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Cargo theft at non-secure parking locations

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Abstract

Purpose – The purpose of this paper is to examine the patterns of reported cargo thefts at non-secure parking facilities in Europe, the Middle East, and Africa (EMEA) with respect to stolen value, frequency, incident category, and modi operandi.

Design/methodology/approach – This study is based on a system-theoretical approach that emphasizes on a holistic rather than an atomistic view. The research method used in this paper is deductive; the analysis is based on data obtained from the incident information service (IIS), a database of transport-related crimes from the Transported Asset Protection Association (TAPA) in the EMEA region. The results are analysed and discussed within a frame of reference based on supply chain risk management (SCRM) and criminology theories.

Findings – We found that 97 per cent of all attacks during a stop occur at non-secure parking locations. Cargo thefts at these locations are more of a volume crime than high-value thefts. Seasonal variations were seen in these thefts, and the most common type was an intrusion on weekdays during winter.

Research limitations/implications – This study is limited by the content of and the classifications within the TAPA EMEA IIS database.

Practical implications – This paper is directly relevant to the current EU discussions regarding the creation of a large number of secure parking facilities in the region.

Originality/value – This is one of the first papers in the field of SCRM that utilizes actual crime statistics reported by the industry to analyse the occurrence of cargo theft by focusing on the non-secure parking aspect in the transport chain.

Keywords Cargo theft, Transport chain, Cargo theft incident types, Non-secure parking, Road transport, Routine activity theory

Paper type Research paper

1. Introduction

Cargo theft is a significant problem globally. Most of the freight transport in the EU is by road. Therefore, road cargo theft can be considered as a threat to one of the EU's core principles, the free movement of goods (Europol, 2009). Annual cargo theft losses in the EU are estimated at EUR 8.2 billion or an average value of EUR 6.72 per trip (EP, 2007). Approximately 41 per cent of all incidents occurred while driving and approximately 60 per cent during a stop (EP, 2007). An International Road Transport Union (IRU, 2008) indicates that 42 per cent of the attacks occurred in truck parks and 19 per cent at motorway service stations. Thus, in at least 61 per cent

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of all cargo thefts, freights outside the terminal areas have been targeted. Further, research indicates that incidents occurring outside the facilities (non-secured parking, secured parking, and en route) account for 78 per cent of all incidents, but only 57 per cent of the loss value (Ekwall and Lantz, 2013). Forced stops and hijacks must also be included in this figure, although Ekwall and Lantz (2012) find that hijacks constitute < 2 per cent of all attacks. Thus, non-secure parking outside terminals has attracted considerable attention because they are primary locations for cargo thefts. To enhance security against cargo theft, the characteristics of these types of incidents must be examined in further detail.

Theft has and will probably always be a part of society, and for many businesses, theft is a part of doing business (Guthrie and Guthrie, 2006). The research on retail crimes has evolved through the years and both the focus and the theoretical background have changed. The focus for retail theft was linked to the perpetrators' relations with the affected organization (internal theft, external theft, or vendor fraud), the product's vulnerability to theft (CRAVED – concealable, removable, available, valuable, enjoyable and disposable), or the location of the theft (supply chain or geographical) (Beck *et al.*, 2003; Beck, 2004; Chapman and Templar, 2006; Bamfield, 2006; Ekwall and Lantz, 2013; Clarke, 1999; Bamfield, 2004; Oliphant and Oliphant, 2001). Theft of goods anywhere in the supply chain, particularly closer to the end consumer, will somehow lead to stock replacement costs, diversion of resources from business activities, and opportunity costs of missed sales (Alstete, 2006). Consequently, the occurrence of theft will affect consumer prices in the long run (Bailey, 2006).

The importance of this research as per Guthrie and Guthrie (2006) is as follows: "Understanding retail crime means understanding that the entire distribution system is involved and that reduction of retail crime levels is as much about establishing "best practice" in the distribution channel as it is about knowing why people steal". Thus, this paper focuses on a single aspect of physical distribution, the non-secure parking locations. We are aware of the limitation of focusing on non-secure parking problems. The reason for this focus is the current discussion with the EU about the creation of a large network of secure parking locations. Using statistical data based on theories from criminology, we indicate the types of theft problems that are most likely to be solved by this new network.

