An integrated vandalism and theft analysis for the Western Cape rail network

Project Report

Report presented to the Cape Higher Education Consortium and Western Cape Government Joint task team

Workshop 1: Planning for Resilient Growth

PSGs 1 and 4

February 2019

Prepared by:

PRASA Engineering Research Chair
Industrial Engineering
Stellenbosch University
prasachair@sun.ac.za
021 808 4210

WCG Partner:
Van Schalkwyk GP
Department of Transport and Public Works
(Branch: Strategy, Planning and Co-ordination)
Gerrit.vanSchalkwyk@westerncape.gov.za
021 483 8301

1. Abstract

The vandalism and theft of railway assets are a major cause of disruption in the Western Cape rail network. With the increase in population and the increased need for public transportation, the Western Cape rail network is struggling to meet its demand because of these disruptions. A literature review was done to better understand vandalism, theft and the impact these types of incidents have on the rail network in South Africa, and internationally.

A data analysis was done into the vandalism and theft of rolling stock and infrastructure assets for the Western Cape rail network. Data was collected from the Passenger Rail Agency of South Africa (PRASA) offices in Salt River, Cape Town, because this department has an overview of all the vandalism and theft incidents reported against the Western Cape rail network. The analysis for both data sets showed a distinct pattern of increased incidents from 2013 to 2014, a decrease from 2014 to 2015 and a large increase again towards 2017. Hotspot locations for incidents on rolling stock assets were found to be Paarden Eiland, Salt River and Cape Town. Hotspot locations for incidents on infrastructure assets were found to be Bonteheuwel, Lavistown and Nyanga. For both sets of data the components most affected were cables.

Possible solutions were investigated in this study which gives opportunities for further research into the application and effectiveness of these solutions. This project aligns with the priorities of the Western Cape Government to plan for resilient growth by improving transport planning in the Province.

2. Introduction

Transportation in South Africa is an integral part of everyday living and activity. The modern era has seen an increase in population and their need for efficient modes of transportation. More so, in Post-Apartheid South Africa, specifically with the influx of people into the Western Cape, newer transportation methods have been introduced. Some of these methods include, but are not limited to minibus taxis, Golden Arrow busses, My City busses, meter taxis and Uber car transport. Other forms of transport available include train (Metrorail) and personal vehicles. According to Pali Lehohla (2015), most people in South Africa use personal cars, trucks or company cars to travel to and from work. According to a general household survey done by Statistics South Africa (2017), 27.8% of commuters use taxis, 10.6% use the bus services and 10.5% use trains as a means of transportation in the Western Cape alone. A single train coach can accommodate more than 100 passengers at a time while a taxi can only accommodate 14-16 passengers. It would make sense that the amount of people using trains as a mode of public transport should be higher than that of taxis, but this is not the case.

The question that then arises is: why is the Cape Town passenger rail network so underutilized? Long delays and lines not working on certain days, result in pressure on the other modes of public transport. One of the major delays in the railways network has been attributed to **vandalism** and **theft** of railway assets.

Preliminary research established that vandalism and theft on railway infrastructure assets are major contributors to disruptions. However, this should be managed holistically and based on an integrated approach. This research focused on integrating vandalism and theft data from different asset classes obtained from different role-players. Metrorail and Transnet are identified as the role-players, seeing that Metrorail is managing the rail service on infrastructure belonging to themselves as well as on infrastructure belonging to Transnet. Components were identified from the different asset classes that are affected, the monetary value of the components and the value of these components in the system, and finally where, when and how these components are vandalised and stolen. With this clear understanding of the scope of the vandalism and theft problem, solutions are proposed to mitigate rail vandalism and theft holistically.

2.1. Research questions

The following research questions are answered by this research:

1. What are the best practises in mitigating vandalism and theft and what are the effectiveness thereof? (Leads to objective 1).
2. What is the extent and the detail of the vandalism and theft problem in the Western Cape? (Leads to objective 3).
3. What are the hotspots and patterns for vandalism and theft in the Western Cape rail network? (Leads to objective 4).
4. Is there a difference in the approach to vandalism and theft by the different role-players, and how effective are these approaches? (Supports objective 5).
5. How can vandalism and theft be mitigated in the Western Cape rail network? (Support objective 6).

2.2. Research Objectives

The primary objective of this project is to carry out an integrated analysis of rolling stock and infrastructure assets of the Cape Metropolitan and Boland rail network as far as Wellington and Worcester, with the focus on vandalism and theft. To support this, the following secondary objectives are set to be met:

1. Establish an understanding in best practice in mitigating vandalism and theft (answer research question 1).
2. Collect data from role-players on vandalism and theft of railway assets.
3. Determine the scope of the vandalism and theft problem by identifying what specific components are vandalised and stolen, the monetary value of these components in relation to the value of the components in the system, and where, when and how these components are vandalised and stolen (answer research question 2).
4. Analyse data for trends in hotspots and patterns (answer research question 3).
5. Determine the correlation and effectiveness between vandalism and theft for the respective role-players (answer research question 4).

6. Perform final analysis and report and conclude with recommendations and proposals for future work on vandalism and theft (answer research question 5).

3. Research methods

The study approach followed during this research project includes the following:

A literature study:

- Railway systems in general, to determine the critical components, and the effect of vandalism and theft thereof.
- Vandalism, theft and sabotage in general, and specific to railways to determine possible reasons, motives and factors that are responsible for the incidents.
- Local and international reported incidents to understand the extent and impact of the problem.
- Prevention methods from other countries to determine whether it would be possible to apply it to the South-African context.
- Prevention methods and strategies that have been implemented, to provide insight as to what the recommended solutions should avoid or incorporate.

3.1. Literature review

Passenger facilities rely on open buildings and structures to facilitate the movement of commuters in and out of the amenities (Riley, 2004). The rail network is spread over large distances with long stretches of the track going unsupervised (Grey, 2017). These features make rail transportations unique and also make it vulnerable to attacks (Riley, 2004), whether it is in the form of vandalism, theft or sabotage.

Vandalism can be defined as the crime of intentionally damaging property belonging to another person or institution, or any activities committed to destroy or damage something that was good (Cambridge Dictionary, 2018). Ceccato (2013) defines vandalism to be a criminal onslaught involving the defacing or damage of property belonging to the public or other persons.

