THEFT OF GOODS IN PORTS
A review of TAPA EMEA IIS statistics

Ekwall Daniel
Lantz Björn

THEFT OF GOODS IN PORTS
A review of TAPA EMEA IIS statistics

Ekwall Daniel
Lantz Björn

Photo credits for the cover: Mr. Esko Keski-Oja, Finland

Keywords:

Cargo theft, hot products, crime seasonality, incident categories, port facilities

Abstract

This report examines patterns of reported cargo thefts at maritime transport facilities in Europe, the Middle East, and Africa (EMEA) with respect to frequency, incident category, modus operandi, and targeted product category. 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 and criminology theories.

We find that maritime transport facilities constitute a rare target location for cargo thieves, as only 102 of more than 24,500 incidents (0.4%) in the IIS database occur there. Nevertheless, some conclusions can be made. First, there seems to be seasonality in *day of the week*, but probably not in *month of the year*. Second, violent and fraudulent modi operandi of theft at maritime transport facilities are about as common as in the whole data set. Thus, it could be conjectured that the impact from violent and fraudulent incidents is several times higher than the most common types of incident category or modus operandi, although this is unsupported in this study. The product categories signal that there is big variation in value in stolen goods. Third, it is possible that potential perpetrators consider security levels at maritime transport facilities to be higher, leading to fewer theft attempts.

This study is limited by the content of and classifications within the TAPA EMEA IIS database.

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

CRAVED:	Concealable, Removable, Available, Valuable, Enjoyable, and Disposable
ECMT:	European Conference of Ministers of Transport
EP:	European Parliament
EU:	European Union
IRU:	International Road Transport Union
LEA:	Law Enforcement Agencies
TAPA:	Transported Asset Protection Association
TAPA EMEA:	Transported Asset Protection Association, in Europe, the Middle East and Africa
TAPA IIS:	Transported Asset Protection Association, Incident Information Service

1   INTRODUCTION

The theft of goods poses a significant problem across the globe. According to the European Union (EU), the value of goods stolen annually is €8.2 billion (EP, 2007), a conservative estimate. It is difficult and sometimes even impossible to collect accurate data for cargo theft losses owing to limited reporting by the transport industry as well as the lack of an international law enforcement system to ensure consistency in reporting and tracking (ECMT, 2001).

Supply chain vulnerability reflects the sensitivity of a supply chain to disruption (Waters, 2007) and can be described as 'unwanted effects' or the consequence of risk to the supply chain. Juttner (2005) defines supply chain vulnerability as 'an exposure to serious disturbance arising from supply chain risks and affecting the supply chain's ability to effectively serve the end customer market'. Cargo theft is a clear type of disruption of the flow of goods, which affects the ability of supply chains to serve end consumers. Theft has been and will probably always be a part of society, and for many businesses, theft is a part of doing business (Guthrie and Guthrie, 2006).

Research on cargo crimes has evolved over the years and both the focus and theoretical background have changed. The focus of cargo theft was linked to perpetrators' relations with the affected organization (internal theft, external theft, or vendor fraud), the product's vulnerability to theft (concealable, removable, available, valuable, enjoyable, and disposable, CRAVED), or the location of the theft (supply chain or geographical) (Clarke, 1999; Oliphant and Oliphant, 2001; Beck et al., 2003; Beck, 2004; Bamfield, 2004; Bamfield, 2006; Chapman and Templar, 2006; Ekwall and Lantz, 2013). Theft of goods anywhere in the supply chain, particularly that which is closer to the end consumer, leads to stock replacement costs, diversion of resources from business activities, and opportunity costs of missed sales (Alstete, 2006). Consequently, theft affects consumer prices in the long run (Bailey, 2006).

1.1   Background

According to general cargo theft statistics, 41% of all incidents occur during the driving phase of transport and involve threatening the driver or tearing the canvas of the load unit (EP, 2007). In 15% of incidents, the truck is stolen along with the goods. Another 15% occur during hijacking and robbery (EP, 2007). According to a report by the International Road Transport Union (IRU) (2008), trucks and their loads were targeted in 63% of all thefts, while 43% were either direct thefts of transported goods or included the theft of the drivers' personal belongings. Of these thefts, 42% occurred in truck parking lots and a further 19% on motorways (IRU, 2008). In other words, 61% of all thefts occurred at temporary rest areas along roads. Cargo theft typically occurs on trucks that are temporarily parked along roads, with thieves often waiting for loading and unloading opportunities (EP, 2007; TruckPol, 2007; IRU, 2008). In this context, prior research shows that a violent modus operandi has a greater impact in terms of the higher value of the stolen goods (Ekwall and Lantz, 2013; Ekwall and Lantz, 2015a, 2015b, 2016).

The main reason for attacking road transport is mainly linked to the flexibility and multitude of different targets. It is no surprise that theft of goods from either road transport or road transport-linked terminal facilities dominates the statistics. However, very few studies analyse the theft patterns at specific location types, such as maritime transport facilities, to any extent.

1.2   Research purpose

The purpose of this study is to explore the patterns in reported theft frequencies at maritime transport facilities in the EMEA region with respect to seasonality, incident category, modus operandi, and product category.

2   METHOD

The TAPA EMEA IIS database is used to derive the data for case study. All incidents in the database between 2000 and 2016 (except the years 2012–2014) are included. For 2016, incidents from the Americas and Asia-Pacific were also included. We used all incidents occurred at the maritime transport facility in the dataset. This would lead to that in total 102 incidents out of 24,500 incidents (0.4%) was just as data in this case study.