Cargo theft occurs most frequently in trucks parked temporarily at the roadside, often awaiting loading and unloading opportunities (EP, 2007; TruckPol, 2007; IRU, 2008). Temporary parking of this kind has risen in recent times for various reasons including a reduction in the time windows for loading and unloading on account of higher transportation frequencies and the application of lean and just-in-time logistics (Cusumano, 1994). The internal need for temporary storage is vital to the overall performance of the supply chain in terms of both cost efficiency and shorter lead times (Ekwall and Torstensson, 2011). Further, according to the theory of crime displacement, improved security measures at terminals imply that temporarily parked trucks are more frequently targeted by criminals (Ekwall, 2009b). Criminological research has examined the within-year variations or the seasonality of various crimes (Baumer and Wright, 1996). The general understanding is that violent crimes peak during summer and property crimes peak during winter (Falk, 1952). To provide a better understanding of cargo theft, this paper uses a combination of criminology theories (the scientific study of crime) and logistics theories as well as data on cargo theft drawn from the Transported Asset Protection Association (TAPA) Europe, the Middle East, and Africa (EMEA) incident information service (IIS) database.

We adopted an interdisciplinary approach to views, ideas, and theories, as is required when developing an applied science (Klaus *et al.*, 1993; Stock, 1997).

Research purpose

The purpose of this study is to explore the patterns of reported cargo thefts at non-secure parking facilities in the EMEA region with respect to stolen value, frequency, incident category, and modi operandi. The study results have implications for both researchers and practitioners.

2. Frame of reference

According to Colicchia and Strozzi (2012), research on supply chain risk management (SCRM) has been receiving increasing interest from both practitioners and scholars. In their proposal for a comprehensive risk management and mitigation model for global supply chains, Manuj and Mentzer (2008) argue that the risk of any particular type of loss should be conceptualized as the probability of the loss multiplied by its impact. Similar definitions of risk can be found in most of the contemporary research on SCRM (Khan and Burnes, 2007; Norrman and Jansson, 2004; Tummala and Schoenherr, 2011; Wagner and Bode, 2008). Thus, from this perspective, risk should be considered as a combination of the probability or frequency of the occurrence of a certain hazard and the value or impact of its occurrence.

Road transport and cargo theft

Logistical complexity can be illustrated by the following four generic flows involved in logistics activities: material, resources, information, and capital. These flows require geographically fixed constructions and infrastructure to fulfil their logistical scope. The cargo thief aims to remove the goods from the goods flow by attacking the movement of resources and/or the infrastructure used for transporting the goods. A potential perpetrator can also use the information flow to plan the theft of goods better or commit a fraud that targets the flow of capital (Ekwall, 2009a).

Elements of crime and routine activity theory (RAT)

Criminology distinguishes among the following three elements of various crimes ranging from occasional violence to more advanced and complex economic crimes (Sarnecki, 2003; Sherman *et al.*, 1989; Sampson *et al.*, 2010):

(1) motivated perpetrator;

(2) target (goods and equipment); and

(3) location (the place where the perpetrator and the target meet) and the lack of a capable guardian.

Motivated perpetrator. The perpetrator is an individual who, based on the outcome of a decision process, commits a certain action or prepares for a certain action that is prohibited by international, national, or local laws. The perpetrator's behaviour can be modelled as rational at the margin or exhibiting limited rational choice (by circumstance, choice, or a combination of both).

Target. The desirable outcomes or targets of the motivated perpetrator differ greatly depending on the individual's decision process. The target is normally the primary or direct reason for the action; however, it may also be the secondary or indirect reason.

Generally, the primary targets of property crimes are likely to be shipped products, used resources, or infrastructure.

Location. The characteristics of the location or place where the motivated perpetrator and the target meet include the different security measures or crime prevention features directly linked to the location. If the motivated perpetrator considers the security measures to be insufficient, then there is no deterrent for committing the crime. Generally, security characteristics can be directly linked to the crime prevention features for a specific location or area, thus illustrating the relationship between location and security. A good example of this is the provision of closed-circuit television (CCTV) surveillance of areas that may lead to relocation of the crime instead of its prevention (Weisburd *et al.*, 2006). Our data set contains no information regarding the security (capable guardian) features of any given location other than the difference between unsecured and secured parking; therefore, we assume that this difference exists among security levels.

