring or give relevant information.
- **Buyer/business partners:** wait for the merchandise.

### Conditions and tools
- Offenders are aware of the geographical characteristics of the area where they plan to act.
- Offenders perceive the probability of being stopped and questioned by the police as very low because they use a standard car like any other highway user.
### Crime Script of Highway Cargo Theft Robbery in Mexico

#### 2. Transportation to the robbery location

**Preparation**

- Offenders define the facilitating location where the meeting before committing the theft will be. These locations tend to be close to the highway. Offenders regularly choose restaurants, parking spots or car repair centres as facilitating locations.
- Offenders define the location of the robbery and the escape routes.
- The lead offender can hire/extort co-offenders to monitor the police activities close to the meeting and the robbery location.
- Lead offender is concerned about potential confrontations with security forces (law enforcement agencies or private security guards) and hires a support offender skilled in using guns.
- Driver offender is aware of the geographical context of where they plan to act and designs the escape route based on these conditions. Offenders are likely to use rural roads or other less crowded roads to evade the police and to escape quickly to the warehouse.

**Cast**

- The lead offender calls the employee of the transportation firm to ensure the cargo truck is ready to go out. Also, they call the lookouts to inform them of any accident on the highway or patrolling activity.
- Support offenders: obtain guns to commit the robbery; design the escape route.
- Current employee of the transport firm shares information about the characteristics of the cargo truck and its schedule.
- Lookouts (highway maintenance workers or local co-offenders): inform of any patrol activity or incident on the highway.

**Conditions and tools**

- Geographical characteristics of the locations where offenders plan to commit the cargo theft help to determine the meeting point, escape routes and modus operandi.
- The risk of being stopped by the police while travelling from the meeting point to the robbery location is low. It does not matter if the vehicle being used is stolen.
- The use of high-power guns is common. Criminal groups have access to buy guns and hire trained offenders.

**Pre-activity**

- Arriving at the meeting point at the hour with all the necessary equipment to commit the robbery.
- Lead offender calls the lookouts to ensure everything is ready at the chosen location and to be aware of any patrol activity.
- Lead offender communicates with the bribed/extorted police officers to know their location in real-time.
- Support offenders (including the driver) check the guns and the GPS blocker.

**Cast**

- Lead offender ensures everything is ready to depart:
- calls the lookouts to get the last information on the patrolling in the zone.
- calls the employee to ensure the cargo truck is on its way.
- calls the bribed/extorted officers to inform them the attack is imminent.
  - Support offender 1 checks the guns and the GPS blocker is ready.
  - Support offender 2 calls the lookouts to ensure everything is ready.
- Lookouts (highway workers or local co-offenders) are alert to communicate any inconvenience on the highway.
- Police officers: receive the call from the lead offender and provide critical information about the patrolling.

### Conditions and tools

- Offenders meet in person at their meeting point, which is unknown to the security agencies.
- The area and the route to the robbery location are familiar to the offenders, especially the driver offender, who is typically familiar with the geographic context near these highway segments.
- Corrupt officers could protect the meeting point, or they do not know where it is.
- High levels of impunity allow offenders to bribe or extort employees of transportation firms and highway maintenance.
- Access to illegal markets allow offenders to get guns and stolen cars.

### Activity

- Offenders travel from their meeting point to the highway to encounter the target cargo truck.
- Lead offender communicates with the lookouts to ensure no patrol activity nearby.
- Support offenders oversee that no one is following them.
- Offenders stalk the targeted cargo truck until the specific segment, and once they are there, they commit the robbery.

### Cast

- Lead offender: drives and coordinates the stalking of the cargo truck.
- Support offender 1: watches to ensure no one is following them and is ready to drive the cargo truck once the other offenders attack it.
- Support offender 2: watches to ensure no one is following them and is ready to attack.
- Lookouts: bring critical information on the conditions of the highway and if some patrols are close.
- Driver of the cargo truck: drives the targeted cargo truck.
- Police officers: change their patrolling schema to avoid the zone.

### Conditions and tools

- The possibility of being intercepted by police officers is very low, even if they are driving a stolen car.
- Offenders use sedan cars because they are very common, and offenders look like any other highway user.
Most Law enforcement agencies do not have a well-designed strategy to prevent cargo theft. Moreover, most agencies do not have enough officers to guard the highway network efficiently. Cargo truck drivers have training on how to act in case of robberies. As part of their training, they are aware of certain types of non-normal situations. However, drivers cannot detect if offenders drive an ordinary sedan car.