In order to eliminate the idea that vandalism is a single act committed by mindless adolescents, different motivations for vandalism will be defined. There are many ways to define vandalism. The types of vandalism that is referenced to the most in literature was first defined by Stanley Cohen, a sociologist (Moffatt, 2003; Forsyth & Copes, 2014). Motivations for vandalism given by Cohen include: Acquisition vandalism, tactical vandalism, ideological vandalism, vindictive vandalism, play vandalism and malicious vandalism (Forsyth & Copes, 2014).

Acquisition vandalism includes looting, petty theft, and any other act to acquire money or goods (Forsyth & Copes, 2014; Moffatt, 2003). Tactical vandalism includes intentional property damage done to advance some other end or draw attention to a grievance or to force a reaction. Prisoners who

damage their cells when protesting for better facilities or a man who intentionally breaks the law with the hopes of being arrested to get a bed and food in a cell (Forsyth & Copes, 2014; Zimbardo, 1971).

Ideological vandalism is similar to tactical vandalism in the sense that the act is done intentionally. This type of vandalism, is however, done specifically to further an ideological cause (Forsyth & Copes, 2014; Zimbardo, 1971; Cohen, 1973). This can include burning buildings and train couches or painting anti-government slogans on governmental property to make a statement or to deliver a specific message.

Vindictive vandalism can be defined as damage done specifically to get revenge, this includes acts like arson (Forsyth & Copes, 2014). In the Case of the South African rail network it can be used to describe any member of the public that vandalise the rail assets to take revenge on PRASA specifically or the government.

Play vandalism is seen as vandalism as a result of an unintentional act such as a ball breaking a window while playing a game (Cohen, 1973; Forsyth & Copes, 2014). And lastly malicious vandalism is the damage done to property resulting from a general expression of frustration or rage. This vandalism may be unplanned or aimless, but is often directed at public institutions, symbols of middle-class property and anonymity-promoting systems, such as train stations, schools and other forms of public transport like busses (Zimbardo, 1971).

Vandalism, theft and sabotage of railway assets are not exclusive to South Africa, it is a global problem. A recent article in the Los Angeles Times report on striking staff at the national rail company SNCF in France, that began a series of two-day walkouts planned every five days for the following months, leaving many passengers stranded (Willsher, 2018). In Frankfurt Germany, Deutsche Bahn company lost over €100m due to a strike by Germany's train drivers (Reuters, 2014). A strike by railway employees in Sydney was estimated to cost their economy more than $100 million. Patricia Forsythe, executive director of the Chamber said that the estimate was based on the fact that about 10 percent of the workforce in Sydney use the rail system to get to work (Clun, 2018).

3.1.1. International approaches to the prevention of vandalism, theft and sabotage

Some prevention strategies for the vandalism and theft of railway assets that are currently investigated and implemented by international railway companies. Some of these solutions include:

Anti-theft trigger alarms:

This product sets off an alarm before the cables are removed. The system can detect when a manhole lid is lifted, or when a cable tray is opened, allowing time for intervention to prevent the actual theft.

Replacing copper with other substitutes:

A possible solution strategy for preventing copper cable theft is replacing it with alternatives. Some of the alternatives have already been implemented successfully and others are still in the development

and investigative phase. By looking at both the implemented and new technology an idea can be formulated as to the possibilities that exists. This includes the following:

Replacing copper with Aluminium:

Aluminium is a cheaper alternative to copper with the same conductive properties as copper. By replacing copper with aluminium, there is a significant reduction in the cost ace when the cables are stolen. According to Deangroup (2017) the British rail have been using aluminium cables in their signalling power supply since the 1970s. These lines are still operational after 40 years, which prove that aluminium cables are a good investment. They can last for a long time before having to be replaced (Deangroup, 2017).

Carbon wire to replace copper:

One of the main reasons for the use of copper in cables is its excellent conductive properties. Literature shows advancements in the field of conductive materials in the form of carbon nanotube wires (CNTs). These wires are said to be ten times lighter than copper, more flexible, and stronger. This technology was first developed in a usable form by researchers from the University of Cambridge, in June 2013 (Koziol, 2013). Their main objective for looking at CNTs to replace the use of copper was its weight, and the fact that it does not corrode or oxidise like copper does. These properties are especially important in electrical systems that are continuously exposed to the elements. The only negative of this product is that it is very expensive compared to copper.

Property marking

Property marking is a form of marking your possessions or property in the hopes of preventing theft. The literature shows two main forms of property marking: permanent marking and invisible marking (SelectaDNA, 2018; Northamptonshire Police, 2018). Permanent marking involves stamping, engraving, writing or etching a security code onto items that is important. The problem with permanent marking is usually that the thief can remove the marking by filing it off, or in the case of metal, smelting it. The marking disappears entirely.

Invisible marking would be the proposed solution to prevent the theft of railway assets. Invisible marking includes UV pens, Micro-dotting, Chemical marking or DNA marking. UV pens is one of the first type of property marking techniques used by the police in the 1980s. The problem with UV ink is that it fades away when it comes in contact with the sun (The Crime Prevention Website, 2018).

DNA marking involves applying synthetic DNA to valuable assets. This DNA is transferable to whoever touches it. Each batch is connected to a tracking number, so when thieves steal a valuable asset this artificial DNA assists the authorities in the identification, and conviction of the guilty parties (SeekerDNA, 2018; The Crime Prevention Website, 2018).

Video surveillance

One of the many security solutions offered on an international platform is video surveillance. A study done in the United States suggests that the effects of videos surveillance are amplified when the cameras are visible to offenders, because of an increased awareness among them (McLean, et al., 2013). Four studies done by McLean et al. also suggested a 23% decrease in crime related incidents in the public transportation sector.

Concrete cable troughs

In the United Kingdom there are companies that manufacture troughs for encasing cables for power plants, mass transit or railroad cables. In the troughs the cables are protected against acts of vandalism and accidental damage (Thorne & Derrick, 2018). These troughs not only protect the cables from the elements, but if they are buried deep enough, they can be buried by another layer of concrete to prevent the theft of the cables. Access points can then be protected with various methods including trigger alarms, CCTV etc.