2.1   Research method

The concept of risk is related to the future and thereby includes uncertainty to some extent. Past events, by definition, are not risky, as uncertainty is no longer linked to any single event, having already occurred. Nevertheless, the use of historical data can be of great value to predict and analyse future risks related to past specific events. Therefore, in this study, we use historical incident frequencies to estimate the probability of future incidents. We use secondary data and follow the reasoning of Rabinovich and Cheon (2011), who argue that the importance of secondary data analysis has been overlooked in logistics research and should be used to address contemporary challenges in logistics and supply chain research. Secondary data in research provides high internal validity and more importantly, provides an opportunity to replicate a study (Rabinovich and Cheon, 2011). In this study, we do not use inferential statistics to analyse theft patterns, because there are too few total reported incidents in maritime transport facilities—just over 100 reported in the EMEA since 2000. Hence, we describe only the frequency distributions and discuss the patterns in general terms.

2.2   The TAPA EMEA IIS database

The TAPA EMEA IIS database printouts used in this research comprise approximately 24,500 individual reported incidents of cargo theft incidents committed between 2000 and 2016 within the EMEA area. The database itself is not public, but we have been given access to it for research purposes on the condition that results are presented and discussed on an aggregate level. The crime statistics in the TAPA EMEA IIS database are prepared by TAPA members and various law enforcement agencies (LEAs) in the EU. The identities of the companies involved, directly and indirectly, are not disclosed in the reports to avoid negative publicity and ensure better data reliability. Furthermore, the reporting entity determines the extent of disclosure of the incident details, thereby suggesting that the quality of data varies across incidents and countries. Nevertheless, the TAPA EMEA IIS database is considered the most accurate database in the EU for crime incidents (Europol, 2009). The reporting procedure ensures that the database presents an accurate picture of cargo theft incidents in terms of absolute numbers and trends. The global TAPA structure has three regions (the Americas, EMEA, and Asia-Pacific), each of which 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 seasonality (time of year) of the northern hemisphere.

Reports for the database are generally created using the online reporting interface at the website www.tapaemea.com. The reports include a number of mandatory facts, such as the reporting person (name with contact details), incident date, and description. Furthermore, there are a number of fixed descriptions about the incident in the following categories: incident type, modus operandi, product type, type of location, country of occurrence, and product and loss value in euros. It is possible that the reports contain additional data about each incident.

In this study, we utilize the TAPA EMEA IIS (2000–2011 and 2015) and TAPA global IIS (2016) under the reported locations 'maritime transport location'. During the period 2000–2016 (the years 2012–2014 were excluded because of general data quality issues) 102 incidents with 'Maritime transport facility' as the incident location were reported. This leads us to use only the data descriptive and focus on frequency, as the impact data (stolen value) are missing in several instances.

2.3   Typology of incidents types

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

- **Hijacking**: Force, violence, or threats are used against drivers, and the vehicles and/or goods are stolen. Hijacking includes forcibly stopping vehicles.
- **Robbery**: Force, violence, or threats are used against individuals, and the vehicles and/or goods are stolen. Robbery does not include forcibly stopping vehicles.
- **Theft**: Goods are stolen.
- **Theft of**: Unattended vehicles and/or trailers are stolen along with their loads.
- **Truck theft**: Trucks are stolen but not their cargo.
- **Theft from**: Theft of loads from stationary vehicles (e.g., by curtain slashing) or from delivery vehicles left unlocked/unattended, or theft from facilities.
- **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 vehicles and/or goods are stolen.
- **Burglary**: Theft from commercial premises that are part of a supply chain in all the abovementioned cases.

2.4   Typology of modus operandi

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

➢ **Deception:** 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-crime' wherein bogus logistics companies are established to divert the delivery.

➢ **Deceptive Stop:** A deceptive method is used to stop a vehicle without the use of violence or force.

➢ **Forced Stop:** Force, violence, or threats are used against drivers, and the vehicles or goods are stolen. Hijacking is a form of forced stop.

➢ **Internal:** Thefts are committed by employees belonging to either logistics companies or one of the players in the supply chain.

➢ **Intrusion:** Incidents in which perpetrators 'break' their way in to the goods. Burglary is a form of intrusion.

➢ **Pilferage:** Theft wherein the value *or* quantity of the stolen goods is low.

➢ **Violent:** Incidents in which force, violence, or threats are used against drivers or terminal workers, and the vehicles or goods are stolen. Robbery is considered a violent crime.

2.5   Definition of maritime transport facilities

The definition of maritime transport facilities used in this study is the same as that in the TAPA IIS, namely:

Maritime transport facilities: A ferry terminal/port/dockyard facilities

3   FRAME OF REFERENCE

The research area of supply chain risk management, according to Colicchia and Strozzi (2012), has received increased attention from both practitioners and scholars. Within this field of research, risk is mainly conceptualized as the probability of loss multiplied by the impact of any particular type of loss (Norrman and Jansson, 2004; Khan and Burnes, 2007; Manuj and Mentzer, 2008a, 2008b; Wagner and Bode, 2008; Coyle et al., 2011; Tummala and Schoenherr, 2011). Thus, risk is the combination of the probability or frequency of the occurrence of a certain hazard and the value or impact of its occurrence. Thus, a high-risk event is an unfortunate event with a high probability of occurrence *and/or* an unfortunate event with a high potential impact (Ekwall and Lantz, 2016). Hence, risk management is a prioritization process in which the risks with the greatest potential loss (or impact) and the greatest probability of occurrence are handled first, and risks with a lower potential loss and a lower probability of occurrence are handled in descending order.

Determining the relative risk makes it possible to identify risks that must be addressed and those that must be accepted, and a higher impact is often considered more serious than a higher possibility (Bernstein, 1996). In this study, owing to low sample size and questionable reliability of the reported data, we disregard the value of goods and use only frequency of occurrence in a descriptive manner.