**Post – Activity**

- Offenders stalk the cargo truck all the way.
- Driver offender verifies that no one is following them before beginning the robbery.
- Lead offender makes a last call to the lookouts to ensure no patrols are close to the location.
- Lead and support offenders are ready to use guns.

**Cast**

- Lead offender: calls the lookouts to ensure the police are not close.
- Support offender: is ready to use the guns if necessary.
- Driver offender: is ready to jump on the cargo truck and drive it.
- Lookouts: send information about the patrols and other significant conditions.
- Driver of the cargo truck: does not suspect the offenders are stalking them.

**Conditions and tools**

- On most occasions, there is a lack of patrols over the highway.
- Most transportation/logistics firms do not hire a “security car” to drive along the cargo truck. Then, they are not aware that the truck is being stalked.
- Offenders perceive they have identified the best location because they know the geographic context near that place, and they previously observed the patrolling in that area. Offenders are likely to act as commuters because they travel to the defined segment. They act as a stalker because once they identify their target, they follow until the point where they will commit the robbery.
### Crime Script of Highway Cargo Theft Robbery in Mexico

#### 3. Robbery

**Preparation**

- Lead offender previously identified the most common type of merchandise transported on the selected segments. Offenders are likely to know the different models of cargo trucks and the merchandise they are transporting.
- Review the “Preparation stage” in Act 1 for more details.

**Cast**

- **Lead offender:**
  - Aware of the merchandise the targeted truck is transporting.
  - Coordinates all the actions to stalk and attack the cargo truck.
  - Negotiates the absence of capable guardians (extorting or bribing potential guards such as officers or private security hired by the transportation/logistics firms).
- **Driver support offender** designs the escape route based on their knowledge of the area and the distance to the storage facility.
- **Support offender 2** prepares the guns and the GPS blocker before the robbery.
- **Police officers:** give information about their position, or they change their scheduled patrolling.
- **Lookouts** (highway workers or local co-offenders): provide information about the conditions of the highway and patrolling.
- **Current employees of transportation firms:** provide information about the targeted cargo truck, the type of merchandise it carries, and the departure time and route.

**Conditions and tools**

- Offenders are likely to act in two ways when committing the robbery:
  1. The offenders *only* stole the merchandise. In most cases, without harming the driver.
  2. The offenders stole the merchandise *and* the cargo truck. In this case, offenders tend to use violence against the driver. This could include using guns or hitting the driver, as documented in Section 6.4.
- Lead offender perceives that the risk of being caught at the place is minimal.
- The lead offender is aware that they can escape more quickly than the offender who will drive the cargo truck if they decide to steal it. If not, all the group members are aware of the easiness of escape.
- Offenders know there is a risk of being captured in the act, but they perceive this risk as low in comparison to the potential rewards of the activity.
- The offender who will drive the stolen cargo truck is aware of faster escape routes based on the geographical conditions and secondary roads where they plan to act.
- Offenders have a stolen car(s) and the equipment (tools and guns).

**Pre-activity**

- Offenders board a suitable vehicle. Typically, a sedan (such as Volkswagen or Nissan Versa).
- Most commonly, the lead offender is the driver.
- Support offenders can drive the stolen cargo truck or use the guns if necessary.
- Lead offender calls the lookouts, who are aware of the traffic and patrolling conditions on the selected highway segment.
- Offenders drive to the location of the robbery.
- Offenders began the process of forcing the stop of the cargo truck. In most cases, this could include:
  1. shooting at the truck to force the driver to stop.
  2. blocking the highway and stopping the cargo truck.

**Cast**

- The lead offender drives the sedan, stalking the cargo truck.
- Support offenders are ready to use the guns or push the driver off the cargo truck if necessary.
- Driver support offender is ready to drive the stolen cargo truck if the offenders are planning to steal it. If not, the offender helps in the CCP.
- The legitimate driver of the cargo truck is following their schedule.
- Lookouts inform the position of the police or any change of the conditions on the highway.

**Conditions and tools**

- Offenders are aware of the geographical characteristics of the selected segment.
- Offenders are aware that members of the Mexican National Guard are not close to disrupting the crime.
- Cargo trucks are likely to be intercepted near the offenders’ storage facility.
- Offenders are aware that once the GPS blocker interrupts the cargo truck system tracking, they will have time (up to 30 minutes) to complete the theft. Offenders assume that there is enough time to drive the cargo truck to their storage place.
- Lead offender communicates with the lookouts and with the support offenders through walkie-talkies or encrypted phones.