Crime theory posits that a crime occurs only when all the three elements come together at the same time and place; thus, if any of these elements is missing, the crime is impossible (Cohen and Felson, 1979). Any combination of location and target is usually referred to as "criminal opportunity". According to Cornish and Clarke (2003), both a motivated perpetrator and a criminal opportunity are essential for the occurrence of a crime. As per the RAT in criminology (Cohen and Felson, 1979), criminal opportunities depend on routines or the predictability within certain boundaries, thus, implying that system predictability or routine provides criminal opportunity. The RAT provides a strong theoretical foundation for understanding crime and criminal opportunity. It holds that normal movement patterns and other related theories play a significant role in potential crime (Mustaine and Tewksbury, 1998; Sherman *et al.*, 1989). It also states that potential perpetrators may seek locations where their victims or targets are numerous, available, convenient, and/or vulnerable (Cohen and Felson, 1979). To explain the practical relevance of the RAT, Felson (1987) uses the example of "how lions look for deer near their watering hole". According to Hawley (1950), the RAT can be described as the rhythm (the regular periodicity with which an event occurs) between a victim and an offender; in our study, we examine the rhythm between the transport network and the movements of potential perpetrators.

The RAT states that predictability in infrastructure and resource movement contributes significantly to criminal opportunity. While the flow of material varies widely, it depends on the actors within the supply chain. Regarding antagonistic threats against transport networks, the RAT states that the theft opportunity changes with the change in the transport network. Thus, the weekly rhythm of the transport network can influence crime opportunities and alter the seasonality of cargo theft. The same reasoning applies to the daily rhythm; however, the database used in this paper does not provide reliable data for drawing conclusions regarding the daily seasonality of cargo theft.

Seasonality in crimes

Criminology research posits that crime is a somewhat seasonal phenomenon. Cohen (1941) argues that there are two types of seasonality at the local level:

(1) crimes of property (burglaries, robberies, and thefts); and

(2) crimes of aggression (assaults, homicides, and rapes).

Property crimes are high during the fall and winter, whereas crimes of aggression peak in midsummer and are lowest in January. Two general theories on seasonality have emerged from previous research – the temperature aggression hypothesis and the needs-based view of property crime (Falk, 1952). The needs-based view of property crime suggests that seasonal unemployment and living expenses influence the level of criminal activity at different times of the year (Gorr *et al.*, 2003), thus suggesting that non-violent crimes are more frequent during the fall and winter, and violent crimes (hijacking and robbery) are more common during summer.

The temperature aggression hypothesis (i.e. causality between hot temperatures and an increase in aggression and violence crimes) has been supported by laboratory experiments, field experiments, correlational studies, and archival studies of violent crimes (Anderson *et al.*, 2000). In terms of seasonality, studies which compare the violence rates of regions have all supported the conclusion that hot years, hot seasons, hot months, and hot days all contribute to the use of violence in crimes (Anderson *et al.*, 1997). Even the global warming can lead to an increase in the violence used in crimes, according to Anderson *et al.* (1997). Non-violent crimes, on the other hand, seem unaffected by hot temperatures. (Anderson *et al.*, 2000). For cargo theft at non-secure locations does the temperature aggression hypothesis mean that there will be a seasonality variation (increase during summer) for violent modus operandi (hijack, violent, robbery), while the needs-based view of property crime, means that there will be a seasonality variation (increase during fall/winter) for non-violent modus operandi.

"Opportunity" theories of crime such as the RAT, crime patterns, and rational choice (Felson and Clarke, 1998) may offer different views on the seasonality of crime. According to the RAT (Cohen and Felson, 1979), criminal opportunities are concentrated at times and in places relevant to the three elements of crime, thus suggesting that changes in any one of these three elements will influence seasonality differently. According to Hylleberg (1995), the exogenous causes of crime, namely calendar events, weather, and time of year, are important for understanding seasonality, as they can lead to an increase or decrease in criminal behaviour depending on the local contextual circumstances. The time of year (e.g. during the Christmas shopping season) can influence criminal opportunities in various ways (Gorr *et al.*, 2003). The seasonality of crimes may be influenced by time of year depending upon the number of targets available and the potential customers for stolen goods. For similar reasons, seasonality can also be linked to calendar events such as the day of the week. However, in this case, seasonality largely depends upon the number of available targets. The seasonality of crimes aids crime forecasting (Gorr *et al.*, 2003) and the relocation of security measures as a proactive response to an expected increase in crime.

This research combines the two general theories on seasonality together with the RAT consequence of seasonality in criminal opportunities as well as with the seasonality in the transport network in order to reach four testable hypotheses.

Hypotheses

Based on the above literature review, our overall supposition is that there are seasonality patterns in cargo theft at non-secure parking locations. This supposition can be broken down into four testable hypotheses:

H1. Incident values in cargo theft at non-secure parking locations differ across months.

H2. Incident frequencies in cargo theft at non-secure parking locations differ across months.