3.1   Freight, transport and logistics

In general, descriptions of supply chains are achieved using a system approach in logistics research. According to Arnäs (2007), it is useful to separate logistics and transport and instead emphasize the dialectical relationship between the terms or systems. The logistics system is composed of three structured elements or components: products, locations, and facilities. The transport system is composed of three structured elements or components: vehicles and vessels; freight; and ways and terminals. Cargo thieves remove goods (products) from a supply chain by attacking different transport chain locations. In different and short time periods, certain locations can be considered geographically fixed whereas cargo carriers are moveable; however, this movement is predictable in place yet less predictable in time.

The pattern of the transport network is different both for time of day and time of week (Rosa and Lumsden, 2009). This difference can depend on transport carrier scheduling but also on the extended use of time windows. In addition, there is a yearly pattern in transport volume due to differences in end customer demand (Tarn et al., 2003; Kazim, 2007) as well as different weather conditions (Datla and Sharma, 2008). This seasonality leads to differences in the utilization of different transport chain locations by changing the number of available targets (number of trucks and volumes at a facility).

3.2 Crime opportunity

Crime opportunity is a cornerstone of criminal behaviour. The following 10 crime opportunity principles are identified by Felson and Clarke (1998).

1. *Opportunity plays a role in causing all crimes.*
2. *Crime opportunities are highly specific.*
3. *Crime opportunities are concentrated in time and place.*
4. *Crime opportunities depend on everyday movements.*
5. *One crime produces opportunities for another.*
6. *Some products offer more tempting crime opportunities.*
7. *Social and technological changes produce new crime opportunities.*
8. *Opportunities for crime can be reduced.*
9. *Reducing opportunities does not usually displace crime.*
10. *Focused opportunity reduction can produce wider declines in crime.*

Some of these principles are self-explanatory and easy to understand. All of them are valid for every type of crime. The most important thing to remember about crime opportunity is that an opportunity alone does not explain why a crime occurs, because a crime needs a motivated perpetrator and opportunity to occur (Clarke et al., 2003). The incentives could range from vindication to morality, ethics, altruism, and determinism. Within specific criminological control theories of criminology, the main method to reduce crime is to reduce different opportunities for crime.

3.3 Situational crime prevention

Situational crime prevention began to develop in the early 1980s. The aim was to reduce factors specific to different types of crimes, locations, and situations. Situational crime prevention is based on the theoretical premise of rational choice (Clarke and Cornish, 1985). Therefore, the key factor in situational crime prevention recognition is that a crime often reflects the risk, effort, and payoff as assessed by the perpetrator (Clarke, 1995). These include the effort involved, potential payoff, degree of peer support for the action, risk of apprehension and punishment, and individual needs (Reppetto, 1974). The theory does not state that a perpetrator will commit a crime every time an opportunity occurs, but instead, the potential perpetrator makes a calculated decision about the opportunity to commit a crime (Lab, 2000). In summary, a perpetrator acts according to rational choice theory, seeking to maximize his or her utility with regard to a particular time and available resources (Bodman and Maultby, 1997).

Criticism against situational crime prevention includes that this method leads to property crime receiving more attention than is appropriate. Furthermore, situational crime prevention addresses the symptoms and not the causes of crime. This can lead to excessive trust in technology (Crawford, 1998). Since cargo theft is a property crime, situational crime prevention is a useful method to address this problem. Basically, situational crime prevention is achieved by applying the following three prevention principles (Clarke, 1992).

Increased perceived effort (Clarke and Homel, 1997): Motivation to commit a theft is reduced if the perpetrator believes the crime is too difficult to commit. Preventive actions based on this idea can be categorized as physical separation of the potential perpetrator and the object of the theft. This can be accomplished by using access control and physical barriers (fences, locks, etc.).

Increased perceived risks (Clarke, 1992): If perpetrators think they will get away with a theft, it is more likely they will commit it. Increasing the risk for perpetrators makes it less likely they will commit a theft. This can be accomplished with surveillance systems and security personnel, and by increasing employees' security awareness.

Reducing anticipated rewards (Clarke, 1992): People are more likely to commit theft if they can benefit from it. Making the target of theft worthless or reducing its resale value causes theft to become less attractive for potential perpetrators. This can be accomplished by marking the goods with unique numbers or a product destruction device. Good examples of this principle are safety cases used in the transport of valuables and money and ink tags used in fashion stores.

Clarke and Homel (1997) added a fourth preventive principle based on rational choice theory.

Inducing guilt or shame: Theft is more likely to occur if it can be excused by appeal to reason, such as 'the company can afford it' or 'I've worked hard for the company but they have not thanked me for it' (Tyska and Fennelly, 1983). This is a form of ethic relativity. Companies and organizations can affect this ethic relativity by using company rules, signs, and regulations that demonstrate the right moral values. When theft is seen as an additional wage benefit for employees, this preventive action fails (Muir, 1996). By appealing to people's morals and making it easy for them to do the right thing, it is more difficult for them to make excuses to benefit from theft (Clarke and Homel, 1997).

3.4   Seasonality in crimes

Within the criminology research, there is general agreement that crime is a seasonal phenomenon, at least to some extent. Normally, two types of crime are subject to seasonality at the local level: (1) property crimes (burglary, robbery, and theft) and (2) crimes of aggression (assaults, homicides, and rape) (Cohen, 1941). Property crimes are high during autumn and winter while crimes of aggression peak in midsummer and are lowest in January (midwinter). Within criminology, two general theories on seasonality have been developed: the *temperature aggression hypothesis* and the *needs-based view of property crime* (Falk, 1952). The needs-based view suggests that seasonal unemployment and living expenses influence levels of criminal activity at different times during the year (Gorr et al., 2003).

