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Preface

This master's thesis is the final part of my two-year Master of Technology in City and Regional Planning at the University of Stavanger. It is written over the spring semester in 2020. It has been a challenging semester due to the covid-19 pandemic. It hit Norway in March and changed the circumstances over night by closing the university, the library and thus restricted the students' leeway for the rest of the semester.

I have, however, pushed on to the best of my ability. I decided to get my thesis through on time, even though the circumstances were slightly more challenging than initiated. Like urban security, events happen that are out of our control. It is important that we adjust to them as best as we can with the time that is given to us and the tools that are available.

I owe thanks to everyone who has been helping to get me through this semester, and a special thanks goes to my supervisor Tegg Westbrook. Thank you for being so supportive throughout the process. Without your feedback, help and motivation, I would have lost my course.

Furthermore, I must say a thank you for the support from those I have interviewed or discussed my ideas with – it has been most helpful.

I also owe thanks to my family and my friends. Your unwavering support has been invaluable, and this would not have been possible without you.

Finally, I would like to encourage anyone reading this thesis to carefully go through both its purpose and discussion before jumping to any conclusions. A little knowledge can be a dangerous thing – especially while assessing urban security.

With that said, I hope that you find it interesting!

Thomas Olsen Schive

June 2020.

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Vocabulary

Asset:	A useful or valuable thing or person.
CCTV:	Closed-circuit television also known as video surveillance.
CPNI:	The UK Centre for Protection of National Infrastructure.
CPTED:	Crime prevention through environmental design. Design strategy for urban safety and security.
Crowded urban area:	An urban area where >50 people are present at the same time and the density of people is >1,0 people/m^2.
Decision maker:	A person who makes important decisions.
Decision taker:	A person who alters activities and commits to resource allocation.
DESURBS:	Designing Safer Urban Areas. Former EU research project.
DRR:	Disaster Risk Reduction.
DSB:	The Norwegian Directorate for Civil Protection.
IS:	The Islamic state of Iraq and the Levant (ISIL, ISIS, Daesh).
ISR:	Integrated Security and Resilience framework.
Liveability:	A community's quality of life.
NSM:	The Norwegian National Security Authority.
NS:	Norwegian Standard (e.g. 5830 series).
IED:	Improvised Explosive Device. With "VB": Vehicle-borne.
PAT:	The Proportionality Assessment Tool.
Proportionality:	The quality of correspondence. Proportionality is defined contextually in the thesis' theory.
SCP:	Situational Crime Prevention. Design strategy for urban safety and security.
Security risk:	A person or situation which poses a possible threat to security.
Stakeholder:	A person or organisation with interest or concern in something.
Threat:	A person or thing likely to cause damage or danger.
Urban security:	Security in the urban environment.
Urban security measure:	A physical installation that contributes to urban security.
Vulnerability:	The quality or state of exposure to one or more threats.

Summary

Cities and crowded urban areas are increasingly becoming targets of terrorist attacks. They are attractive because they are easily accessible and provide a plethora of high value assets. Even though they have been targeted frequently over the last century, fatal consequences have increased over the latest few decades (Jenkins & Butterworth, 2019; Law, 2009). Both the Al Qaeda and the IS have changed the means of terrorism by lowering the effort to achieve most possible harm. They have turned vehicles into rams, and it has never been easier to construct an IED with instructions found on the internet (Burke, 2018).

Society has become increasingly familiar with terrorism. The importance of urban security is being addressed, and cities are now adapting to the threats through resilience and by retrofitting urban security measures into the built environment. The response has, however, also brought with it disproportional and irrational urban security measures at the expense of both townscape aesthetics and liveability. In Norway, there are two main reasons for this. One is tied to the city governments' and municipalities' incapacity to deal with urban security (Westbrook & Jore, 2020). The other is the lack of a toolbox for assessing it. As a result, we have seen obtrusive anti-riot trucks blocking off roads in the city centre of Oslo during the children's 17th of May parade and dumper trucks parked all over Arendal square during the Christmas tree lighting ceremony in 2017.

Not only do such security measures come at the expense of people's perception of security, they also deeply influence the lives of citizens (Sennett, 2018). But we must not forget where the problem originates. Disproportional security measures are the consequence of poor assessments. How can we expect that assessors will be able to select proportional security measures, when they are only given tools that rely on their own subjective interpretation of urban security?

The thesis helps us deal with this issue. It uses proportionality as key to provide us with a new tool for assessing urban security: The Proportionality Assessment Tool. The tool is supplementing the existing framework such as the ISR and the NS 5832. It is built on the idea of an expanded, contextual definition of proportionality that comes with two new abilities: Performance and Design. 'Performance' ensures that the measures do the job and 'Design' ensures that it is done in an appropriate manner. Together, they give us a measure of proportionality and thus allows us to prioritize urban security measures thereafter.

The tool must, however, be used carefully. Its research methodology leads to certain uncertainties and requirements for use since it is developed by using trial and error, and its trials have been of limited extent. We must, therefore, make sure that we follow the tool's guidelines whenever we use it. Otherwise, we cannot – and should not – rely on it.

1 Introduction

The first chapter presents proportionality's background. It puts the term into a research context, which consists of a problem, research questions and a purpose.