H3. Incident values in cargo theft at non-secure parking locations differ across days of the week.

H4. Incident frequencies in cargo theft at non-secure parking locations differ across days of the week.

Incident categories for cargo theft

This study's frame of reference uses the RAT to explain the interaction among the supply chain (goods owner), transport network (goods mover), and motivated perpetrators; herein, the incident category is determined by the unique combination of the transport chain, location, and lack of security.

3. Method

The TAPA EMEA IIS database

The TAPA EMEA IIS database analysed in this paper comprises approximately 20,000 individual reported incidents of road transport crimes committed between 2000 and 2011 within the EMEA area. The crime statistics in TAPA EMEA IIS database are prepared by TAPA members and various law enforcement agencies (LEAs) in the EU. The identities of the companies involved both directly and indirectly have not been disclosed in the reports in order to avoid negative publicity and ensure better data reliability. Further, the reporting entity determines the extent of disclosure of the incident details, thus suggesting that the quality of data varies across incidents and countries. Nevertheless, due to this strategy, the TAPA EMEA IIS database is considered to be the most accurate database in the EU for incidents of crimes (Europol, 2009). This reporting procedure ensures that the database presents a true picture of cargo theft incidents in terms of both absolute numbers and trends. The data is limited to the EMEA region as a result of the global TAPA structure because there are three TAPA regions (Americas, EMEA, and Asia-Pacific), where each region has its own IIS database. Within the EMEA region, the vast majority of the data is for countries in Northern and Western Europe. Consequently, the data cover the same seasonality (time of year), that is, the seasons of the northern hemisphere.

Reports for the database are generally created using the online reporting interface at www.tapaemea.com. The report includes a number of mandatory facts such as reporting person (names with contact details), incident date, and description. Furthermore, there are a number of fixed descriptions about the incident mentioned in the following categories – incident type, modus operandi, type of location, country of occurrence, and product and loss value in Euros. It is also possible to add more data to the report. This paper utilizes the data in the fixed description fields for the non-secure parking location

Research method

Risk is a concept related to the future. Past events, by definition, are not risky because there is no uncertainty regarding what has already happened. However, historical data on certain events can often be used to analyse future risks related to those events. Therefore, in this paper, we use historical incident frequencies to estimate the probability of future incidents, and historical incident values to estimate the impact of future incidents. We have only used secondary data in this paper. This paper follows

the reasoning by Rabinovich and Cheon (2011) who argue that the importance of secondary data analysis has been overlooked in logistics research and that it should be used to address the contemporary challenges in logistics and supply chain research.

The use of secondary data in this paper provides both high internal validity and a good opportunity to replicate this study (Rabinovich and Cheon, 2011). This paper follows the tradition of logistics research by using a systemic approach to understand the problem from a holistic perspective while focusing on the interactions among components rather than on the causes (Aastrup and Halldórsson, 2008). We describe and analyse the values and frequencies of incidents using relevant statistics; the analyses are based on the logarithm of the incident value after standardizing for the length of the month. Moreover, for comparing the mean values, we use a one-way ANOVA when the Levene's test does not reveal significant heteroscedasticity and the Brown-Forsythe test when it does. If the ANOVA or Brown-Forsythe test is rejected, a *post hoc* analysis is conducted using pairwise *t*-tests with the Bonferroni correction or Tamhane's T2. The frequencies among the various groups are compared using the χ^2 test; if it is rejected, a *post hoc* analysis is conducted using pairwise χ^2 tests with the Bonferroni correction.

When the data are closer to a census than to a random sample, the results of regular significance tests are less valuable because the observed parameters coincide with the actual population parameters in a true census. Because our data are drawn from a census of incidents reported between 2000 and 2011, our descriptive statistics can be considered as actual population parameters. However, since we use these data to study the future of transportation security, the data should be considered as a consecutive sample and, hence, be subject to significance testing.

Typology of road cargo theft incidents

The definition of road cargo theft used in this paper is the same as that by the TAPA IIS and Europol (2009) – any theft of a shipment during road transportation or within a warehouse, but excluding internal petty theft. Further, the incident category definitions (Europol, 2009) are as follows:

- Hijacking: force, violence, or threats are used against the driver, and the vehicle and/or goods are stolen. Hijacking includes forcibly stopping a vehicle.
- Robbery: force, violence, or threats are used against individuals, and the vehicle and/or goods are stolen. Robbery does not include forcibly stopping a vehicle.
- Theft: Goods are stolen.
- Theft of: an unattended vehicle and/or trailer are stolen along with their load.
- Truck theft: a truck is stolen but not its cargo.
- Theft from: theft of loads from stationary vehicles (e.g. by curtain slashing) or from delivery vehicles left unlocked/unattended, or theft from a facility.
- Deception/Diversion: drivers or companies are deceived into delivering to a destination other than the one intended (commonly referred to as "round the corner"); this includes "e-crimes" wherein bogus logistics companies are established to divert the delivery.
- Fraud: individuals are intentionally deceived and the vehicle and/or goods are stolen.