**Activity**

- Lookouts monitor the area to advise if patrols are coming to the location.
- The cargo truck driver is forced to stop the vehicle. The forced stop may involve blocking the route somehow and/or threatening or using force (using weapons) to force the driver to stop. Or the driver stops due to some pre-arrangement with the criminal group.
- Offenders get out of the car and jump in the cargo truck. They use their guns to intimidate the driver and sometimes beat him (it does not matter if he complains).
Driver offender takes control of the cargo truck.
Offenders, in less than 5 minutes, take control of the cargo truck and, depending on how they act, can either hijack the driver or leave him at the robbery location.
In some cases, offenders are likely to kidnap the driver to ask for a ransom (this has increased in the last two years).
Support offenders use the blocker device to block the GPS or destroy the tracking system of the truck.
Driver offender is the new driver, and the armed offender oversees the legitimate driver to avoid any communication with the police or with the transportation/logistic firm.

<table>
<thead>
<tr>
<th>Cast</th>
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<tbody>
<tr>
<td>Lead offender: forces the cargo truck driver to stop blocking their way (sometimes shooting their guns); intimidates the driver using a gun.</td>
</tr>
<tr>
<td>Support offenders help the lead offender to block the way; if necessary, they use the guns to shoot to force the driver to stop. Once the legitimate driver stops, they jump on the truck and sometimes beat the driver. Otherwise, they ensure the driver does not communicate with their employer.</td>
</tr>
<tr>
<td>Driver support offender, the new driver, jumps on the cargo truck to drive it, turns on the GPS blocker and begins driving.</td>
</tr>
<tr>
<td>Lookouts: monitor the area close to the activities.</td>
</tr>
<tr>
<td>The driver of the cargo truck: Once the offenders intercept them, stop the truck and give control to the support offenders.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Conditions and tools</th>
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</thead>
<tbody>
<tr>
<td>The offenders' equipment (Illegal guns and the GPS blocker) make them believe that their use or threat of use will assist them in committing the crime.</td>
</tr>
<tr>
<td>There is a lack of highway patrol presence at the location during the robbery activity.</td>
</tr>
<tr>
<td>Employees of the transportation firm, police officers and highway maintenance workers could be easily bribed or extorted by the offenders to participate as co-offenders.</td>
</tr>
<tr>
<td>Offenders know that if they are arrested, they are unlikely to go to jail because of the inefficient justice system.</td>
</tr>
<tr>
<td>Cargo trucks and the merchandise they carry, by law, must be insured. However, this situation can offer more opportunities to offenders because of the weakness of the rule of law in Mexico:</td>
</tr>
<tr>
<td>1) In some cases, transportation firms collude with criminal groups. After the merchandise is stolen, those firms receive the insurance. These firms can previously agree with the offenders to recover part of the merchandise and afterwards sell it in legal markets.</td>
</tr>
<tr>
<td>2) Insurance companies charge expensive fees to insure the merchandise. As a result, some logistic/transportation firms (especially those that are small or new) are not able to pay for it. As these firms still need to transport the merchandise, they are likely to pass through the identified hot spots (routes and highways with more crimes) even</td>
</tr>
</tbody>
</table>
when this is not the safest measure. As the offenders tend to know this, each truck that passes for the familiar segments can generate a new opportunity to commit a theft. Moreover, these small/new firms that can’t pay insurance tend to have old cargo truck models. Then, the offenders could have incentives to steal the truck and resell the parts to other small/new firms using this type of cargo truck.

<table>
<thead>
<tr>
<th>Post – Activity</th>
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</thead>
<tbody>
<tr>
<td>– Offenders inside the truck gather all the equipment used in the robbery (guns, GPS blocker, etc.), and destroy the cargo truck’s tracking system.</td>
</tr>
<tr>
<td>– The sedan driver offender follows and oversees the stolen cargo truck.</td>
</tr>
<tr>
<td>– Support offenders are constantly communicating with the leader (by walkie-talkies or burned phones).</td>
</tr>
<tr>
<td>– Lead offender communicates with the lookouts to know if patrols are coming.</td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>Cast</th>
</tr>
</thead>
<tbody>
<tr>
<td>– Lead offender: returns to sedan to drive and oversees the truck.</td>
</tr>
<tr>
<td>– Driver support offender begins to drive the truck.</td>
</tr>
<tr>
<td>– Support offenders oversee the legitimate driver; check the GPS blocker is working; verify no police are following them.</td>
</tr>
<tr>
<td>– The driver of the cargo truck waits to be released.</td>
</tr>
<tr>
<td>– Lookouts: monitor the activities of the police and the conditions of the highway.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Conditions and tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>– The logistic/transportation firm does not know this robbery is happening in real-time. Their surveillance systems are programmed to alert after approximately 30 minutes of an irregular stop or if the driver takes another route.</td>
</tr>
<tr>
<td>– The lack of police patrols along the route makes offenders think there is a low risk of being caught after the robbery has occurred and they are escaping the crime scene.</td>
</tr>
</tbody>
</table>
### Crime Script of Highway Cargo Theft Robbery in Mexico