The seasonality of crimes can be linked to different opportunities for crimes, which are linked to the elements of crimes theory, which in turn implies that changes in any one of these three elements can influence seasonality differently. According to Hylleberg (1995), exogenous causes of crime are important for understanding seasonality. These causes are *calendar events*, *weather,* and *time of year*, all of which can increase or decrease criminal behaviour depending

on the local contextual surroundings. The *time of year* can affect criminal opportunities in a number of different ways, such as the Christmas shopping season (Gorr et al., 2003). In summary, seasonality in crimes might be influenced by *time of year*, depending on the number of available targets and potential customers to buy the stolen goods. For similar reasons, seasonality is also found in *calendar events*, such as day of the week; however, seasonality in this case largely depends on the number of available targets.

In this study, we utilize seasonal cargo theft from maritime transport locations in terms of *time of year* and *time of week.* It is also possible to consider seasonality in terms of *time of day*, but the quality of the data in the TAPA EMEA IIS is too low to undertaken this kind of seasonality analysis. Previous research on cargo theft has shown seasonal behaviour by *time of day* for cargo theft from road transport cargo carriers, where about two-thirds of all incidents occur after dark (22.00–06.00) (IRU, 2008). Similar analysis utilizing IIS data is not possible.

3.5 Hot products

Within shrinkage management, which is the study of the loss of inventory, the term "hot products" emphasizes particular items or products that are more at risk of theft. One of the most basic requirements for a product to be at risk of theft is that there is demand for it on either the grey or the black market (Ekwall, 2009; Burges, 2012). When there is higher demand for products, both in terms of volume and margin for thieves, brokers, or fencers, theft of those products is more likely to occur (Burges, 2012). Therefore, such products require greater surveillance (Sherman et al., 1989; Beck and Chapman, 2003). According to Clarke (1999), hot products are defined as those that are CRAVED (concealable, removable, available, valuable, enjoyable, and disposable). This term is typically used in a retail context, but it is useful to anticipate higher exposure of certain products for criminal purposes (Ekwall, 2009). Which products are hot is often based on assumptions and opinions, but rarely by robustly derived data (Beck and Chapman, 2003). By using accurate data factors, such as opportunity and black-market prospects, each item can be considered on an equal basis as the pure value of the product (ECR, 2003). According to Burges (2012), it is important to understand black market demand as a function of supply and demand, in which an increase in the black market demand for a certain product can lead to an increase in its theft. Depending on the sellers, these illegal or stolen products can return to legal supply chains, normally through flea markets, pawnshops, jewellers, websites, or second-hand stores (Johns and Hayes, 2003; Ekwall, 2009).

4   RESULTS

4.1   Seasonality

Figure 1 shows the weekly descriptive statistics. The seasonal variation for day of the week indicates that theft at maritime transport facilities is more of a weekday crime than a weekend crime. This follows the general cargo theft pattern observed in other research (Ekwall and Lantz, 2015b).
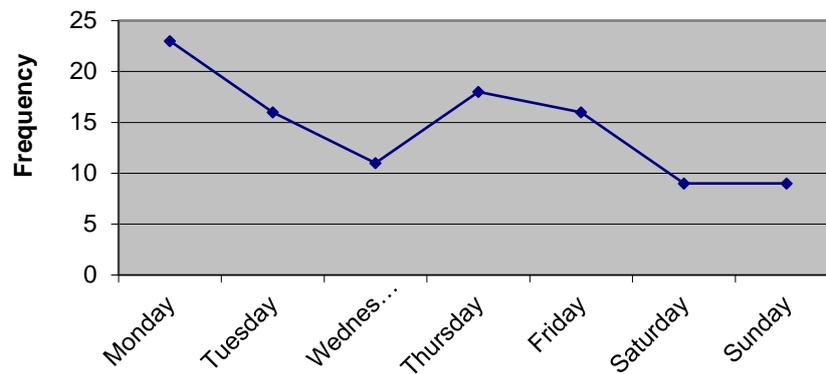

Figure 1: Frequency of theft by day of the week at maritime transport facilities in Europe, Middle East and Asia in 2000-2016 (n = 102). Source: TAPA EMEA IIS (2000–2011; 2015) and TAPA global IIS (2016)

Figure 2 shows the monthly descriptive statistics. The seasonal variation for month of the year indicates that thefts at maritime transport facility are fairly evenly spread over the year. According to the *needs-based view of property crime,* property crimes should be higher during the colder seasons (about October to March). However, that is not the case here. The variations between months are low but February stands out with the highest number of reported thefts, even though it is the shortest month. It is difficult to draw any conclusions from the descriptive statistics in Figure 2.
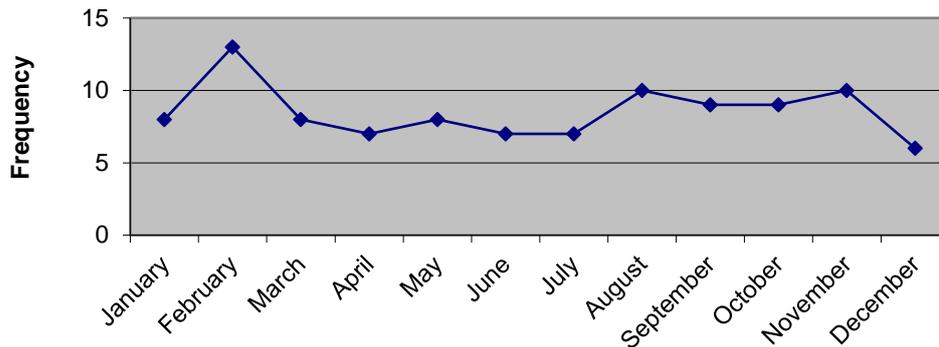
Figure 2: Frequency of theft by month of the year at maritime transport facilities in Europe, Middle East and Asia in 2000-2016 (n = 102). Source: TAPA EMEA IIS (2000–2011; 2015) and TAPA global IIS (2016)

Hence, in terms of seasonality of cargo theft at maritime transport facilities, there seems to be a day-of-the-week effect but a month-of –the-year effect hardly exists.