- Burglary: burglary in commercial premises that are a part of the supply chain in all the above cases.

Typology of road cargo theft modi operandi

The definitions of the various road cargo thefts used in this paper are the same as those by the TAPA EMEA IIS and Europol (2009). Road theft includes theft of a shipment during road transportation or within a warehouse. The modus operandi categories are listed below:

- Deception: rivers or companies are deceived into delivering to a destination other than the one intended (commonly referred to as "round the corner"); this includes "e-crime" wherein bogus logistics companies are established to divert the delivery.
- Deceptive stop: s deceptive method is used to stop a vehicle without the use of violence or force.
- Forced stop: force, violence, or threats are used against a driver, and the vehicle or goods are stolen. Hijacking is a form of forced stop.
- Internal: thefts are committed by employees belonging to either the logistics companies or one of the players in the supply chain.
- Intrusion: incidents where perpetrators "break" their way to the goods. Burglary is a form of intrusion.
- Pilferage: a theft wherein the value or the quantity of the stolen goods is low.
- Violent: incidents where force, violence, or threats are used against a driver or terminal workers, and the vehicle or goods are stolen. Robbery is considered a violent crime.

4. Results

Table I shows the monthly descriptive statistics. As expected, both frequencies and values differ widely and, therefore, necessitate further analysis. A Levene test reveals significant heteroscedasticity in the incident values ($L = 1.801$, $p = 0.048$). A Brown-Forsythe test reveals significant differences in the incident values across

Month	Frequency	Total	Mean	SD
January	612	21,840	36	65
February	503	23,955	48	149
March	496	20,199	41	90
April	380	15,511	41	132
May	444	20,658	47	143
June	358	15,197	42	106
July	346	17,047	49	118
August	383	17,382	45	171
September	441	22,595	51	121
October	369	14,635	40	73
November	349	18,495	53	124
December	287	17,518	61	276
Total	4,968	225,032	45	134

Table I. Descriptive statistics across months (all values in thousands of EUR)

incident categories ($F = 2.940$, $p < 0.001$). A *post hoc* analysis with Tamhane's T2 reveals that both September and November have significantly higher incident values than April. Pairwise χ^2 tests with Bonferroni correction reveal that the incident frequency is significantly higher in January than in all the other months except February, is significantly higher in February than in all the other months except January, May, and September, and is significantly lower in December than in April, May, August, and September.

Table II displays the descriptive statistics for the days of the week. As expected, both frequencies and values differ widely and, therefore, necessitate further analysis. A Levene test does not reveal significant heteroscedasticity in the incident values ($L = 0.245$, $p = 0.962$). An ANOVA reveals significant differences in the mean values across the days of the week ($F = 1.427$, $p = 0.200$). A *post hoc* analysis with pairwise *t*-tests with Bonferroni correction reveals that Monday has significantly higher incident value than Tuesday, Wednesday, Thursday, and Friday. Pairwise χ^2 tests with Bonferroni correction reveal that the incident frequencies on Saturdays and Sundays are significantly lower than those on weekdays, are significantly lower on Fridays than on other weekdays except Mondays, and are significantly lower on Mondays than on Tuesdays.

Table III shows the descriptive statistics for the incident categories. As expected, both frequencies and values differ widely and, therefore, necessitate further analysis. A Levene test reveals significant heteroscedasticity in the incident values ($L = 44.332$, $p < 0.001$). A Brown-Forsythe test reveals significant differences in the incident values across incident categories ($F = 82.601$, $p < 0.001$). A *post hoc* analysis with Tamhane's

Table II.
Descriptive statistics across days of the week (all values in thousands of EUR)

Day of the week	Frequency	Total	Mean	SD
Monday	769	44,045	57	168
Tuesday	908	37,862	42	135
Wednesday	881	38,103	43	119
Thursday	868	36,616	42	117
Friday	738	31,265	42	134
Saturday	419	20,869	50	165
Sunday	385	16,272	42	76
Total	4,968	225,032	45	134

Table III.
Descriptive statistics across incident categories (all values in thousands of EUR)