#### 4. Transport after the robbery

<table>
<thead>
<tr>
<th>Preparation</th>
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</thead>
</table>
| - Offenders are likely to design an escape route based on the characteristics of the highway segment and nearby towns.  
- Driver offender is familiar with the robbery location and knows alternative routes to the storage place.  
- The lead offender knows there is an absence of police patrolling the route between the robbery and the storage facility.  
- Lead offender hires lookouts to provide information about patrol activities near the storage facility. |

<table>
<thead>
<tr>
<th>Cast</th>
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</table>
| - Criminal Group  
  - Lead offender hires lookouts to provide information about patrol activities. Additionally, they extort/bribe police officers to avoid the route between the robbery and storage locations.  
  - Support offender 1 (the driver) is familiar with the route between the robbery and storage locations. Moreover, they designed the escape route based on their knowledge of the geographical characteristics of these places.  
  - Support offender 2 helps the leader to hire people and organises the required equipment to commit the robbery.  
- Lookouts (highway maintenance workers or local co-offenders): provide information about patrol activities and any issues of note across the proposed escape route. |

<table>
<thead>
<tr>
<th>Conditions and tools</th>
</tr>
</thead>
</table>
| - Offenders take advantage of the geographical characteristics of the location to design escape routes and reduce the risk of being captured.  
- Transportation/logistics firms have protocols to act in case of a robbery. Generally, they ask for help from the police if 1) a cargo truck “disappears” off the GPS tracking system, 2) if the truck changes the designed route or 3) the firm cannot communicate with the driver.  
- Offenders are likely to know the protocols of the transportation/logistics firms. In most cases, they know they will have a few minutes to finish the robbery and destroy the GPS tracker system.  
- After the theft, it is likely that no one notices the robbery of the cargo truck. Passing by a cargo truck and sedan on the road is not an unusual sight for highway users (including the police). |

<table>
<thead>
<tr>
<th>Pre-activity</th>
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</thead>
</table>
| - Support and driver offenders oversee the stolen cargo truck.  
- Driver offender comes back to the sedan.  
- Lead offender calls the lookouts to get a report about the patrolling activity near the robbery and storage locations.  
- Lead offender connects to bribed/extorted police officers to know where they are patrolling. |
- Support offenders (including the driver), check if the GPS blocker is working.

**Cast**

- Lead offender: comes back to the sedan and begins to drive.
- Support offender 1: begins to drive the stolen cargo truck.
- Support offender 2: checks the GPS blocker is working. Oversees that the legitimate driver does not communicate with the police or their employer.
- Lookouts: monitor the area near the storage facility to inform if any patrol is coming.
- Legitimate driver of the cargo truck can do nothing more than wait to be released.

**Conditions and tools**

- The planned route is well-known to the driver offender.
- Lack of patrolling close to the location at that moment reduces the perception of risk among the offenders.
- High levels of corruption allow offenders to bribe or extort transportation firms and highway maintenance employees.
- Easy access to GPS blockers.
- Knowing the security protocols of the firms ensures the offenders have enough time to finish the robbery.

**Activity**

- The offender who is driving the sedan follows and guards the stolen cargo truck.
- Lead offender communicates with the support offender by walkie-talkies or burned phones.
- Driver offender drives the designed route to the storage facility.
- Armed offender monitors the GPS blocker to be sure it is always working. If something changes, he calls the lead offender.
- Armed offender oversees the legitimate driver of the cargo truck if they were hijacked or still with them.
- Lead offender communicates with the lookouts to ensure no patrolling activity.
- Supporter offenders verify that no one is following them.

**Cast**

- Lead offender: drives the sedan, follows and watches the cargo truck, calls the lookouts for a new report of the patrols.
- Support offender 1: drives the stolen cargo truck.
- Support offender 2: checks the GPS blocker is working; is aware that no one is following them and ensures the legitimate driver does not communicate with the police or their employer.
- Lookouts (highway workers or local co-offenders): monitor the zone.
- Driver of the cargo truck: if unharmed, is waiting to be released.
The possibility of being intercepted by police officers is very low. Police do not have checkpoints close to the location.

- The route to the storage facility is designed to include secondary or rural roads that the driver knows very well.
- A sedan following a cargo truck is regular on a highway (it does not represent anything unusual to the police or the public).
- Offenders communicate with the lookouts and the offender waiting at the storage facility.
- Offenders have around 30 minutes before the transportation firm might confirm the cargo truck has been stolen, and police officers deploy an operative to catch them.
- Offenders looking for the most significant reward have agreements with firm transportation employees to know the type of merchandise transported in the stolen cargo truck.