4.2 Incident Category

Figure 3 shows the incident category descriptive statistics, which show a substantial difference between incident categories. In particular, the top four categories account for 77% of all incidents. Interestingly, the violent incident categories (robbery and hijacking) account for 6% of the incidents. Other research has shown that violent incident categories are rare (Ekwall and Lantz, 2015b) but can have up to six times the impact in terms of the value of the stolen goods (Ekwall and Lantz, 2015b). Owing to the poor quality of the reported incidents at maritime transport facilities, it is not possible to compare the incident categories, but it is possible or even likely that the impact varies a lot between the different incident categories.

Figure 3: Frequency of theft by incident category at maritime transport facilities in Europe, Middle East and Asia in 2000-2016 (n = 102). Source: TAPA EMEA IIS (2000–2011; 2015) and TAPA global IIS (2016)

4.3 Modus Operandi

Figure 4 shows the modus operandi descriptive statistics, which show a substantial difference. Intrusion accounts for 66% of all incidents. Other research has shown that deceptive modi operandi are rare (Ekwall and Lantz, 2015b) but can have more than six times the impact in terms of the value of the stolen goods (Ekwall and Lantz, 2015b).
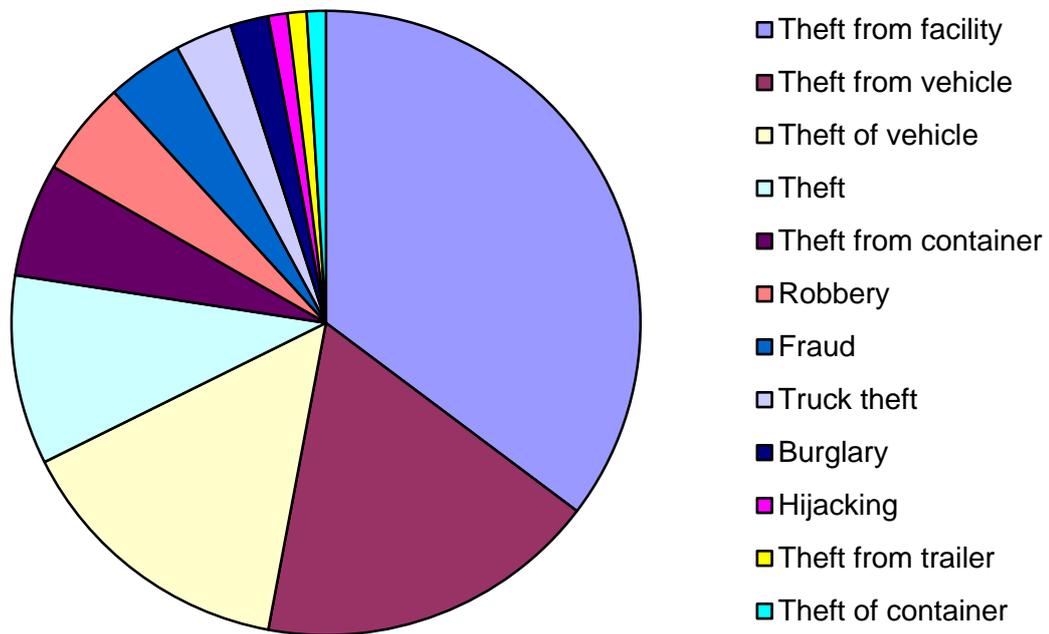
Figure 4: Frequency of theft by modus operandi at maritime transport facilities in Europe, Middle East and Asia in 2000-2016 (n = 102). Source: TAPA EMEA IIS (2000–2011; 2015) and TAPA global IIS (2016)

4.4 Product Category

Table 5 shows the product category descriptive statistics. The statistics of stolen goods signal which types of companies are more common members of TAPA (and thereby reports their losses to the IIS) as well as which types of products are in general at risk of theft. The low number of incidents hinders any further analysis but other research has pointed out the relationship between different transport chain locations and products types (Ekwall and Lantz, 2017).
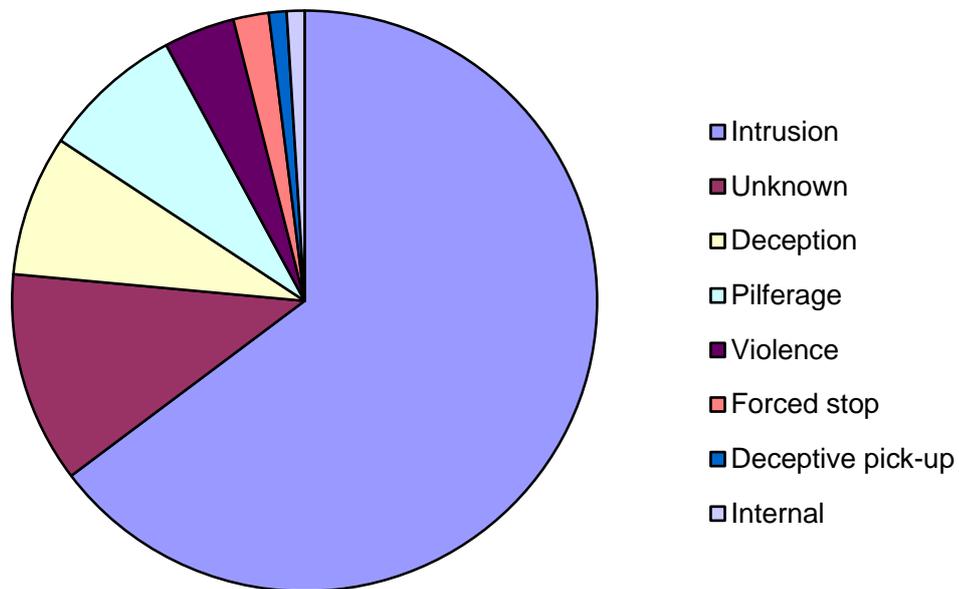
Table 5: Frequency of theft by product category at maritime transport facilities in Europe, Middle East and Asia in 2000-2016 (n = 102). Source: TAPA EMEA IIS (2000–2011; 2015) and TAPA global IIS (2016)