1.1 Background

In September 2017, after the vehicle ramming attack on a bike lane in New York, London mayor Sadiq Khan stated that terrorist attacks are now "part and parcel" of living in a big city (London City Hall, 2017)[1]. Europe has faced a dozen terrorist attacks during the last decade. Even though the attacks have varied in means and consequences, there has been one common denominator: the targeting of crowded urban areas[2] at the core of cities.

Society has become familiar with intentional undesirable actions like terrorist attacks, targeting crowded urban areas. Historically, these areas have been attractive because they often provide a plethora of high value assets in the eyes of terrorists.

We can look, for instance, at the Algerian rebellion of the 1950s[3]. The conflict was a civil war as much as it was a decolonization war, with a number of belligerents. The rebellion was, however, characterized by guerrilla warfare (McCormack, 1973), and this is where the targeting of crowded urban areas becomes relevant. The revolutionary leader of the National Liberation Front (FLN), Abane Ramdane, was the brains behind it. He decided that public attention to their cause was more important than the amount of fatalities, as they fought to win hearts and minds in Algeria (Burke, 2018). Ramdane would rather have one man killed in the city centre of Alger than ten men in the desert, as an incident in the capital would cause a greater scene (Law, 2009). Also, people would instantly know of the event. In the decades that followed, we see many other violent groups and individuals sharing Ramdane's desire for publicity.

The Provisional Irish Republican Army (IRA) is another well-known example. The group performed many attacks targeting crowded urban areas during "The Troubles" (1968-1998). Most of the attacks took place in the last decade of the conflict, such as the Manchester bombing in the busy Corporation street in 1996. Like Ramdane and the FLN, the IRA weighted public attention to their cause more than fatalities, which is why they warned the police 80 minutes before the bomb went off, giving them time to evacuate (BBC, 1996). Their bomb did, however, devastate the busy shopping area and injured more than 200 people (CAIN, 2020).

Al Qaeda is another example of a group targeting and attacking crowded urban areas. The terrorist group is best known for the "9/11" attack taking place in 2001, but this attack was more symbolic in nature than aimed at crowded urban areas (Matusitz, 2015). However, the group has performed many other attacks targeting crowded urban areas during the 2000s. Different from the FLN and the IRA, Al Qaeda desired fatalities and would not warn and allow

[1] This statement is, though, criticised for being controversial and later claimed to be an oversight after Donald Trump Jr. took it out of context and made a fuzz of it on Twitter (Meade, 2017).

[2] Defined as an urban area with >50 people present and a density of >1,0 persons/m^2.

[3] "Modern terrorism" emerged, however, 100 years earlier than the Algerian rebellion, though it is associated with anarchism in league with nationalism (Merriman, 2016). The Algerian rebellion is showcased as the beginning of a new trend where terrorists target crowded urban areas.

evacuation. Two examples from European soil are the detonation of improvised explosive devices (IEDs) in Madrid's public transportation system in 2004, killing 191 people and injuring 1800 people, and the suicide bombing of London's underground in 2005, killing 56 people and injuring about 700 (Stanford Centre for International Security and Cooperation, 2020).

Over the last decade, the Islamic State (IS) has become the main perpetrator of attacks targeting crowded urban areas (Stanford Centre for International Security and Cooperation, 2020). The IS has also introduced new means of attacking. They have optimized the principle of doing the most possible harm with the least possible effort, and have frequently used cars as a weapon. Thus, the IS managed to minimalize the requirements of performing terrorist attacks, while simultaneously lowering the risk of getting caught while planning them. Anyone can own or rent a car without raising suspicion, and any kitchen has knives. During IS' reign, the terrorist group has performed numerous attacks aimed at civilians located in crowded urban areas such as the attacks in Paris (2015), Brussel (2016), Nice (2016), Barcelona (2017), London (2017) and New York (2017) (Stanford Centre for International Security and Cooperation, 2020). And these are only a handful of examples from IS' long list of attacks.

There are, of course, many other violent attacks worth mentioning. In a Norwegian context, the 22nd of July bombing of the Governmental quarter in Oslo, performed by the domestic terrorist Anders Behring Breivik, was motivated by extreme right-wing ideologies (Store Norske Leksikon, 2019). The bomb killed eight people and injured about 200. Two hours later, Breivik attacked the Norwegian Labour Party's youth division's summer camp on the island of Utøya where he opened fire at the participants, killing 69 and injuring at least 100 (Sollid, et al., 2012). In 2019, another Norwegian domestic terrorist attempted to follow in Breivik's footsteps. He attacked a mosque with firearms in Bærum aiming to kill as many Muslims as possible. He was, thankfully, unsuccessful, as he was stopped by Mosque attendants (Riaz, 2020).

Right-wing terrorism is currently rising in Norway and in western Europe. It is showcased in the Norwegian Police Security Service's (PST) threat assessment for 2020, stating that terrorist attacks performed by right-wing extremists are now just as likely to happen as attacks performed by extreme Islamic groups such as the IS (The Norwegian Police Security Service, 2020). The threat assessment differs from the year before, where attacks performed by extreme Islamic groups were considered more likely. Even though the era of IS likely has seen its peak, other terrorist groups are willing to pick up the baton.