**Post – Activity**

- On their way to the storage place, if offenders kidnapped the legitimate driver, they make a quick stop to release the legitimate driver some kilometres after the robbery (but not close enough to the storage facility). This usually happens in a desolate spot; offenders do not spend more than five minutes doing this.
- Offenders verify that no one followed them.
- Lead offender calls to the lookouts to ensure no patrols close to the storage location.
- Offenders arrive at the storage location.

**Cast**

- Lead offender: drives close to the cargo truck and verifies no one is following them; calls the lookouts to receive news about their monitoring; calls the offender at the storage facility to verify that everything is ready; ensures the legitimate driver was released in a spot far from the storage facility.
- Support offender 1: drives the designed route, with one stop to release the legitimate driver.
- Support offender 2: releases the legitimate driver and checks that they can communicate with no one; verifies that the police are not following them and checks that the GPS blocker is still working.
- Support offender 3: waits at the storage facility.
- Lookouts: monitor the zone to inform if something unplanned happens.
- Driver of the cargo truck: after they are released, they try to report the robbery and get help.

**Conditions and tools**

- On the route, there are no police patrolling the area because the officers have been bribed or extorted. For the offenders, this represents a decrease in the risk of being captured.
- If the driver was kidnapped, the driver is kept avoiding informing to police about the precise location of the robbery and then they are released before arriving at the storage facility.
- Offenders obtain the storage facility through a previous agreement with the local co-offenders.
Crime Script of Highway Cargo Theft Robbery in Mexico

5. Storage

### Preparation

- Offenders identify a warehouse that could be used as a storage facility. It must be big enough to hide the cargo truck if the offenders decide to steal, too. Also, ideally, the warehouse must be close to the robbery location.
- There are support offenders in charge of the facility helping to store the stolen merchandise.
- Offenders have previously adapted the warehouse with all the equipment needed to dismantle the cargo truck.
- Lead offender hires a person with mechanical knowledge to dismantle the cargo truck.

### Cast

- **Lead offender:** recruits at least one person with mechanical knowledge to dismantle the truck; identifies a suitable place inside the storage location and fits it out to work on dismantling the cargo truck.
- **Support offender 1:** makes the necessary arrangements to transform the storage facility into a suitable warehouse and disposal centre. Adequate space needs to be made in the facility to dismantle cargo trucks if necessary.
- **Support offender 2:** helps to prepare the storage facility.
- **Support offender 3:** has mechanical skills and experience to dismantle cargo trucks into parts to be sold in illegal markets.
- **Owner of the warehouse:** could be extorted, bribed or is conscious of their role as co-offender but allows their facility to be used as a storage facility for the stolen merchandise and truck.

### Conditions and tools

- This kind of warehouse is usually located in the city's suburban or rural areas or small towns near the highways. Criminal Groups take advantage of the sociodemographic and geographical conditions around those warehouses and offer recompense to the owners and potential earnings to the locals.
- Offenders are mindful that these warehouses are in areas lacking patrolling activity.
- As the mechanical parts of the cargo trucks can be sold too, offenders have agreements with “auto-parts resellers” to maximise the rewards of the crime.
- Usually, the storage facilities are former car repair centres. Offenders fit them out to be used as a storage facility and to dismantle the cargo trucks. Usually, these car repair centres are near a highway. The car repair centre is big enough to hide cargo trucks. The public does not suspect their illegal activities because it is a regular business near the highway.
- High levels of corruption make it easy to bribe or extort authorities that monitor this type of car repair place.

### Pre-activity

- Lead offender calls the support offenders at the storage facility to prepare the equipment to remove the merchandise and dismantle the cargo truck.
- The stolen cargo truck and the vehicle used for the robbery arrive at the storage location.
- Support offenders verify that no one is following them.
- Lead offender calls the lookouts to ensure no patrol activity near the location.

**Cast**

- Lead offender: calls the offender at the warehouse to be ready; calls the lookouts to monitor any patrol activity; arrives at the storage facility.
- Support offender 1: verifies that no one is following them, gets out of the truck and is ready to get the merchandise off the cargo truck.
- Support offender 2: parks the truck and checks that the GPS blocker works.
- Support offender 3: has the tools ready to dispose of the merchandise.
- Support offender 4: is ready to dismantle the truck.
- Support offender 5: helps to store the merchandise (could be part of the group or a local co-offender).
- Lookouts: neighbours of the storage facility monitor and watch for signs of police.