Product Category	Frequency
Desktop, server, networking	27
Consumer electronics	13
Unspecified/unknown	11
Laptops and personal digital assistants	9
Food and beverages	8
Metal	7
Display (monitors)	4
Various IT	4
Tobacco products	3
Clothing and footwear	2
Food and drink	2
Peripheral (hardware)	2
Tobacco	2
Cosmetic and hygiene products	1
Cosmetics and hygiene	1
Miscellaneous	1
Mobile phones	1
Non-electronic products	1
Pharmaceuticals	1
Sports goods	1
Supplies	1

5 DISCUSSION

Maritime transport facilities are, from a statistical perspective, a rare transport chain location for cargo theft. Such facilities account for 0.43% of all incidents in the IIS data set. Interestingly, notwithstanding this small sample, a few points can be made. First, there seems to be seasonality for *day of the week*, but probably not for *month of the year*. The seasonality for day of the week may very well follow the logic of numbers of available targets or be linked to the theory of preferred working day for the perpetrators. Either way, this follows the logic put forward in other studies (Ekwall and Lantz, 2013, 2015b).

Second, violent and fraudulent modi operandi are about equally common in the whole data set for all locations. Thus, we can conjecture (unsupported in this study) that the impact from violent and fraudulent incidents is several times higher than the most common types of incident category or modus operandi. The product categories signal that big variation in value in stolen goods.

Third, a combination of the descriptive statistics in Figure 1 (day of the week), Figure 2 (month of the year), Figure 3 (incident categories), and Figure 4 (modus operandi) support the findings of other studies that the majority of incidents are low-impact crimes while a minority of incidents account for a large proportion of the impact (i.e. normally violent or deceptive modi operandi). The small number of incidents in combination with the poor quality of estimated lost value means that it is not possible to perform a similar analysis in this study. Nevertheless, no finding in this study points toward a different conclusion.

Overall, these general findings about cargo theft at maritime transport facilities suggest some interesting theoretical conclusions. According to the routine activity theory, routine or predictability is an important factor in crime, and this study addresses targets at a certain type of location and how these targets are attacked. As this type of incident represents an extremely low proportion of the total number of incidents, we can conclude that maritime transport facilities are not a preferred target for perpetrators. This could depend on several reasons. First, owing to reporting issues, TAPA members do not use sea freight, as their products are of high value and low weight with a short life span (compare the product categories in Table 5), leading to few incidents. Second, the security levels at maritime transport facility are considered higher than those at other transport chain location types, leading the perpetrators to change targeted locations more frequently. This refers to the theory of situational crime prevention and criminological control theories. Other research has highlighted the increasing security levels at seaport facilities during the last 10–20 years (Closs and McGarrell, 2004; Mazeradi and Ekwall, 2009; Urciuoli, 2010; Haelterman, 2011; Urciuoli and Ekwall, 2015). Simplistically, we could conclude that new security programs and other regulations for ports has affected crime opportunities, resulting in the low numbers of incidents linked to seaports presented in this study.

6   CONCLUSION

6.1   Cargo theft in ports

The low number of cargo theft incidents reported in the TAPA EMAE IIS signals either that the utilization of sea freight is systematically low among goods owners who report incidents to the IIS, or that the security levels at maritime transport facilities are relatively higher than those at other relevant target transport chain locations from the perpetrators' point of view. The first conclusion is less likely than the second is, as the majority of reports come not from TAPA members but from different LEAs, which would mean that the types of goods of non-traditional TAPA members are included in the IIS statistics. This would signal that the low numbers of incidents represent a relatively low risk for cargo theft at maritime transport facilities in general. The variations in incident category and modus operandi occur throughout the full IIS data set leading to the conclusion that perpetrators do not utilize more violent tactics in order to bypass advanced security setups, as other research suggests (EP, 2007). Overall, more research is needed to verify the volume and constitution of cargo crimes in seaports.

6.2   Implications for industry

According to various businesses (Burges, 2012; FreightWatch, 2012), the incidence of theft increases during the 'Christmas rush' period, that is, the period just before Christmas as well as on weekends. However, our results do not support these observations.

6.3   Implications for research

The knowledge that perpetrators might 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. We can only speculate about the reasons for the patterns in the descriptive statistics presented in this study. Possible reasons include variations in the types of goods, types of offenders, transport volumes, and/or numbers of offenders.

7   FUTURE RESEARCH

There has been a growing number of papers published on the subject of supply chain risk management in recent years. This indicates that risk questions in a supply chain context are becoming more interesting for scientists and business. The same development can be observed in the subject of supply chain security. This report addresses a very limited part of security and risk problems linked to supply chains. Furthermore, there are too few statistical incidents in the IIS which can be linked directly to seaports to lead to strong conclusions. Thus, future studies on risk and security require more and better raw data about cargo theft and other types of criminal activities in seaports.

ACKNOWLEDGEMENT

REFERENCES

Alstete, J. (2006), "Inside advice on educating managers for preventing employee theft", *International Journal of Retail & Distribution Management,* Vol. 34, No. 11, pp. 833–844.

Arnäs, P.O. (2007), *Heterogeneous Goods in Transportation Systems – A study on the uses of an object-oriented approach*. Division of Logistics and Transportation, Chalmers University of Technology: Göteborg.

Bailey, A. A. (2006), "Retail employee theft: a theory of planned behaviour perspective", *International Journal of Retail & Distribution Management,* Vol. 34, No. 11, pp. 802–816.

Bamfield, J. (2004), "Shrinkage, shoplifting and the cost of retail crime in Europe: a cross-sectional analysis of major retailers in 16 European countries", *International Journal of Retail & Distribution Management,* Vol. 32, No. 5, pp. 235–241.