3.2. Data Collection and analysis

Data on rolling stock and infrastructure was collected from a South African Rail role player affected by these incidents. The data collected was then analysed using data analysis techniques such as process flow, cause-and-effect diagrams and Pareto principles to determine scope of the vandalism and theft problem by identifying the critical components that are vandalised or stolen. The components with the most incidents were highlighted and focused on for hotspot, patterns and possible engineering solutions. Figure 1 shows the process followed to carry out the data analysis.
From the literature study and the data analysis, recommendations pertaining specifically to the prevention of vandalism and theft in the rail network were provided.

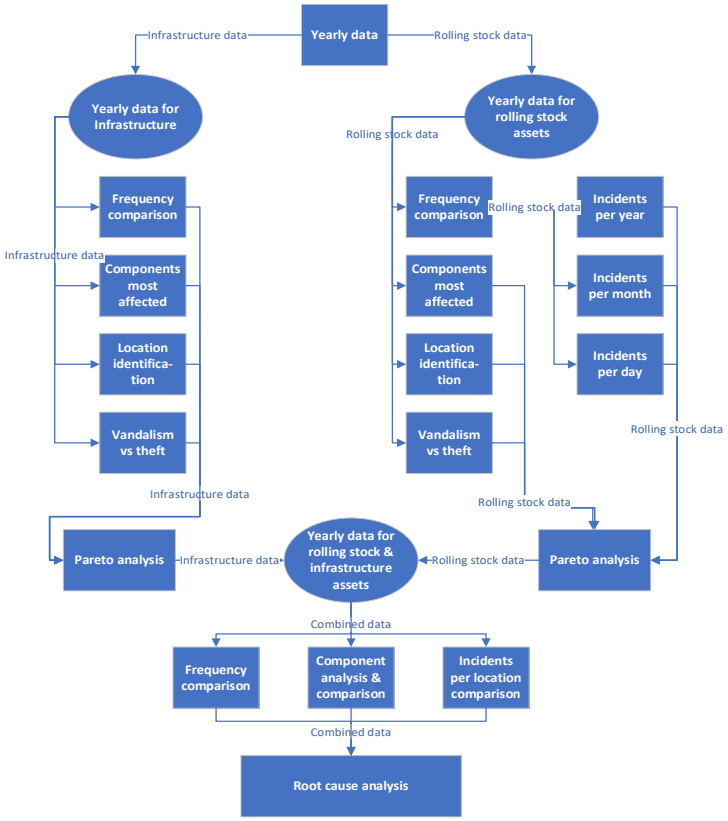

Figure 1: Process flow chart to illustrate the methodology for data analysis

3.3. Project limitations

This research project focused on an integrated analysis of vandalism and theft data from different asset classes from different role players. An integrated analysis on the theft and vandalism of rolling stock and infrastructure in the Cape Metropolitan and Boland as far as Wellington and Worcester was conducted with data from only one role player, namely PRASA. This was due to the lack of cooperation by other role players. Also, data outside the Cape Metropolitan and Boland were not considered as it fell outside the scope of this project.

4. Results.

4.1. Rolling stock data

The analysis of rolling stock data gives an overview of all the components that are vandalised or stolen in the rolling stock department. This section presents the vandalism versus theft incidents, the location specific patterns and critical component analysis for the rolling stock department at Salt River, Western Cape.

4.1.1. Vandalism vs Theft occurrences

After the sorting of the data was done, the data were plot as can be seen in Figure 2(A) and 2(B). In both the figures the type of incident that occurs most in the rolling stock department is vandalism. This can be because the rolling stock components are the components that have the most interaction with passengers.

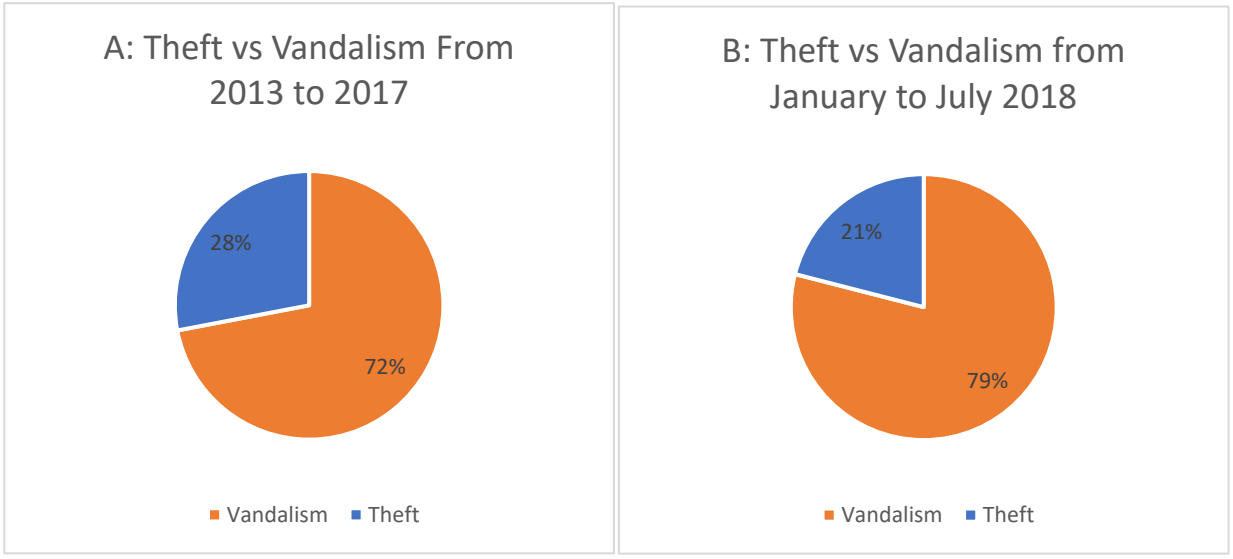

Figure 2: Percentage theft versus vandalism incidents from A: 2013 to 2017 and B: January to July 2018

In Figure 3 the number of vandalism incidents are significantly more for each of the years from 2013 to 2016, but for 2017 the number of theft incidents are more than those of vandalism. One factor that might play a role in the significant number of vandalism incidents, is that that some incidents are merely classified as vandalism incidents. It can be suggested that even with more accurate data acquisition the number of vandalism incidents would still be larger from 2013 to 2017.