To wrap up this quick history lesson, we can have another look at Sadiq Khan and his controversial quote about "part and parcel" in 2017. Although he might have exaggerated to add emphasis, he has a valid point. Recent history shows that violent groups and individuals see crowded urban areas as both attractive and suitable for performing attacks. The areas contain a plethora of high value assets in the eyes of terrorists, complying with the different actors and groups desired outcomes, and are overly present in our cities.

Society is, however, responding to the threat of terrorism. The importance of urban security is being addressed, and cities are now adapting to threats through resilience and by retrofitting security measures into the built environment. Looking to Norway, the national security authorities traditionally use a risk-based approach to handle urban security. Risk assessments

are used as a foundation to make rational, optimal and cost-effective decisions leading to a secure society (Petersen, 1978). Since urban security is subject to both urban planning and societal security, these risk assessments require an unrealistic capacity for most Norwegian city governments and municipalities (Westbrook & Jore, 2020). It is, obviously, problematic when key actors for preventing terrorism cannot see to it (Monstadt & Schmidt, 2019). This leads to decisions that are not rational, optimal nor cost-effective, and to poor security interventions, which deeply influence the lives of our citizens (Sennett, 2018).

Also, while terrorism prevention in Norway remains focused on risk assessments and attempting to stop radicalization (Jore, Utland, & Vatnamo, 2018), the international differs. Internationally, methods for preventing terrorism rely upon urban security concepts such as Crime Prevention Through Environmental Design (CTPED) or Situational Crime Prevention (SCP). The CPTED and the SCP are based around environmental and managerial changes that reduce opportunities or incentives for attacks, rather than creating defensible space, target hardening and excessive manipulation of the built environment (Clarke, 1997; National Crime Prevention Council, 2003; Newman, 1972). These measures need less assessment and are more likely to lead to urban security decisions not intervening with the lives of citizens.

Regardless of concept or strategy, however, there is another aspect to making urban security decisions: Proportionality, also known as the quality of correspondence. Proportionality is the only thing able to assure security measures' correspondence to threats, and to determine a balance among them. It is also the only thing keeping urban security measures from interfering with citizens' quality of life, while holding terrorism at bay. Proportionality is the fine line between urban security measures' performance and society's need of security.

In Norway, there has been a recent change of attitude. Last year, the Norwegian government launched a new Security law addressing terror mitigation measures (The Norwegian Government, 2019). The law's purpose paragraph[4] implies that (urban) security measures must be "proportionate" (Sikkerhetsloven, 2018). This means that even though concepts as the CPTED and the SCP remain absent in Norwegian urban security assessments, proportionality must still be addressed. Currently, this falls into the hands of city governments and municipalities whose hands are already full and whose capacity is limited. A lack of capacity coupled with a limited understanding of proportionality leads to inadequate decisions. Which might explain why the children's 17th of May parade in Oslo city centre three years ago were secured by blocking off roads with armoured, obtrusive anti-riot trucks rather than more civilized urban security measures[5].

[4] § 1-1 c) in the Security law states that security measures must be implemented according to fundamental legal principles and values in a democratic society (Sikkerhetsloven, 2018).

[5] Reference to the use of anti-riot trucks alongside armed police as urban security measures during the children's May 17th parade in Karl Johan, Oslo, in 2017 (Dagsavisen, 2019).