Bamfield, J. (2006), "Sed quis custodiet? Employee theft in UK retailing", *International Journal of Retail & Distribution Management,* Vol. 34, No. 11, pp. 845–859.

Beck, A., Chapman, P. and Peacock, C. (2003), "Shrinkage: A Collaborative Approach to Reducing Stock Loss in the Supply Chain", *ECR Europe*, Brussels.

Beck, A. (2004), "Shrinkage in Europe 2004: A Survey of Stock Loss in the Fast Moving Consumer Goods Sector", *ECR Europe*, Brussels.

Bernstein, P. (1996), *Against the Gods: The Remarkable Story of Risk*, Wiley, Chichester.

Bodman, P. and Maultby, C. (1997), "Crime, punishment and deterrence in Australia", *International Journal of Social Economics*, Vol. 24, No. 7/8/9, pp. 884–901.

Burges, D. (2012), *Cargo theft, loss prevention, and supply chain security,* Butterworth-Heinemann, Oxford, UK.

Chapman, P. and Templar, S. (2006), "Scoping the contextual issues that influence shrinkage measurement", *International Journal of Retail & Distribution Management,* Vol. 34, No. 11, pp. 860–872.

Clarke, R. V. (1995), "Situational crime prevention", in Tonry, M. and Farrington, D.P. (Eds.), *Building a Safer Society: Strategic Approaches to Crime Prevention,* University of Chicago Press, Chicago.

Clarke, R. V. and Cornish, D. (1985), "Modelling offenders decisions: A framework for policy and research". In Tonry, M and Morris, N (ed.), *Crime and justice*, Vol. 4, Chicago: University of Chicago press.

Clarke, R.V. (1999), *Hot Products: Understanding, Anticipating and Reducing Demand for Stolen Goods (Police Research Series Paper 112)*, Home Office, London.

Clarke, R. V. (1992), *Situational crime prevention: Successful case studies*. Harrow and Heston, New York.

Clarke, R. V. and Homel, R. (1997), "A revised classification of situational crime prevention techniques". In, Lab, S. P. (ed.) *Crime prevention at a crossroads*. Andersson Publishing Co Cincinnati US.

Clarke, R. V. and Cornish, D. (2003), "Opportunities, precipitators and criminal decisions: A reply to Wortley's critique of situational crime prevention", *Crime Prevention Studies*, Vol. 16, pp. 41–96.

Closs, D. and McGarrell, E. (2004) *Enhancing Security throughout the Supply Chain*, IBM Centre for the Business of Government, Washington, DC.

Cohen, J. (1941), "The Geography of Crime". *Annals of the American Academy of Political and Social Science*, Vol. 217, Crime in the United States, pp. 29–37.

Colicchia, C. and Strozzi, F. (2012), "Supply chain risk management: A new methodology for a systematic literature review", *Supply Chain Management: An International Journal*, Vol. 17, No. 4, pp. 403–418.

Coyle, J.J., Novack, R.A., Gibson, B.J., and Bardi, E.J. (2011), Transportation: A Supply Chain Perspective, 7th edn. South-Western Cengage Learning, Mason, OH.

Crawford, A. (1998), *Crime prevention and community safety: Politics, policies and practice*. Longman London.

Datla, S. and Sharma, S. (2008), "Impact of cold and snow on temporal and spatial variations of highway traffic volumes". *Journal of Transport Geography*, Vol. 16, pp. 358–372.

ECMT (2001), *Theft of goods and goods vehicles*. CEMT/CM (2001)19, Lissabon.

ECR (2003), *Shrinkage: A Collaborative Approach to Reducing Stock Loss in the Supply Chain*. ECR Europe, Brussels, Belgium.

Ekwall, D. (2009), *Managing the Risk for Antagonistic Threats against the Transport Network,* Division of Logistics and Transportation, Chalmers University of Technology, Göteborg.

Ekwall, D. (2010), "On analyzing the official statistics for antagonistic threats against transports in EU: A supply chain risk perspective", *Journal of Transportation Security*, Vol. 3, No. 4, pp. 213–230.

Ekwall, D. and Lantz, B. (2013), "Seasonality of cargo theft at transport chain locations". *International Journal of Physical Distribution and Logistics Management*, Vol. 43, No. 9, pp 728–746.

Ekwall, D. and Lantz, B. (2015a), " Modi operandi and incident categories for cargo theft in EMEA – a seasonality analysis". *Journal of Transportation Security*, Vol. 8, No. 3, pp. 99–113.

Ekwall, D. and Lantz, B. (2015b), "Cargo theft at non-secure parking locations". *International Journal of Retail and Distribution Management*, Vol. 43, No. 3, pp. 204–220.

Ekwall, D. and Lantz, B. (2016), "Supply chain risk analysis and assessment – a cargo theft example". *Transportation Journal*, Vol. 55, No. 4, pp 400–419.

Ekwall, D. and Lantz, B. (2017), "Cargo theft risk and security: Product and location". *In proceedings of Nofoma 2017*, Lund, Sweden.

EP - European Parliament's Committee on Transport and Tourism (2007), Organised Theft of Commercial Vehicles and Their Loads in the European Union, European Parliament, Brussels.

Europol (2009), Cargo Theft Report: Applying the Brakes to Road Cargo Crime in Europe, Europol: The Hague.

Falk, J. J. (1952), "The influence of the seasons on the crime rate", *Journal of Crime and Law Criminology*, Vol. 43, pp. 199–213.

Felson, M. and Clarke, R.V. (1998), *Opportunity Makes the Thief: Practical Theory for Crime Prevention,* Home Office Police and Reducing Crime Unit, London.

FreightWatch (2012), FreightWatch International Global Threat Assessment, FreightWatch Austin TX.