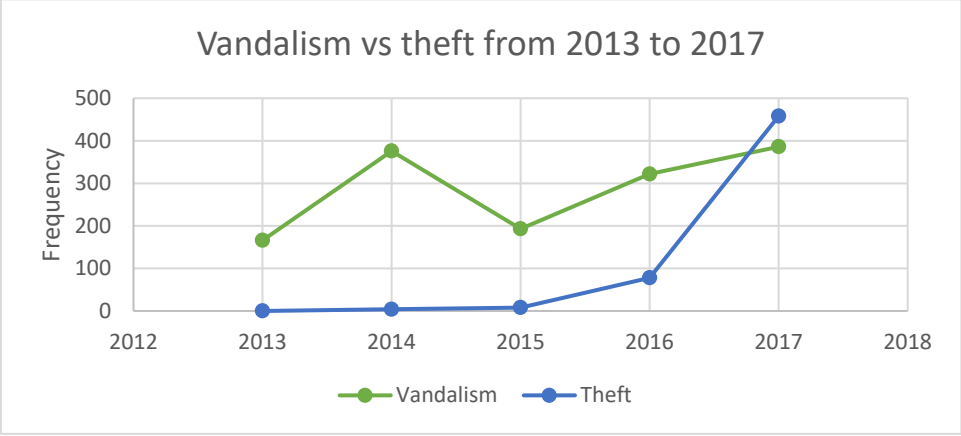

Figure 3: Vandalism versus theft from 2013 to 2017

4.1.2. Location Specific patterns

The data from 2018 was excluded because when the analysis was done during the year. Only data from 2015, 2016 and 2017 were used to identify location specific patterns.

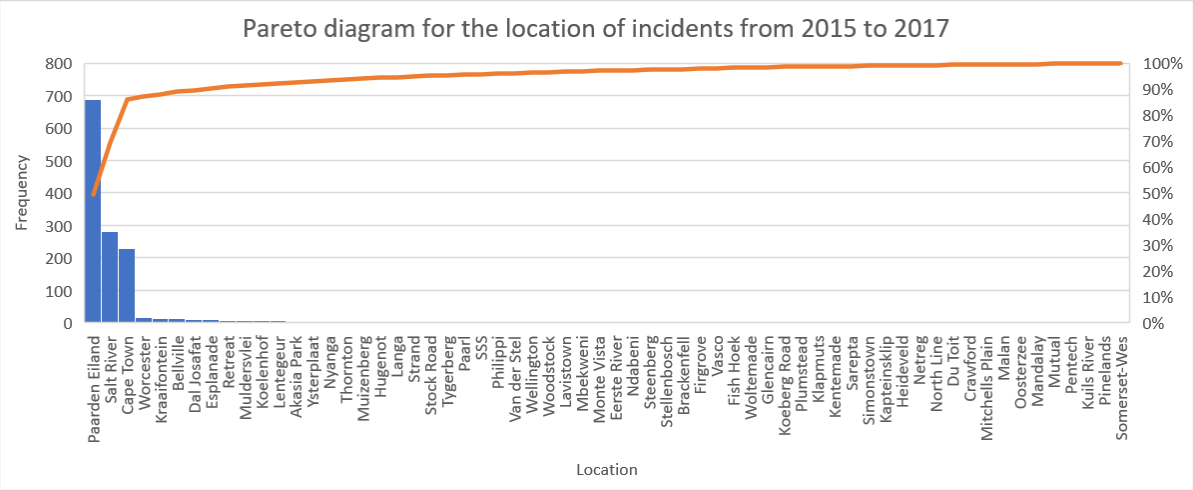

Figure 4: Pareto diagram for the location identification of incidents from 2015 to 2017

Figure 4 shows a Pareto diagram for the location of incidents from 2015 to 2017. The maximum number of incidents is 687 at Paarden Eiland, followed by 281 at Salt River and 229 at Cape Town. This can be because Cape Town station is the most secure station of the three locations, with Paarden Eiland being the least secure.

4.1.3. Critical component analysis

Figure 5 shows that cables are the components most affected by vandalism and theft incidents. Windows, damage from fire (total or partial coach damage) and panels vandalised or stolen fall in the 20% of problems according to the Pareto principles. Damages from fires are not explained in detail in the data and is thus only categorised as fire damage in the analysis.

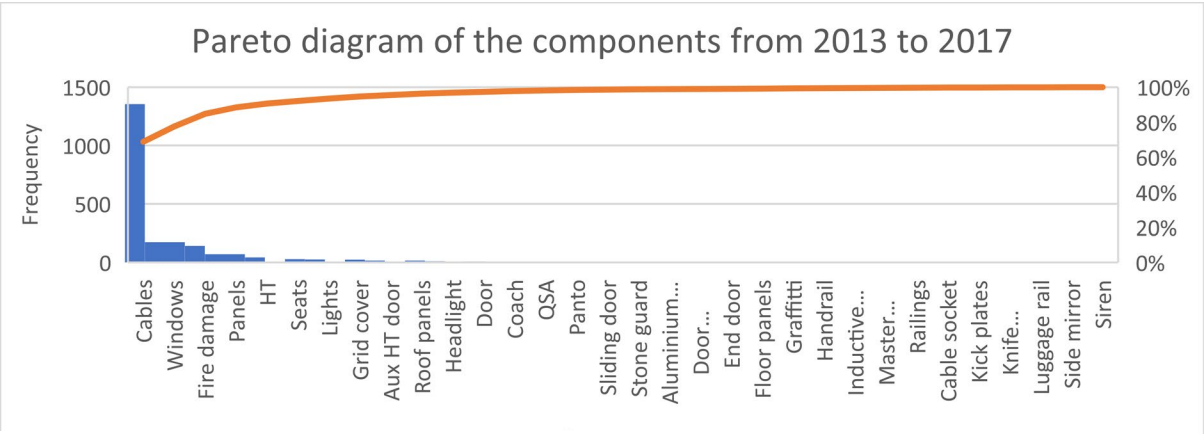

Figure 5: Pareto diagram for the components vandalised and/or stolen from 2013 to 2017

4.2. Infrastructure data

The analysis of infrastructure data gives an overview of all the components that are vandalised or stolen in the infrastructure data department. This section presents the vandalism versus theft incidents, the location specific patterns and critical component analysis for the incidents against the Western Cape rail network infrastructure. The data was obtained from the Signals and Perway departments at the Western Cape rail network Salt River offices.