**Conditions and tools**

- Lack of patrolling near the facility storage increases the opportunities to hide stolen merchandise and cargo trucks.
- People who live close to this warehouse and know about these illegal activities do not report them because they do not trust the justice system and security agencies.
- People living near the facility are likely to receive bribes or some stolen merchandise for work as lookouts.
- Offenders decrease the risk of being captured by communicating between them using walkie-talkies or encrypted phones.

**Activity**

- Meeting with the offender in charge of the storage facility.
- Support offenders break the locks of the cargo truck.
- Offenders offload the merchandise.
- Offenders dispose of the merchandise in the specific place prepared in the warehouse.
- Mechanical offender dismantles the truck and separates the parts that will be sold.
- It is verified that no police or the private security of the firm is following them or is close to the storage facility.
- The storage facility is secured.

**Cast**

- Lead offender: meets with the offender in charge of the storage facility; helps to offload the merchandise out of the cargo truck; calls the lookouts to check if the police are close.
- Support offender 1: breaks the lock of the truck and begins to offload the merchandise.
- Support offender 2: after parking the truck, helps to offload the merchandise.
- Support offender 3: Check if all the containers prepared in the facility have enough space to store the merchandise.
- Support offender 4: the mechanical offender ensures the GPS is destroyed and start to dismantle the cargo truck.
- Support offender 5: helps offload the merchandise from the cargo truck to the containers in the warehouse.
- Lookouts: monitor the zone near the warehouse.

<table>
<thead>
<tr>
<th>Conditions and tools</th>
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<tbody>
<tr>
<td>There is a lack of confidence in law enforcement agencies and the justice system. The offenders perceive a low risk of being captured. Some people living near the storage facility could be attracted to join criminal groups or they may be amenable to being lookouts.</td>
</tr>
<tr>
<td>Warehouse owner is aware of the use of the facility. However, this person is likely to decide to become a co-offender because they perceive the risk of being captured and prosecuted is very low.</td>
</tr>
<tr>
<td>After the owner transfers control of the warehouse the lead offender designates a support offender to manage and supervise the storage facility.</td>
</tr>
<tr>
<td>The location of the storage facility is unknown by law enforcement agencies. Usually, the warehouse is in an area lacking policing activities.</td>
</tr>
<tr>
<td>For offenders, getting the equipment required to dismantle the truck is easy. Most of those products do not need special permits to buy (the offenders could pretend to be car repair technicians). They are likely to make a low investment and perceive a big reward for committing the robbery.</td>
</tr>
<tr>
<td>People will likely prefer to pay low prices at illegal markets (such as illegal car parts centres). To them does not matter if those products are illegal or stolen. Criminal groups are likely to take advantage of this to offer stolen products.</td>
</tr>
<tr>
<td>If the stolen merchandise requires specific storage conditions, offenders can buy refrigerators, specific containers, chemical products, or any other material for appropriate storage.</td>
</tr>
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<thead>
<tr>
<th>Post – Activity</th>
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<tbody>
<tr>
<td>Offenders offload the stolen merchandise to the containers and storage-designed spaces.</td>
</tr>
<tr>
<td>After dismantling the truck, offenders move the truck parts to the containers adapted to this activity.</td>
</tr>
<tr>
<td>Lead offender calls the buyers and business partners to communicate that the merchandise is ready to be transferred.</td>
</tr>
<tr>
<td>Offenders negotiate (or extort) the price of the merchandise with the buyer and business partners.</td>
</tr>
<tr>
<td>The meeting place, day, and time to exchange the stolen merchandise with buyers and business partners are agreed upon.</td>
</tr>
<tr>
<td>The meeting place, day, and time to exchange the truck parts with buyers and business partners are agreed upon.</td>
</tr>
<tr>
<td>Lead offender, buyers, and business partners determine how the payment will be made.</td>
</tr>
</tbody>
</table>


− Lead offender negotiates with leads of other OCG to use the money in other activities. Most of these activities are catalogued as “money laundering”.
− Transportation firms notify the police that the cargo truck was stolen. Both began searching for it.