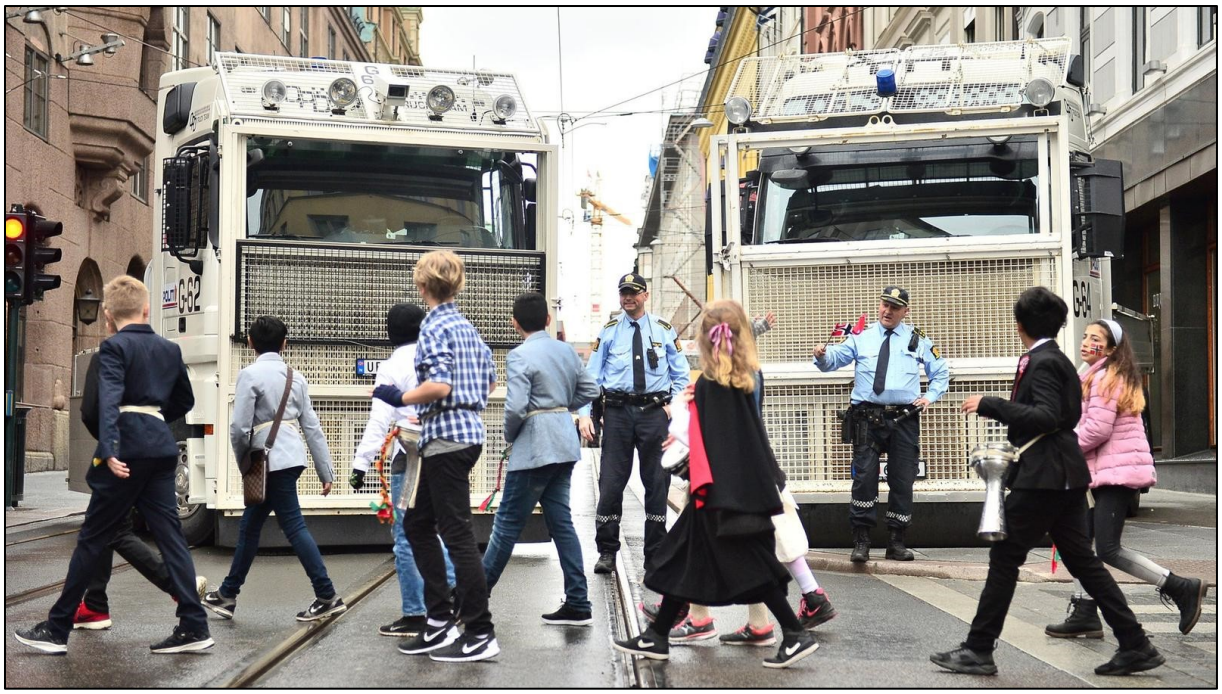

Figure 1: Anti-riot trucks in Karl Johan, Oslo, in 2017 Photo by Fredrik Varfjell

Dealing with proportionality is no easy task. It is, by definition, subjective. There is no universal way of assessing or measuring it. Currently, proportionality is treated binary and as a design principle: Either something is proportionate, or it is not (Centre for Protection of National Infrastructure, 2014). There is, also, no measure indicating how disproportionate urban security measures are, telling us how far they are from either corresponding to or exceeding occurring threats. While city governments and municipalities are responding to the threat of terrorism, required by the law, they are given an impossible task by the Norwegian authorities. How can they assure that their urban security measures are corresponding to the occurring threats? And that the urban security measures do not go on accord with the citizens' quality of life? As long as proportionality remains subjective and based on limited knowledge and experience, alongside gut feeling, they simply cannot. And thus we end up with obtrusive anti-riot trucks, comprehensive surveillance and other disproportional urban security measures which will continue to inhabit our cities and influence people's lives.

1.2 Research problem

While the research aims to be on a general basis, some context, such as the use of examples and regulations in Norway, is inevitable. International standards and other countries' regulations are, however, also relevant, and thus used for comparison.

Urban security measures come in various forms. They are proposed, maintained, and preserved by different decision makers, decision takers and stakeholders. Decision makers are politicians, the national government, city governments and municipalities. Decision takers are urban planners, preparedness planners, architects, risk managers, police and first responders. Stakeholders are retail associations, business owners and other relevant actors. Urban security does, in other words, affect everyone, and there are many different actors from various disciplines that have a say in its assessment. Urban security is both comprehensive and interdisciplinary. Therefore, to research it within a time frame of six months, necessary delineations to intersecting disciplines must be touched upon first.

This research has its roots in urban planning. It is, therefore, essential to keep it relevant and related to urban planning. This means that the assessment of proportionality is focused on physical urban security measures located in urban areas or as part of the built environment. It entails "hard engineering" and design solutions to protect or prepare cities from attacks rather than "soft governance" and management, although both contributes to urban security[6]. A guiding notion is that any aspect that is out of the hands of an urban planner, is not subject of this assessment. While the installation of bollards, planters and CCTV are relevant, visible police in the streets and stricter sanctions for violation of the law, are not. This means that terrorism prevention in this research is focused on more than risk assessments and crisis management. Which is why urban planning strategies, such as the CPTED and the SCP are given their warranted attention throughout this research.

1.2.1 Status quo

In Norway, the Norwegian Standard for protection against intentional undesirable actions (NS 5832:2014) supplements the new Security law with a method for security risk assessment. The standard claims that proposed security measures' effect must be equal to the relevant area's need of security (Standard Norge, 2014, p. 7). The cost and requirements of the measures must also be part of the assessment, which partly implies proportionality in the NS 5832. It is, however, left like that – seemingly incomplete. Neither the Security law nor the NS 5832 explain what proportionality is or how it can be achieved (Sikkerhetsloven, 2018; Standard Norge, 2014). What they do say, however, is that the assessment of security measures is a contextually dependant and qualitative procedure. To leave the assessment of proportionality to city governments and municipalities, with their relevant decision makers, decision takers and stakeholders, would be appropriate if they had also been given the proper tools to deal with it. But no such tools are given, as they currently do not exist. Thus, proportionality is left to the

[6] Since different actors must collaborate for urban security, there must be applied a citizen coexistence to fight crime or insecurity and social knowledge to justify the use of physical security measures.

assessors' subjective interpretation of urban security. On top of this, we know that these assessors have a limited capacity to deal with such matters (Westbrook & Jore, 2020).

The lack of assessment tools leaves the process vulnerable and relying on the individuals sitting around the table in Norwegian city governments and municipalities. And these individuals are not necessarily capable of dealing with complex urban security matters (such as proportionality). As a result of this, irresponsible or excessive measures may be put in place, like when the Arendal square was full of dumper trucks during the Christmas tree lighting ceremony in 2017 (Agderposten, 2017). It also explains why disproportionally concrete urns occupy Oslo's busiest shopping street, forcing citizens to zigzag in the blind spots of delivery vehicles (Dagbladet, 2017).

The integration of such ill designed urban security measures leads us to the research problem of the thesis. Who can blame the city governments and the municipalities for using what resources they have available? While there are no tools to help them, disproportional urban security measures are consequences of the status quo. This leads us to the assurance of proportionality while assessing urban security. How can it be assured? How can it be measured? The following research problem occurs:

- How can crowded urban areas be secured proportionally?