4.2.1. Vandalism vs Theft occurrences

Each incident recorded were classified under vandalism and theft descriptions and plotted to see the difference. Figure 6 (A) shows the Vandalism versus theft incidents from 2103 to 2017. This figure shows that the occurrences of theft is significantly more than those of vandalism for the infrastructure data. Figure 6 (B) show the vandalism versus theft incidents for January to July 2018. By comparing both figures, the number of vandalism incidents have increased in 2018.

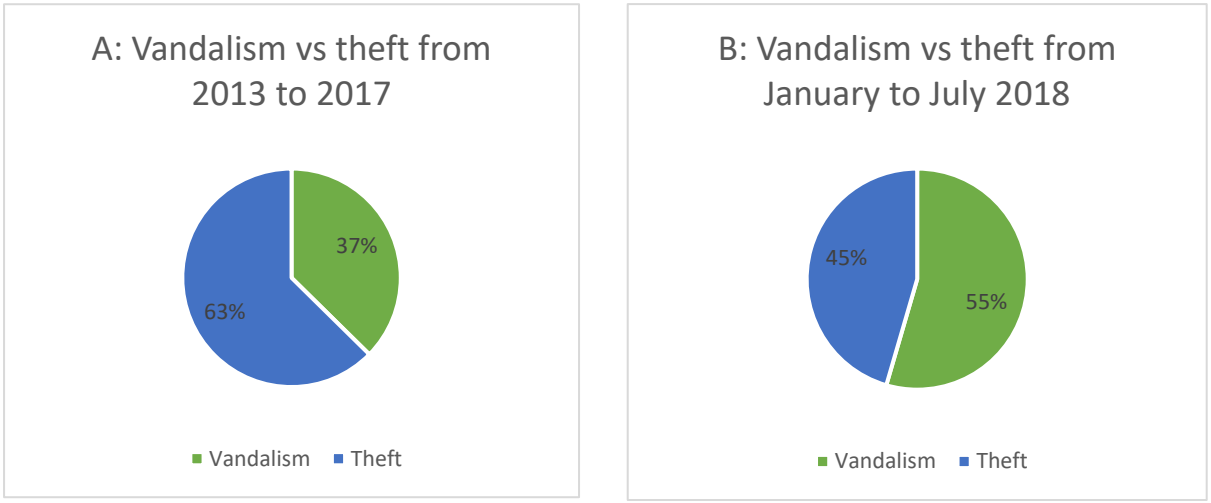

Figure 6: The vandalism versus theft for A: 2013 to 2017 and B: January to July 2018

Figure 7 shows a more detailed representation of the vandalism versus theft incidents. The figure shows how the number of vandalism incidents versus theft incidents increases from 2013 to 2017, with the smallest difference in 2017. This is consistent with the larger number of vandalism incidents in 2018.

.

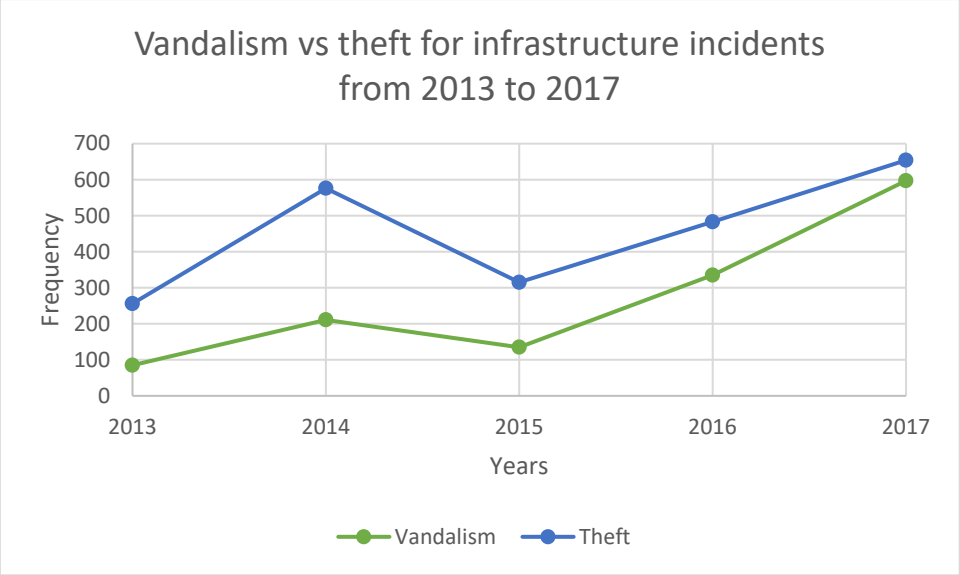

Figure 7: Vandalism versus theft for infrastructure incidents from 2013 to 2017

4.2.2. Location Specific patterns

Data from 2018 were excluded from this analysis, because the recorded data for 2018 are incomplete given that the project was conducted during the year. Figure 8 shows a Pareto diagram of the location of incident from 2015 to 2017. The maximum number of incidents is 245 at Bonteheuwel, followed by 170 at Lavistown, 153 at Nyanga, 126 at Retreat, 120 at Stellenbosch and Blackheath. A separate analysis was done for January to July 2018, the results showed that the prevention methods applied at those locations are effective with the location most affected now

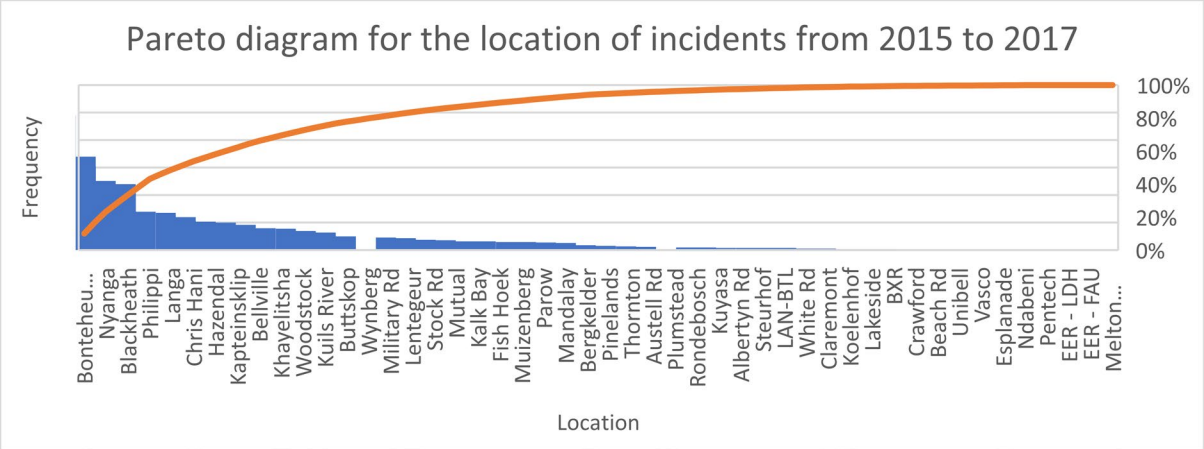

Figure 8: Pareto diagram for the location of infrastructure incidents from 2015 to 2017

Stellenbosch with 32 incidents, Retreat with 26 incidents and Blackheath with 25 incidents. Bonteheuwel and Nyanga only have two reported incidents and Lavistown has one reported incident, for the first half of 2018.