<table>
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<tr>
<th>Cast</th>
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<tbody>
<tr>
<td>− Lead offender calls the buyers and business partners to communicate the merchandise transfer and final price. The place and day to exchange the merchandise are determined, and how the payment will be made. This offender calls members of other OCGs to sell part of the merchandise or to be part of money laundering activities.</td>
</tr>
<tr>
<td>− Support offender 1: finishes transferring the merchandise in the available containers.</td>
</tr>
<tr>
<td>− Support offender 2: helps to dismantle the cargo truck and move it if necessary.</td>
</tr>
<tr>
<td>− Support offender 3: finishes dismantling the truck and disposes of the container parts.</td>
</tr>
<tr>
<td>− Buyers and business partners agree with the lead offender on the meeting place and how they will pay for the merchandise.</td>
</tr>
<tr>
<td>− Offenders from other OCGs: may agree with the lead offender to participate in the money laundering or to buy some stolen merchandise if it is relevant to their activities.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Conditions and tools</th>
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<tbody>
<tr>
<td>− Stolen merchandise is easy to move in illegal markets. As most products are considered CRAVED, there is a high demand for them. Cargo truck parts are sold on illegal markets below the market price.</td>
</tr>
<tr>
<td>− Most potential buyers are likely to be conscious of some products’ illegal origin but prefer to pay low prices.</td>
</tr>
<tr>
<td>− To increase the rewards, offenders may extort business partners on legal markets to buy stolen merchandise.</td>
</tr>
<tr>
<td>− Cargo theft offenders can be related to other bigger OCGs. They can agree to exchange part of the stolen merchandise for guns and property the OCGs possess. Moreover, cargo thieves can participate in money-laundering activities. In most cases, by selling the auto parts.</td>
</tr>
<tr>
<td>− Authorities in charge of monitoring the origin of the products sold in markets (or in the “auto parts shops”) can be easily bribed and do not call the police if they detect the illegal origin of the stolen products.</td>
</tr>
</tbody>
</table>
### Crime Script of Highway Cargo Theft Robbery in Mexico

#### 6. Disposal

**Preparation**
- Lead offender identifies potential buyer/business partners likely to buy the stolen merchandise (i.e., owners of commercial venues in populated neighbourhoods, retailers willing to sell it at markets, other OCGs, etc.)
- Lead offender identifies potential buyer/business partners likely to buy truck parts (i.e., small transportation firms, car parts shop owners, other OCGs, individuals willing to sell stolen parts, car repair centres, etc.)
- Offenders investigate the prices of legal products in markets. They negotiate prices below the legal market with their buyers and business partners.
- Lead offender negotiates or extorts authority regulators overseeing local markets to sell the stolen merchandise there.
- Offenders related to cargo theft agree with members of OCGs or Drug Trafficking Organisations (DTOs) to get guns.

**Cast**
- Lead offender identifies potential business partners to sell the merchandise/truck parts; bribes or extorts market regulators to sell the stolen merchandise there.
- Support offender 1 investigates the prices in legal markets to sell the stolen merchandise below those prices.
- Support offender 2 contacts members of other OCG/DTOs likely to exchange guns for part of the stolen merchandise. Also, for being involved in money laundering activities.
- Buyers and business partners: people willing to buy stolen merchandise.
- Market authorities monitor and regulate the legal sale of merchandise.
- Offenders from other OCG/DTOs: agree to exchange guns with stolen merchandise or another agreement.

**Conditions and tools**
- As part of the population is willing to pay less for stolen products, this represents an opportunity for the offenders to sell the merchandise to owners of local commercial venues.
- Stolen merchandise and truck parts do not have a traceable mark. This represents less risk for detection of the crime.
- The authorities poorly monitor the origin of the products sold at local markets.
- Auto-part shops are poorly monitored; there is little legislation to regulate their activities. This generates an opportunity for criminal groups to expand their illegal activities.
- Small transportation firms are willing to buy stolen parts at lower prices to cover their mechanical necessities.
- High levels of corruption facilitate the bribing or extorting of authorities that monitor the legal markets.
Cargo theft offenders could have agreements with DTOs. If so, the offenders can target specific products or merchandise that DTOs use as precursors to manufacture drugs. For example, in some areas of Mexico, cargo theft of pharmaceutical products is likely related to this situation.

### Pre-activity

- Lead offender calls buyers/business partners to close the deal (sell stolen merchandise and truck parts).
- Offenders and buyers agree on where and when to meet to exchange the products.
- Offenders load the containers on the vehicle designated for this activity.
- Lead offender calls the lookouts to ensure no police patrolling close to the agreed location or the storage facility.

### Cast

- Lead offender: calls the buyers and business partners to finish the selling and disposal of the stolen merchandise.
- Support offender 1: loads the merchandise on the vehicle.
- Support offender 2: helps to load the merchandise on the vehicle to dispose of it and closes the warehouse.
- Buyers and business partners: reach agreement with the lead offender on the disposal of the stolen merchandise, the price and how the payment will be made.
- Lookouts: monitor the locations to inform if police are close.