More specifically, the goal for this research is to strengthen the process of assessing urban security measures for crowded urban areas. The way to do this is to create a tool that fills in gaps of the status quo's urban security assessment framework.

1.3 Research questions

The research problem is how crowded urban areas can be secured proportionally. Urban security measures integrated in those areas must be proved proportional. And to do so, two research questions must be answered first:

- How can proportionality be measured in an urban security context?
- How can urban security measures be proportionally designed?

When it is clear how proportionality can be measured and designed in an urban context, it is possible to answer how urban areas can be proportionally secured. Together, the research questions along with the research problem, form a research composition.

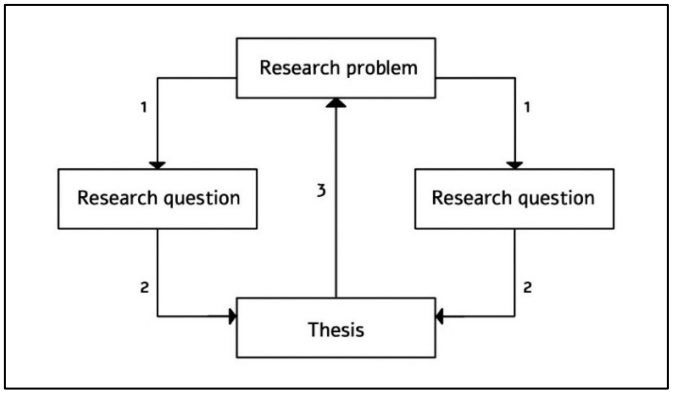

Figure 2: Research problem and research questions

1.4 Purpose

The outcome of the research is a tool for assessing proportionality. Such an assessment tool would make sure that urban security measures are proportionally designed, which provides answers to the thesis' research questions. And answering the research questions makes it possible to deal with the research problem.

The assessment tool has three main purposes. The first is to complement the existing framework, such as the NS 5832. The key is to create something complementary and supplementary, not revolutionary. A tool that overcomes the shortcomings of the status quo by strengthening the existing framework's functionality regarding urban security concerns. Another quality that comes with the assessment tool, is its ability to expand views on urban security by introducing a new perspective on vulnerability. This new perspective is a turn of tables. It considers vulnerability through the eyes of potential attackers and include their rational thinking and careful planning in the vulnerability assessment.

Though the assessment tool is untraditional, its original perspectives contribute knowledge to the field – which is its next purpose. The assessment tool is built upon a theoretical basis with roots in a thorough literature study of urban security. This means that in the undesired outcome of failure, the assessment tool still contributes knowledge to the field. Its theoretical basis is recyclable. Yet, in the desired outcome of success, it contributes more. Increased field knowledge is helpful as it also provides a common ground for the various actors and disciplines having a say in the assessment of urban security today.

The third purpose is to emphasize proportionality in the context of urban security. To put proportionality in its rightful place where its importance is weighted more than as a simple, binary design principle. As long as proportionality remains as it is, its influence on our urban areas is undermined. The assessment tool fixes this issue by introducing a contextual definition of proportionality. By doing so, it makes it much more accessible, and also allows us to measure and design proportionality.

The assessment tool is developed for decision makers, decision takers and stakeholders, for city governments and municipalities. It is suitable for anyone responsible for urban security, and provides them with the necessary tools for making proportional decisions. It helps developing our townscape from threatening anti-riot trucks to esthetical and liveable urban areas, while still remaining secure. For efficient use of the assessment tool, however, being familiar with the existing framework and its methodology is required.

2 Theory

Now that the background of the assessment tool has been explained, it is time to move on to theory found in the literature study of urban security. First, the assessment tool is complementing the existing framework. This means that it builds upon existing literature. This literature is also the core foundation of the assessment tool's theoretical basis. Mapping this literature is, therefore, an essential first step of development.

The next step is to define and communicate the assessment tool's use and limitations. The theory also elaborates on other topics necessary to justify its relevance to urban planning. Additionally, establishing a theoretical basis makes sure that the outcome is testable through the principles of abductive reasoning.

2.1 Building upon existing literature

We can start with how the assessment tool complies with existing literature. This shows us the assessment tool's practical use. While there are many different approaches and methods "out there" concerning urban security, the assessment tool can only be built upon one of them. A common denominator for the various methods is that they are either qualitative or quantitative. The majority is qualitative, such as the UK's Integrated Security and Resilience (ISR) framework and the Norwegian standard 5830-series for protection against intentional undesirable actions (Chmutina, Bosher, Coaffee, & Rowlands, 2014; Standard Norge, 2014). Among the contrary and quantitative frameworks, we find the US' Federal Emergency Management Agency (FEMA) 400-series (FEMA, 2007). Using the Norwegian framework as a starting point, it makes sense to stick to the qualitative. That does, however, not mean that different frameworks cannot be of use for comparison or inspiration.

First, though, we need to take a step back, towards international standards in order for us to establish relevance. The starting point of the qualitative frameworks is the ISO 31000:2018 which is the international standard for risk management. The ISO 31000 is where the "security risk"[7] derives from (Chmutina, Bosher, Coaffee, & Rowlands, 2014). It expresses security risk as a qualitative product of occurring threats, and exposed assets located in areas with a vulnerability to the threats. For instance, using the IS' vehicle ramming of civilians in Barcelona in 2017 as an example, the threat would be hostile vehicles, the assets would be civilians (human lives) and the vulnerable area would be La Rambla, the crowded shopping street.