4.2.3. Critical component analysis

Figure 9 shows a Pareto diagram of the infrastructure components affected from 2013 to 2017. The diagram shows that cables, booms, track boxes and rail clips are the four components most affected in descending order. Cables, however, have more than four time the number of incidents than any of the other components. A separate analysis was done from January to July 2018 which gave similar results.

4.3. Root-cause analysis

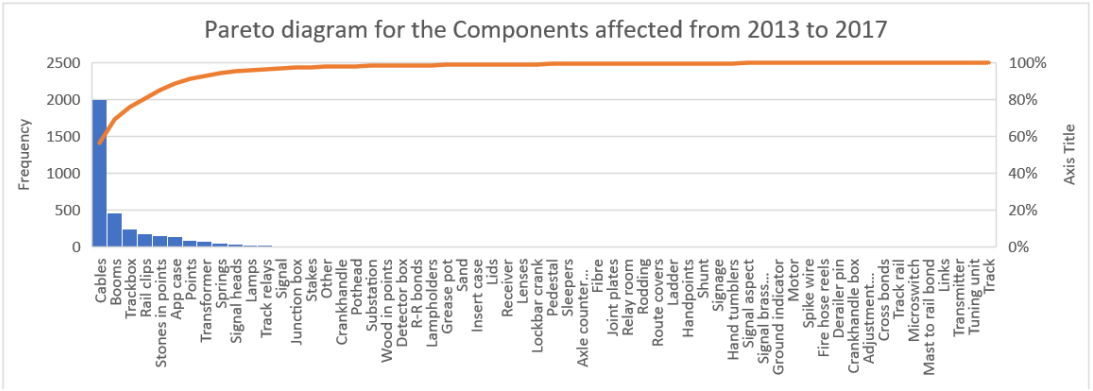

Figure 9: Pareto diagram for the infrastructure components affected from 2013 to 2017

A cause-and-effect analysis was used to determine the root causes of vandalism and theft incidents against the Western Cape rail network. The results from this analysis will be important in recommending strategies for the prevention of incidents. From the literature study, it was found that all incidents, whether it be vandalism, theft or sabotage, can be classified under the broader description of vandalism. The causes in the cause-and-effect analysis shown in Figure 10 were classified under the different types of vandalism.

The analysis done shows many possible causes for the same problem, vandalism. From the cause-and-effect diagram done for vandalism, the cause with the largest contribution to the number of incidents recorded was identified to be acquisition vandalism, or more commonly known as theft. Acquisition vandalism is thus identified as the root cause of vandalism incidents. The graphical representation of acquisition vandalism can be seen in Figure 11. From the acquisition vandalism diagram the root cause was identified to be the illegal business opportunities that exists because of the high value of copper, and the accessibility to the rail network assets