Incident category	Frequency	Total	Mean	SD
Burglary	11	2,116	192	271
Fraud	13	1,154	89	177
Hijacking	69	24,337	353	566
Robbery	134	24,604	184	368
Theft	339	13,399	40	91
Theft from facility	23	569	25	33
Theft from vehicle	3,088	102,852	33	94
Theft of vehicle	486	40,040	82	119
Truck theft	805	15,963	20	21
Total	4,968	225,032	45	134

T2 reveals that both Hijacking and Robbery have significantly higher incident values than all other incident categories except Burglary and Fraud. Further, both Theft and Theft from Vehicle have significantly higher incident values than Truck theft. However, Theft, Theft from Vehicle, and Truck Theft have significantly lower incident values than Theft of Vehicle. Finally, incident frequencies differ significantly across incident categories ($\chi^2 = 14{,}159$, $p < 0.001$).

Table IV shows the descriptive statistics for the modus operandi categories. As expected, both frequencies and values differ widely and, therefore, necessitate further analysis. In this section, their total frequency is lower than that in the other tables because some modus operandi values were missing. A Levene test reveals significant heteroscedasticity in the incident values ($L = 2.753$, $p = 0.011$). A Brown-Forsythe test reveals significant differences in the incident values across incident categories ($F = 80.596$, $p < 0.001$). A *post hoc* analysis with Tamhane's T2 reveals that Deception and Violent have significantly higher incident values than Intrusion and Pilferage. The other differences in the incident values are not statistically significant. Finally, incident frequencies differ significantly across modi operandi ($\chi^2 = 19{,}237$, $p < 0.001$).

5. Discussion

The EP (2007) states that approximately 41 per cent of all incidents occur while driving, and approximately 60 per cent occur during a stop. The TAPA EMEA IIS states that 84 per cent of all attacks outside terminal areas occur during a stop (at both secure and non-secure parking locations), and 16 per cent occur while driving (en route). Overall, 55 per cent of all attacks occur during a stop (at both secure and non-secure parking locations), and 10 per cent while driving (en route). Moreover, 97 per cent of all attacks during a stop occur at non-secure locations. Over 50 per cent of all cargo theft attacks reported by the IIS occur at non-secure locations. Of the total losses, 63 per cent are incurred outside the terminal areas, and 6 per cent are incurred while parking at secure parking locations. Interestingly, losses incurred while driving (en route) account for 32 per cent of all the losses outside the terminal areas. Thefts at non-secure parking locations account for 53 per cent of all attacks and 40 per cent of all losses. These results indicate that cargo thefts at non-secure parking locations are more of a volume crime than high-value thefts. Thus, the TAPA IIS statistics provide an interesting perspective on cargo theft at non-secure parking facilities.

Cargo thefts at non-secure parking locations show seasonal variations, as shown by the fact that our four hypotheses were supported. The number of attacks generally increases during winter but decreases in December. Moreover, during December, the mean value of stolen goods is significantly lower, which indicates that the total value of

	Frequency	Total	Mean	SD
Deception	41	8,373	204	490
Deceptive stop	7	661	94	124
Forced stop	10	2,493	249	314
Internal	8	1,686	211	289
Intrusion	3,602	130,412	36	94
Pilferage	60	1,672	28	37
Violent	206	42,238	205	395
Total	3,934	187,537	48	145

Table IV. Descriptive statistics across modi operandi (all values in thousands of EUR)

stolen goods in a particular month depends primarily on the number of attacks. The number of attacks increases during the week but decreases over long weekends (Friday-Monday). The logic behind the seasonal variation in the mean values for stolen goods is the same as that for the variation in the yearly means. Both these seasonal trends are in-line with the general seasonal trend described by the IIS statistics (Ekwall and Lantz, 2012). However, the incident types and modi operandi for cargo theft attacks at non-secure parking locations are interesting. Violent crimes like hijacking and robbery have significantly higher incident mean values (353 and 184, respectively) and are relatively infrequent (69 and 134, respectively). Thus, hijacking at non-secure parking facilities is a rare but high-impact crime, whereas robbery is an equally dangerous threat (in terms of total value of losses) but is twice as common. Over a 12-year period, there were five to ten incidents of hijacking and robbery at non-secure parking locations on an annual basis within the EMEA region. Theft from vehicle accounts for 62 per cent of all incident categories at non-secure parking locations. The main modus operandi is intrusion, which comprises 92 per cent of all attacks; this is consistent with the findings of the EP (2007) that the most common method for theft from vehicles is tearing the canvas of the load unit. The same report states that the second most commonly used method is threats against the driver; this was neither supported nor refuted by the IIS statistics. The theft incident types (theft, theft from vehicle, theft of vehicle, and truck theft) collectively represent approximately 95 per cent of all incidents. The most common cargo theft at a non-secure parking location is intrusion on a weekday during the winter. This generalized conclusion is consistent with the findings of previous studies (Ekwall and Lantz, 2012; EP, 2007).