While the ISO 31000 is the foundation of the qualitative frameworks, such as the ISR and the NS 5830s, the use of security risk and its terms are also used by FEMA. But FEMA's use of it is quite different. It actually calculates the security risk (FEMA, 2007):

$$Security\ risk = Threat * Asset * Vulnerability$$

Here, threats, assets and vulnerabilities are scored 1-10 based on their presence. This means that the security risk is indicated by a whole number between 1 and 1000, where a score of 1-60 indicates a low risk, 61-175 indicates a medium risk and >176 indicates a high risk.

[7] Reference to the use of threats, assets and vulnerability as a qualitative measure of security risk.

Though the mention of FEMA's framework might seem like a digression at this point, it does serve a purpose. Looking only at the Norwegian framework is a much too narrow approach. Introducing other, more developed frameworks for comparison, is beneficial for the development of the assessment tool. The fact that other frameworks are built upon the same idea of security risk (deriving from the ISO 31000), as well as the same terminology, makes them ideal for comparison. Two existing frameworks have been selected to build upon, and one has been selected for comparison:

To build upon:

- The Integrated Security and Resilience (ISR) framework used for assessing security risk in the United Kingdom.
- The Norwegian standard (NS) for protection against intentional undesirable actions (5832), with a framework for security risk analysis.

For comparison:

- FEMA's guidance manuals against potential terrorist attacks in the US.

The UK and the US is selected because of their experience with terrorism. They have handled security risk and intentional undesirable actions for decades. The Norwegian framework, on the other hand, must be included due to the assessment tool's contextuality[8].

The frameworks to build upon are so-called "linear tools", meaning they are step-by-step processes going from a starting point to an end. The linear steps are as follows[9]:

1. Identify, characterize and assess threats.
2. Assess assets and vulnerabilities exposed to specific threats.
3. Determine the risk.
4. Identify ways to reduce the risk.
5. Prioritise risk management measures.

Though the linear framework is quite generic, it works as a basis for development. Its first and forth step are, however, subjects to societal security rather than urban planning. Therefore, the assessment tool only supplements the second, third and fifth step of the framework. Even though it is done to sustain the assessment tool's relevance to urban planning, it shows yet again how urban security is complex and interdisciplinary.

Another aspect of the framework is that it is, like any qualitative and contextually dependant concept, relying on interpretation. Because of this, security risk assessments are performed by interdisciplinary expert cabinets in order to achieve thorough assessments (Chmutina, et al., 2014; FEMA, 2005; Standard Norge, 2014). However, if we take another look at **1.2.1 Status quo**, we see that most Norwegian city governments and municipalities are short of

[8] The assessment tool is developed in Norway and comes with a portion of inevitable Norwegian contextuality, as touched upon in **1.2 Research problem**.

[9] The linear steps are extracted from the ISR framework (Chmutina, Bosher, Coaffee, & Rowlands, 2014).

interdisciplinary expert cabinets (Westbrook & Jore, 2020). This is problematic. Assessments that are not thorough will likely lead to disproportional decisions.

Additionally, the framework has "offspring" that warrants mentioning to ensure the research's originality and innovative qualities. There are two noteworthy concepts related to urban planning that descend from the linear framework or go together with security risk: Disaster Risk Reduction (DRR) and the Designing Safer Urban Spaces (DESURBS) project.

First is the DRR which combines security risk with the urban context (Chmutina, et al., 2014). The DRR utilizes urban planning as an opportunity to regulate long-term use of urban space, and thus limits assets' exposure to natural hazards and human-incited threats such as terrorist attacks (Bosher & Chmutina, 2017). In a Norwegian context, the regulation of urban space is subject to the Planning and building act[10] (Plan- og bygningsloven, 2008), which sees to the zoning of urban areas. It is through this act that DRR influences urban security. Since the act is a legal requirement, DRR plays an important role for our cities.

Second is the DESURBS project funded by the EU. The project is built upon the ISR framework and aimed at creating a "Decision Support System Portal" (DSSP) for the EU countries (The DESURBS Consortium, 2014). The project began in 2011 and lasted 48 months (European Commission, 2019). Among the contributors to the research were the universities of Loughborough and Warwick being UK's leading universities within the field of security and planning (The Guardian, 2020). The DSSP took the ISR framework one step further and expanded upon its five stages. It did, however, stick to the first three steps; the assessments of threats, assets, and vulnerability. Its most relevant outcome for the proposed assessment tool were its new arguments and measurable abilities related to security risk.

There are, however, two issues with the DSSP that do not fully comply with the idea of a future assessment tool, which makes it less applicable:

- The DSSP considers safety and security threats all together. The framework is therefore not just focusing on intended undesirable actions.
- The DSSP lists proportionality as a design criterion. It therefore fails to address proportionality's importance at the required level.

Still, the DSSP is the closest we get to the idea of the proposed assessment tool. Even though it is not entirely applicable, it has an interesting expansion to the ISR framework's first three steps. Additionally, knowing which frameworks assessors are familiar with, and how they function, makes it easier to structure the assessment tool accordingly. As a conclusion to the chapter, structural compliance strengthens the assessment tool's practical usability and sees through that its supplementary purpose functions as intended.