### Conditions and tools

- High demand for cheap products represents an opportunity to offer stolen merchandise.
- Offenders sell it at prices below the legal market price (their expected reward is higher than the initial investment).
- In addition to having sedan cars, offenders have suitable vehicles to dispose of stolen merchandise (such as Ford F-150 and Ranger, Dodge Ram series, Nissan pickups, etc.)
- Offenders communicate between them using walkie-talkies or burned encrypted phones.

### Activity

- Arrive at the meeting point with the buyers/business partner to exchange the merchandise or the cargo truck parts.
- Receive the payment (generally in cash because it is not traceable, and offenders can spend it quickly).
- If the merchandise is some drug precursor, other OCG/DTOs members can exchange it for guns or other drugs (cocaine, heroin or others for re-sell or personal use).
- Verify that the police are not looking for them or patrolling near the meeting point.

### Cast

- Lead offender: arrives at the meeting point with the agreed merchandise/truck parts; receives the payment from the buyer/business partners. If the merchandise were a specific shipment for members of other OCG/DTOs, they would receive the agreed-upon payment (guns, drugs, or money).
- Support offender 1: goes with the lead offender to support them.
- Support offender 2: stays at the warehouse managing and supervising it.
- Support offenders 3 and 4 stay at the warehouse preparing another package of stolen merchandise or truck parts for disposal to buyers and business partners.
- Buyers and business partners: pay for the stolen merchandise/truck parts.
- Offenders from other OCG/DTOs: pay for their specific cargo shipment (guns, drugs or money).
- Lookout 1: monitor that the police are not patrolling near the warehouse.
- Lookout 2: monitor that the police are not patrolling near the rendezvous point.

**Conditions and tools**
- There are enough buyers/business partners to pay for stolen merchandise because they know what types of products are more in demand in the market.
- Buyers and business partners benefit more from buying and reselling stolen merchandise. They pay lower prices to cargo theft offenders than buying the same merchandise from legal enterprises. These buyers also know the risk of being prosecuted for this illegal activity is low, and the earnings are high.
- Society does not widely disapprove of illegal commercial markets. In some parts of Mexico, people are likely to support illegal and not well-established commerce because of the lower prices.
- There is a lack of efficient public policies and control mechanisms to tackle the demand for stolen merchandise.

**Post – Activity**
- Return to the storage place used as a warehouse.
- Begin planning the next robbery. Offenders are likely to identify new highway segments to commit their crimes. Or decide to attack the same spots as they are familiar with these locations.
- Offenders divide the profits between them.
- Offenders keep some merchandise for personal use or to pay to other co-offenders.
- Look for more potential buyers and business partners.
- If offenders have agreements with other OCG/DTOs, they may get involved in money laundering crimes.
- Use the profits to bribe/extort more police officers, employees of transportation firms or maintenance highway workers.

**Cast**
- Lead offender: returns to the storage facility and pays the rest of the offenders; pays bribes to the police, highway workers and employees of the transportation firms; begins to look for new business partners; begins to plan the next robbery.
- Support offender 1: returns with the leader, receives the payment, and looks for new co-offenders.
- Support offender 2: oversees the storage facility, receives their payment, and monitors the warehouse.
− Support offender 3: tends to be the cargo truck dismantler expert. Receives their upon-agreed payment or auto parts.
− Support offenders 4, 5 and N: receive their payments and use the profits for personal pleasure.
− Buyers and business partners: sell the stolen merchandise.
− Offenders from other OCG/DTOs: exchange the guns and receive the drugs, stolen merchandise, or their payment.
− Lookouts: receive their payment.
− Police officers, employees of transportation firms and maintenance highway workers: receive their payment.

<table>
<thead>
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<th>Conditions and tools</th>
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<tr>
<td>− Mexico has weak legislation to combat cargo robbery. This generates a perception of low risk and high rewards.</td>
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<td>− Weak monitoring of the origin of products in local markets and car part shops</td>
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<td>− Lower prices increase the possibility of quickly selling stolen merchandise.</td>
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<td>− A lack of intelligence products to efficiently deploy the law enforcement agencies’ resources permits extended areas of highways to be without a capable guardian for long periods.</td>
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<tr>
<td>− The perception of an inefficient justice system permits offenders to consider the risk of being captured and prosecuted as low, increasing the participation of other actors as co-offenders.</td>
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<tr>
<td>− There is social acceptance of buying stolen merchandise, which decreases the effort of the offenders to look for markets, and it is easy to sell the stolen merchandise.</td>
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Dedicado a mi mamá, papá, tía, hermanos y Manu. Especialmente, esta tesis es para ti, Pau y para nuestros hijos.

It is what it is.