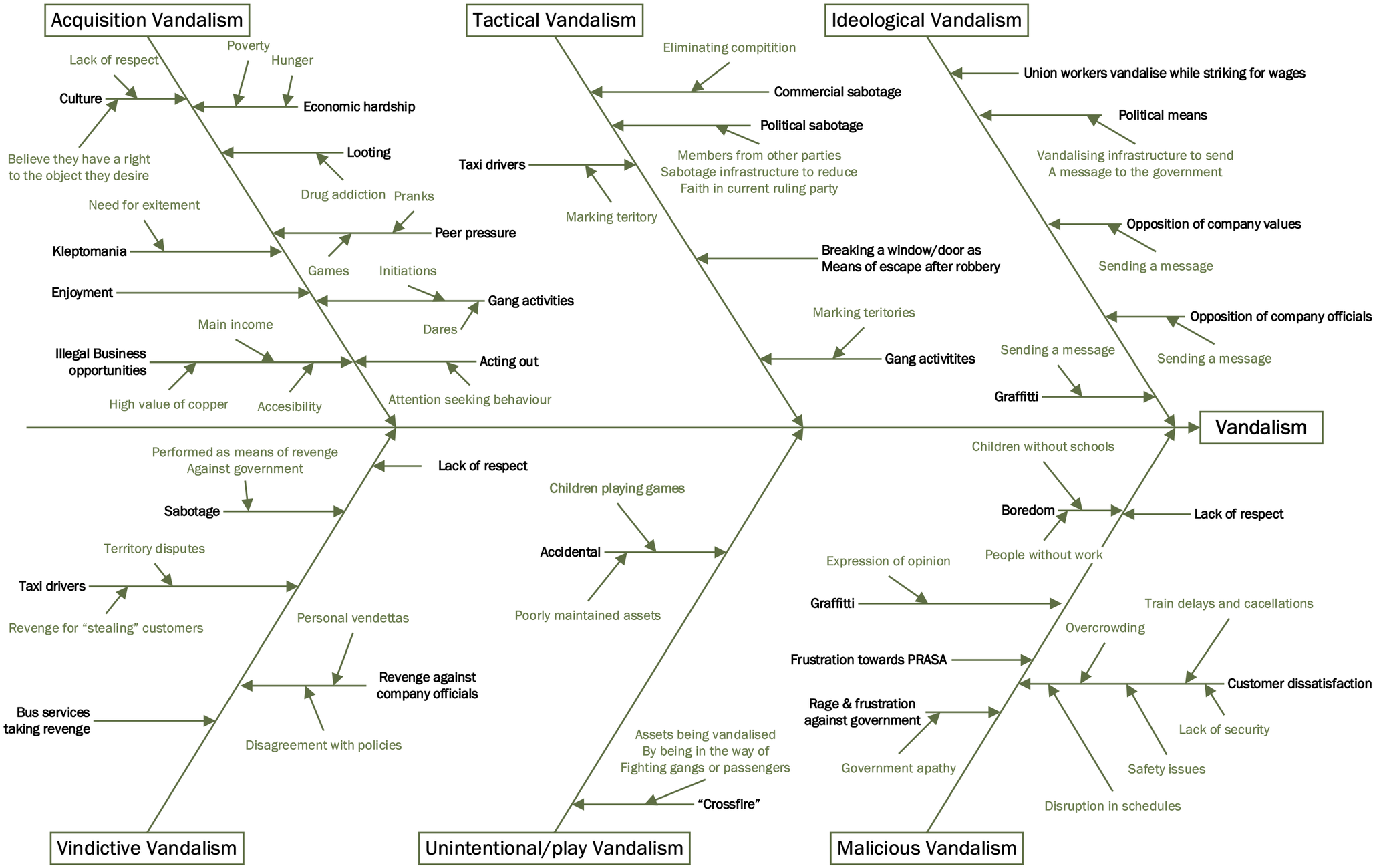

Figure 10:Cause-and-effect diagram for Vandalism

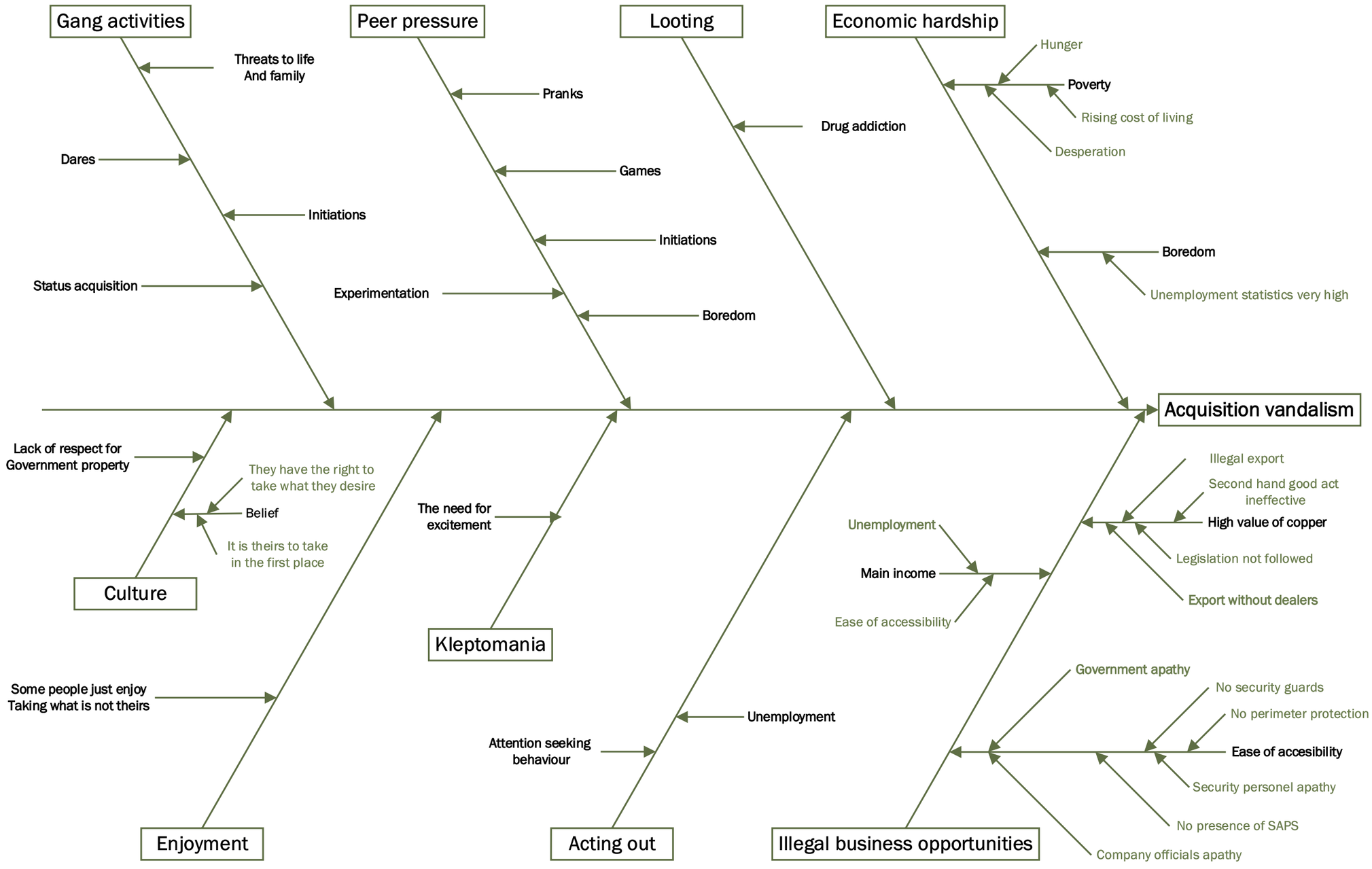

Figure 11; Cause-and-effect diagram for Acquisition Vandalism

5. Conclusions

This project focused on rolling stock and infrastructure asset data separately to determine patterns for each department. The results from the separate analyses were then used to compare and provide possible engineering solutions for the patterns found in the data.

When comparing the original research questions as posed in Section 2.1, the conclusions can be classified as follows:

- Extent of the vandalism and theft problem: From analyses it was found that there was a distinct pattern when looking at incidents per year. Both sets of data showed a definite increase in incidents in 2014 with a decrease in 2015 and a large increase again from 2015 to 2017.
- Hotspot and patterns for vandalism and theft: Hotspot locations were different for rolling stock and infrastructure assets. This means that solutions should be implemented to reduce incidents at the three most affected locations for both rolling stock and infrastructure assets separately. Incidents showed no definite pattern when looking at the incidents per month which means that the rail network is vulnerable all year round.
- Different approaches to vandalism and theft: From the literature and the cause-and-effect analysis, it was clear that although vandalism and theft are described separately in the conventional manner, all incidents can be classified as vandalism incidents. With six different types of vandalism namely, acquisition vandalism, tactical vandalism, ideological vandalism, vindictive vandalism, play vandalism and malicious vandalism, the study showed that the type of vandalism with the most incidents on the rail network is acquisition vandalism (theft).
- Best practises in mitigating vandalism and theft: PRASA can treat the symptoms of vandalism and theft by implementing engineering solutions to prevent these incidents by making the rail network less accessible with increased protection and creating awareness campaigns to stress the importance of reporting offenders to the authorities.