[10] § 12 Concerns the zoning of urban areas (Plan- og bygningsloven, 2008).

2.2 Urban planning and security

We now take one step down from the assessments of urban security to elaborate on urban planning as a piece of the puzzle. We can ask ourselves whether we should fear counter terrorism and security more than terrorism itself. While the balance between security and people's mental freedom is all about proportionality, it should be possible to plan ahead to counter developing threats, and at the same time welcome events without frightening people with overt security measures, nor disrupt their freedom with comprehensive surveillance.

2.2.1 Thesis' relevance to urban planning

First, however, we will look at the thesis' relevance to urban planning. One way of tying them together is to look at the concept of resilience and resilient cities, while also chronologically elaborating upon the earlier stages of the history of urban security.

Since the beginning of urban civilisation, defence against people or natural hazards has always been influencing the landscape of cities. Ancient rulers sought to defend and secure their interests through creating feelings of safety and to repel intruders (Coaffee, 2016). As early urbanisation advanced, their defensive systems became increasingly sophisticated. First came the use of physical barriers such as city walls, gates and moats which simultaneously created a socio-economical distancing for the civilisation's elite, who resided inside of the city walls. The city walls withstood many intruders, but also kept out the less privileged (Coaffee, 2016). This method of defence worked well (for the rich) all the way up to the 1200s in China, and 1300s in Europe when cannons came along (Lorge, 2008). The cannons made the city walls less effective, but the layout of city defences remained more or less the same. They continued to build walls although their use were more of a symbolic character at the time (Mark, 2009). However, another significant change occurred in the following centuries of the history of urban security. Danger was now increasingly originating from within. The less privileged who had resided on the outside of the city walls, started to ask questions about governance, justice and taxes. They even raised their torchers and pointed their pitchforks, eventually leading to the decapitation of quite a few noble heads (Norbert, 1978).

Today's cities are no different from their predecessors (Coaffee, 2016). They too attempt to embed defence into the urban landscape, though their means have changed. City walls, moats and oil cauldrons are subjects of the past. They are substituted by other approaches advocated to design out crime, such as Newman's idea of "Defensible space"[11] or the CPTED which came about in the 1970s. While Newman's theory is now a subject of the past, the CPTED has been altered and revised since its inception (Crowe, 2000). It has endured over the decades and is still frequently used. The CPTED has also laid the foundation of other relevant, recent theories, such as the next one in our breakdown of urban security, which is the idea of resilient cities.

[11] Oscar Newman (1972) proposed to control and mitigate crime by designing urban space in way that encompasses territoriality, natural surveillance, image, milieu, and safe adjoining areas. Though Newman's defensible space is controversial due to lack of compliance to legal acts, several of his principles are continued in the broader and more agreed upon concept of CPTED.

The term "cities of resilience" was introduced in a collaboration study performed by an urban planner and an ecologist with the purpose of finding common ground among the two disciplines (Pickett & Grove, 2004). The study did indeed find common ground (Musacchio & Wu, 2002), and the term has remained within the field of urban planning and security ever since[12]. In the context of a city or an urban area, resilience is defined as its ability to bounce back to its original state if it is exposed to so-called "external stress" (Engen, et al., 2017). External stress can be explained as the dangers worrying our predecessors who responded to it by building city walls. Today, however, it is more likely to be to natural disasters or terrorist attacks, though there are many other and less disastrous forms of external stress.

While previous millennia's defensive strategies are all advocated to eliminate or design out danger, the idea of resilient cities is a drastic change of means. We have come to terms with it being impossible or grossly disproportional to design out all forms of danger – especially when they originate from within such as domestic terrorist attacks. The idea of resilient cities is a way of addressing this issue. According to the idea of resilience, our cities will be able to bounce back to its original state whenever danger expose us for external stress, meaning that we are well suited and up for the challenge. Whether we really are up for it and can rely on resilience, is, however, a thesis of its own. With our current state of incapacity[13] for dealing with urban security, it might not seem like the best idea to rely on it. As with so much else, resilience and our reliance on it, is yet another question of balance.

To wrap things up: Urban security, whether it consists of city walls, moats and oil cauldrons, rings of steel, Newman's protective architecture, the CPTED's natural surveillance, or resilient defensive mechanisms, is subject to the DRR. Though the DRR has had various means of seeing to it, its most efficient tool today is urban planning. What makes urban planning especially useful is its legal roots in acts such as the Planning and building act (Plan- og bygningsloven, 2008)[14]. Though the DRR embraces a wider scope than the urban planning (David & Borrás, 2016), their relationship is dynamic. Concepts like resilient cities make the DRR and urban planning co-dependent of each other, and the fact that more than half of the world's population currently live in urban areas, focuses the DRR towards our cities (United Nations, 2018). Thus, the DRR and urban planning go together.

[12] Resilience is also subject of other disciplines, such as societal security and risk management. The term's use and definitions vary among the various fields (Engen, et al., 2017).

[13] Reference to Norwegian city governments and municipalities' incapacity of dealing with urban security matters. This issue is touched upon in **1.2.1 Status quo**.