Gorr, W., Olligschlaeger, A and Thompson, Y. (2003), "Short-term forecasting of crime", *International Journal of Forecasting*, Vol. 19, pp. 579–594.

Guthrie, J. and Guthrie, A. (2006), "A research agenda for loss Prevention", *International Journal of Retail & Distribution Management*, Vol. 34, No. 11, pp. 873–878.

IRU (2008), Attacks on drivers of international heavy goods vehicles, International Road Transport Union, Geneva.

Haelterman, H. (2011), Re-thinking the cost of supply chain security', *Crime, Law and Social Change*, Vol. 56, No. 4, pp.389–405.

Hylleberg, S. (Ed.) (1995), *Modelling Seasonality,* Oxford University Press, New York.

Johns, T. and Hayes, R. (2003), "Behind the fence: Buying and selling stolen merchandise". *Security journal*, Vol. 16, No. 4, Perpetuity Press.

Juttner, U. (2005), "Supply chain risk management: Understanding the business requirements from a practitioner perspective". *The International Journal of Logistics Management*, Vol. 16, No. 1, pp. 120–141.

Kazim S, (2007) "Exploring the benefits of vendor managed inventory". *International Journal of Physical Distribution & Logistics Management*, Vol. 37, No. 7, pp.529–545.

Khan, O. and Burnes, B. (2007), "Risk and supply chain management: Creating a research agenda", *International Journal of Logistics Management*, Vol. 18, No. 2, pp. 197–216.

Lab S. P. (2000), *Crime prevention: Approaches, practices and evaluations*. Fourth edition. Andersson Publishing Co, Cincinnati US.

Manuj, I. and Mentzer, J.T. (2008a), "Global supply chain risk management", *Journal of Business Logistics*, Vol. 29, No. 1, pp. 133–155.

Manuj, I. and Mentzer, J.T. (2008b), "Global supply chain risk management strategies". *International Journal of Physical Distribution & Logistics Management*, Vol. 38, No. 3, pp. 192–223.

Mazeradi, A. and Ekwall, D. (2009), "Impacts of the ISPS code on port activities – A case study on Swedish ports". *World Review of Intermodal Transportation Research*, *Vol. 2, No. 4,* pp. 326–342.

Muir, J. (1996), "Theft at work". *Work Study*; Vol. 45.

Norrman, A. and Jansson, U. (2004), "Ericsson's proactive supply chain risk management approach after a serious sub-supplier accident", *International Journal of Physical Distribution & Logistics Management*, Vol. 34, No. 5, pp. 434–456.

Oliphant, B.J. and Oliphant, G.C. (2001), "Using a behavior-based method to identify and reduce employee theft", *International Journal of Retail & Distribution Management*, Vol. 29, No. 10, pp. 442–51.

Rabinovich, E. and Cheon, S. (2011), "Expanding horizons and deepening understanding via the use of secondary data sources", *Journal of Business Logistics*, Vol. 32, No. 4, pp. 303–316.

Reppetto, T. A. (1974), *Residential crime,* Ballinger Publishing Company, Cambridge.

Roso, V. and Lumsden K. (2009), "The dry port concept – Moving seaport activities inland?" *UNESCAP Transport and Communications Bulletin for Asia and the Pacific*, No. 78, Development of Dry Ports, pp. 87–102.

Sherman, L.W., Gartin, P. R. and Buerger, M. E. (1989), "Hot spots of predatory crime: Routine activities and the criminology of place", *Criminology*, Vol. 27, No. 1, pp. 27–55.

Tarn, J. M and Razi, M. A. and Wen, H. J. and Perez, A. A. (2003), "E-fulfillment: the strategy and operational requirements", *Logistics Information Management*, Vol. 16 No. 5, pp.350–362.

TruckPol (2007), TruckPol Annual Report 2007, Homeoffice, TruckPol, UK.

Tummala, R. and Schoenherr, T. (2011), "Assessing and managing risks using the supply chain risk management process (SCRMP)", *Supply Chain Management: An International Journal*, Vol. 16, No. 6, pp. 474–483.

Tyska, L.A. and Fennelly, L.J. (1983), *Controlling cargo theft*. Woburn: Butterworth Publishers, Boston.

Urciuoli, L. (2010), "Supply chain security – mitigation measures and a logistics multi-layered framework", *Journal of Transportation Security*, Vol. 3, No. 1, pp. 1–28.

Urciuoli, L. and Ekwall, D. (2015), "The perceived impacts of AEO security certifications on supply chain efficiency – a survey study". *International Journal of Shipping and Transport Logistics,* Vol. 7, No 1, pp. 1–20*.*

Wagner, S.M. and Bode, C. (2008), "An empirical examination of supply chain performance along several dimensions of risk", *Journal of Business Logistics*, Vol. 29, No. 1, pp. 307–325.

Waters, D. (2007), *Supply chain risk management: vulnerability and resilience in logistics*. Kogan-page, London.

HAZARD project has 15 full Partners and a total budget of 4.3 million euros. It is executed from spring 2016 till spring 2019, and is part-funded by EU's Baltic Sea Region Interreg programme.

HAZARD aims at mitigating the effects of major accidents and emergencies in major multimodal seaports in the Baltic Sea Region, all handling large volumes of cargo and/or passengers.

Port facilities are often located close to residential areas, thus potentially exposing a large number of people to the consequences of accidents. The HAZARD project deals with these concerns by bringing together Rescue Services, other authorities, logistics operators and established knowledge partners.

HAZARD enables better preparedness, coordination and communication, more efficient actions to reduce damages and loss of life in emergencies, and handling of post-emergency situations by making a number of improvements.

These include harmonization and implementation of safety and security standards and regulations, communication between key actors, the use of risk analysis methods and adoption of new technologies.

See more at: http://blogit.utu.fi/hazard/