When making suggestions to prevent the vandalism of assets, it is important to remember that criminals are very intelligent and resourceful, and that although some strategies for prevention might decrease the incidents against a specific asset, criminals that have intent will find a way to get what they want. It is therefore also important to conduct sociological studies into the problem.

6. Recommendations

It is recommended that all engineering solutions identified be further investigated in detail to determine whether it would be financially and socially viable to implement these solutions. A further recommendation regarding the engineering solutions, is to implement the solutions that were found to be the most viable. A lot of projects can be done to study this problem, but if none are implemented, the rail network remains in the same condition.

Future projects recommended from problems identified include:

1. Security improvement and optimization strategies/projects (Security Engineering) to improve the security of railway assets.
2. An in-depth study should be conducted on hotpots identified to determine location specific solutions.
3. Building theoretical models to see what will happen when certain solutions are implemented.
4. Do sociological and behavioural studies in the regions of the locations identified to determine whether the solutions suggested would be viable.
5. Complete an analysis on the components replaced or ordered per department to do an in-depth study on the individual components affected and the scope of it, for e.g. how many meters of cable were stolen/vandalised or how many meters of which cable were stolen/vandalised.
6. A project for the standardization of data recording could be launched. In this project it would be recommended that Excel and the VBA functions be used to write an interface program that forces the user to input all the required fields that is required for further data analysis.
7. Awareness campaigns can be deployed to educate the communities on the effects of the vandalism and theft of rail assets. It could be that the communities witness these incidents, but that the offenders are not reported, because they are scared that the community or the offenders might harm them if they report the incidents.

7. Budget

The actual monetary value spent against the budget included in the original proposal is given below. Please note that the figures are determined by calculating the hourly rate of the engineers and hours spent on each activity.

Table 1: Actual spend budget as an indication of proposal budget

	Description of budget line item	Budget (R)	Spent (R)
a.	Establish an understanding in best practice: Travelling, interviews, research	10000	9600
b.	Collect data from role-players: Travel cost and communication	8000	9200
c.	Analyse data: Lab time	25000	22300
d.	Determine correlations: Lab time	8000	11500
e.	Determine scope: Conducting field work, performing interviews, system analysis and financial analysis.	42000	48700
f.	Compile final report and recommendations	5000	7300
	TOTAL	98000	108600

8. References

1. Cambridge Dictionary, 2018. *'Meaning in the Cambridge English Dictionary'.* [Online], Available : https://dictionary.cambridge.org/dictionary/english/vandalism [2 July 2018].
2. Ceccato, V., 2013. *Vandalism,* Sweden: Royal Institute of Technology.
3. Cohen, S., 1973. Property reduction: motives and meanings. In: *C.Ward (Ed.) Vandalism.* New York: Van Nostrand Reinhold, pp. 23-53.
4. Clun, R., 2018. *The Sydney Morning Herold.* [Online] Available : https://www.smh.com.au/national/nsw/simply-outrageous-train-strike-could-cost-sydney-economy-100m-20180117-h0jld8.html [09 July 2018].
5. Deangroup, 2017. Network rail is replacing copper with aluminium in their cables. [Online] Available at: https://www.deangroup-int.co.uk/network-rail-is-replacing-copper-with-aluminium-in-their-cables/ [13 July 2018].
6. Evans, J. R. & Lindsay, E. M., 2016. Root cause analysis. In: *Managing for Quality and Performance Excellence.* Boston : Cencage Learning, pp. 488-491.
7. Forsyth, C. J. & Copes, H., 2014. Vandalism. In: C. J. F. H. Copes, ed. *Encyclopedia of Social Deviance.* London: Sage Publications inc., pp. 769-770.
8. Grey, E., 2017. *Cable theft still plagues the industry.* [Online] Available : https://www.railway-technology.com/features/featurecable-theft-still-plagues-the-rail-industry-5932428/ [10 July 2018].
9. Koziol, K., 2013. *Carbon 'candy floss' could help prevent energy blackouts,* s.l.: University of Cambridge.
10. Lehohla, P. (2015). National Household Travel Survey - Western Cape profile. [online] Pretoria: Statistics South Africa, pp.5-7.
11. McLean, S., Worden, R. & Kim, M., 2013. An Evaluation of Public. *Criminal Justice Review,* 38(3), pp. 303-334.
12. Moffatt, G. K., 2003. Vandalism. In: *Wounded innocents and fallen angels.* London: Greenwood Publishing Group, pp. 249-253.
13. Northamptonshire Police, 2018. *Property Marking and Identification.* [Online] Available: http://www.northants.police.uk/page/property-marking-and-identification [13 July 2018].
14. Reuters, 2014. *Fin 24.* [Online]. Available: https://m.fin24.com/Economy/German-rail-strike-costs-more-than-100m-20141109 [9 July 2018].
15. Riley, J., 2004. *Terrorism and Rail security,* Santa Monica: Rand Corporation.
16. SelectaDNA, 2018. *Property marking.* [Online]. Available: https://www.selectadna.co.za/property-marking [13 July 2018].
17. STATSSA, 2017. General Household Survey, Pretoria: Statistics South Africa, pp. 26.
18. The Crime Prevention Website, 2018. *Methods of property marking and tagging.* [Online]. Available: https://thecrimepreventionwebsite.com/property-identification--marking-tagging-and-tracking/592/methods-of-property-marking-and-tagging/ [13 July 2018].
19. Thorne & Derrick, 2018. *Cable containment & support.* [Online]. Available: https://www.cablejoints.co.uk/power-products/cable-containment-rail [11 September 2018].

20. Willsher, K., 2018. *Los Angeles Times.* [Online]. Available: http://www.latimes.com/world/europe/la-fg-france-railway-strike-20180403-story.html [9 July 2018].
21. Zimbardo, P. G., 1971. *A social-Psychological analysis of vandalism: Making sense of sensless violence,* s.l.: Stanford University: Department of Psychology.