Surprisingly, most thefts are committed on weekdays instead of weekends. This result undermines the reliability of the data because the exact time of the crime can be determined only for those incident types where somebody (like the driver or guard) is either fooled (as in fraud, deception, or deceptive stop) or threatened (as in hijacking, robbery, forced stop, or violent). For all other types and modi operandi, the exact timing and place of the theft is unknown. Precise data regarding the timing of the crimes is not available in the TAPA EMEA IIS database. Interestingly, research based on statistics from other geographical regions indicates a different pattern in that cargo theft incidents increase during weekends (Burges, 2013). This implies that the time of week seasonality differs across places. The IRU (2008) states that 70 per cent of all attacks on trucks are committed between 22:00 and 06:00 hours when most drivers take a break. The same report states that approximately 60 per cent of all attacks occur at stops, and that 42 per cent of all cargo thefts of trucks occur at night at non-secure parking locations. While the IIS statistics do not entirely support this conclusion, they strongly indicate that this data is accurate.

Analysing the seasonality in terms of two general theories in criminal seasonality gives an interesting view to the statistics in IIS. As the number of attacks generally increases during winter but decreases in December, the needs-based view of property crime is supported in this research as the majority of modus operandi are non-violent. The temperature aggression hypothesis, on the other hand, can neither be supported nor rejected. This depends mainly on the low number of incidents (69 hijacks and 134 robberies). The temperature aggression hypothesis in cargo crimes therefore needs to be further investigated in future research. Perhaps a different cross-section of the IIS statistics can bring some light over this issue.

One of the more surprising findings is the big difference in the value of stolen goods for different modus operandi. Thefts using the violent modus (Violent and Forced stop),

along with the feared Internal, and the different Deception methods have a mean loss value of over 200,000 Euros per incident. Compared with the majority of incidents using the Intrusion modus, where the mean loss value is 36,000 Euros, the difference in mean loss value is over five times. However, the Intrusion modus is nearly 14 times more likely to be used as all the four methods and has the highest combined impact. We conclude that the modus operandi used the most frequently is a much bigger problem than the high impact, but lesser used methods, which is important for understanding and preventing cargo thefts at non-secure parking locations.

Altogether, these general findings about cargo theft at non-secure locations point towards a few interesting theoretical conclusions. The RAT states that routine or predictability is important in crime, and this study addresses targets at a certain type of location and how these targets are being attacked. Statistically, it is possible to state that the perpetrators using Intrusion and Pilferage, the methods having almost the same mean value of stolen goods and accounting for the modus in 93 per cent of all attacks, plan the least (this assumption is based on the lesser mean value of stolen goods). They check the local non-secure parking spaces and steal whatever they can find that they can sell/use on their own. There is, therefore, a systemic predictability within the boundaries of cargo theft at a non-secure parking location. This paper does not look into each specific non-secure parking location that has been exposed to a cargo theft incident. However, there must be a pattern, as some locations will have commonalities in terms of the frequency of occurrence (both per year and per week), similarities in modus operandi, incident category, and value of stolen goods (maybe even the stolen products). Assuming that the elements of criminal theory remain unchanged (same motivated perpetrator, similar target, and same insecure location), the likelihood that the thefts will continue is relatively large as compared to a change in any of the three elements.

The analysis of the TAPA EMEA IIS statistics on cargo thefts at non-secure parking locations confirms the presence of seasonality and reveals different seasonality patterns across categories on both yearly and weekly bases. This study concludes that the key issues are perpetrators' ability to exploit various crime opportunities and the seasonality of cargo thefts. Theft opportunities are created by a perpetrator's ability to exploit the target's daily routine and the lack of security (Ekwall, 2010). Each perpetrator's decision process outcomes clearly lead to preferred time/place/method combinations for cargo thefts. Kroneberg *et al.* (2010) observe that actors often "stick to a particular action alternative in an automatic-spontaneous mode of decision making, which leaves aside other alternatives and incentives", implying that criminal behaviour can be both easy to predict (as perpetrators repeat past behaviour regardless of incentives or security efforts) and very dynamic because of the bounded rationality of the perpetrators (Ekwall, 2012).

6. Conclusion

The differences in the mean values of attacks across modi operandi and incident types may indicate that crime often reflects the perpetrator's assessment of the crime's risk, required effort, and payoff (Clarke, 1995); the relevant considerations include effort required, potential payoff, degree of peer support for the action, risk of apprehension and punishment, and individual needs (Reppetto, 1974). Perpetrators act according to the rational choice theory, seeking to maximize the utility of a particular time and available resources (Bodman and Maultby, 1997). Therefore, perpetrators may

specialize in a certain type of attack method (a combination of target, method, and time/place) to maximize their efforts.

Generally, incident types like hijacking and robbery (or forced stop and violent) receive greater attention from the authorities, carry higher conviction risks, and lead to more severe punishments. The profit from an attack (the mean value of the stolen cargo) must be sufficiently high to cover the crime risk or cost as assessed by the perpetrator. Similar reasoning applies to incident categories like deception and internal because they both require stronger planning and execution abilities; this is indicated by the higher mean losses per incident.

These results clearly indicate that crimes against transport are low-cost (with lower mean loss values), and that high-cost crimes (with higher mean loss values) are likely to be more severe (i.e. violent crimes with harder punishments). This suggests that opportunistically driven perpetrators target less secure locations, as indicated by prior research (Europol, 2009; EP, 2007; Ekwall, 2009a; Ekwall and Lantz, 2012).

Implications for research

The knowledge that perpetrators may specialize in a certain attack method to maximize their results can aid the development of managerial approaches to security. Moreover, at a macro-level, the predictability of criminal behaviour can be used in criminal forecasting. As demonstrated in this paper, crime against the flow of goods is a real threat and must be considered in the research on SCRM. We can only speculate about the reasons for the seasonality in cargo thefts at various locations in the transport chain. Possible reasons for this phenomenon include variations in the types of goods, variations in the types of offenders, variations in transport volumes, and/or variations in the number of offenders. The reason for this seasonality should be addressed in future research using other data sources. This paper also highlights the need for an interdisciplinary approach to provide an understanding of the effects of crime from a risk perceptive. Further, the seasonality of theft at non-secure parking locations may also be analysed from an organizational relationship perspective (internal theft, external theft, or vendor fraud) (cf. Alstete, 2006) or from a product perspective (the types of products that are stolen) (cf. Clarke, 1999). Finally, even though one of the two of the general seasonality theories in criminology was supported, both needs to be further investigated. That being said, the temperature aggression hypothesis may be more important to investigate as the violent MOs have a lot higher impact even though they are less frequent.

Implications for practitioners

According to various businesses, the incidence of thefts increases during the "Christmas rush" period, that is, the period just before Christmas; however, our results do not support this observation. Businesses also assert that thefts increase on weekends; this observation is also not supported by our results, although other sources indicate more thefts during weekends (Burges, 2013; FreightWatch, 2012). The most common type of cargo theft is the theft of low-value goods from a parked truck. Consequently, there may be greater demand for more secure parking lots (cf. SETPOS, 2009) or better transport schedules (in terms of both place and time) so that truck drivers can avoid parking, to the extent possible, in non-secure parking lots (cf. Ekwall and Torstensson, 2011). This paper also highlights the importance of analysing cargo theft risk from the frequency/probability and impact perspectives because the costliest

losses (with the highest mean values) are usually incurred as a result of violent methods (hijacks and robbery) or fraud (deception or internal), while the more frequent thefts result from more opportunistic modi operandi (intrusion and pilferage). Different types of prevention measures are effective against different types of threats. One easy and quick preventive measure is to stop using non-secure parking locations in the transport chain when the frequency of attacks is increasing.

This issue needs more attention from both researchers and logistics companies. The results of this paper support the conclusions of previous studies (Ekwall, 2009a; Ekwall, 2010; Ekwall and Lantz, 2012) in that perpetrators (actions and decision triggers) need to be included in the analyses of cargo theft (cf. Guthrie and Guthrie, 2006). This is a basic conclusion; however, the current trend in SCRM research is to not include criminal threats other than terrorism to supply chains (Sheffi, 2001; Christopher and Lee, 2004; Rao and Goldsby, 2009; Khan and Burnes, 2007). In this perspective, this paper not only points out that cargo theft very much exists, but also throws light on the disturbing statistic that due to non-secure parking locations, losses of 225,032,000 Euros have been incurred over a time period of 12 years.

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