[14] Alongside other legal acts such as the new Security law with a broader function than urban planning.

2.2.2 Key design principles

Certain tools have been developed to help us plan ahead and to counter threats. One of them is especially relevant for the proposed assessment tool. It is the Centre for Protection of National Infrastructure's (CPNI) Integrated Security guide (Centre for Protection of National Infrastructure, 2014). The guide provides six key design principles related to hostile vehicle mitigation in the public realm through a holistic and layered urban security approach.

The CPNI key design principles are:

1. Consider forward planning and flexibility to counter developing threats.
2. Provide mitigation measures proportionate to the threats.
3. Design to enhance the setting.
4. Include multi-functional elements.
5. Ensure an accessible and inclusive environment.
6. Design with maintenance in mind.

(Centre for Protection of National Infrastructure, 2014, p. 35)

The CPNI key design principles comply, interestingly, with the afore-mentioned urban security approaches[15]. Especially the approaches aiming to design out crime by limiting its opportunities and incentives through managerial and environmental changes of urban areas. Another notable feature is that the CPNI key design principles are tied to the consequences of implementing urban security measures. The principles are not fixed on performance to counter or mitigate the threats. Instead, they are focused on the urban environment remaining accessible and inclusive. Regarding proportionality, this is especially relevant when assessing design. There is, however, one big issue with the key design principles. In the second principle, proportionality is treated as a binary design principle. Its importance is, therefore, not addressed on the desired level.

[15] Reference to the CPTED, the SCP and Newman's "Defensible space" which were touched upon in **1.1 Background** and in **2.2.1 Thesis' relevance to urban planning**.

2.2.3 Holistic planning and security

Another relevant concept is holism. The concept itself differs little from the word's literal meaning[16]: Parts of a whole are in intimate interconnection and cannot exist nor be understood without a reference to the whole (Stanford Encyclopedia of Philosophy, 2014). The concept is subject to various recent urban security theories and practices. One practice that exemplifies holistic planning, is the Commission for Architecture and the Built Environment's (CABE) seven elements of "Good design" (CABE, 2000):

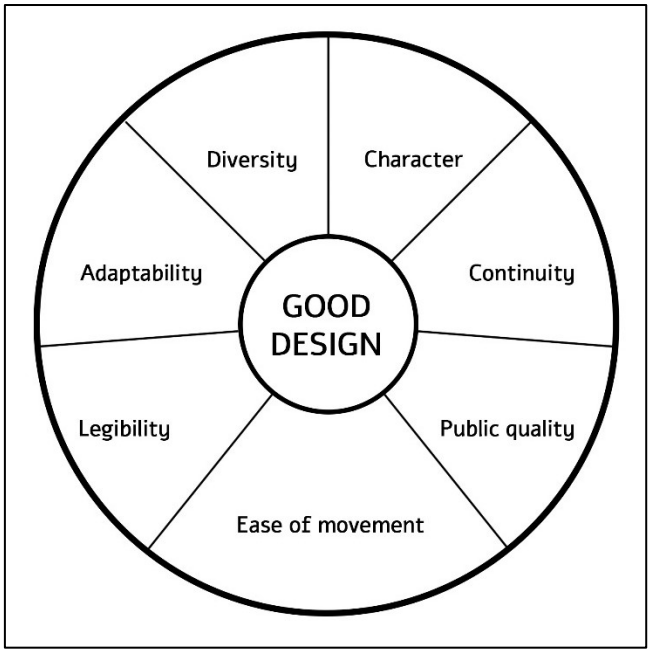

Figure 3: Principles of good design

The practice shows seven elements that we need to address to achieve good design. Elaborating on the elements is, however, of less interest in this context. The point is to showcase their synergies. The elements contribute little to achieving "good design" without interconnecting with one another, and thus contributing to the whole. While an urban area can have great public qualities and legibility, it is of little use if accessing it is difficult, and no one wants to visit. On the other hand, the whole – meaning "the good design" – consists of the seven elements. As a result, it will only be successful if all of them are addressed.

A holistic understanding of the environment is required for urban planning and security whenever the quality of a local setting is concerned (Shimizu & Murayama, 2014). And while securing crowded urban areas, the qualities of the local settings must always be part of the assessment (Coaffee, 2016). It is, therefore, a requirement for achieving well-designed, secure urban areas. The holistic understanding encompasses both holistic planning and security. Since we have already touched upon holistic planning, our next step is holistic security.

Like CABE's seven elements of good design, holistic security involves synergies. A key difference here, is that the synergies are now between urban security measures. Holistic security is most efficient when it is implemented on several geographical layers (Forsvarsbygg,

[16] "Holistic security" derives from "Holism" which is referred to in regards of literate meaning.

2016). While aiming to protect an asset, for instance people or buildings, it is essential to add proportionate "defence" in the asset's surrounding layers or zones. These layers are the asset's threshold – its immediate surroundings – and its site context which refers to the nearby, surrounding area. However, layers of defence can also be added to other layers, such as the asset's district site context, if mitigation of threats requires handling on this scale. Holistic security acknowledges and responds to the interdependence of physical urban security measures. It does so to ensure that security is enhanced rather than compromised (Centre for Protection of National Infrastructure, 2014).

The devision of security layers can be generally illustrated as follows:

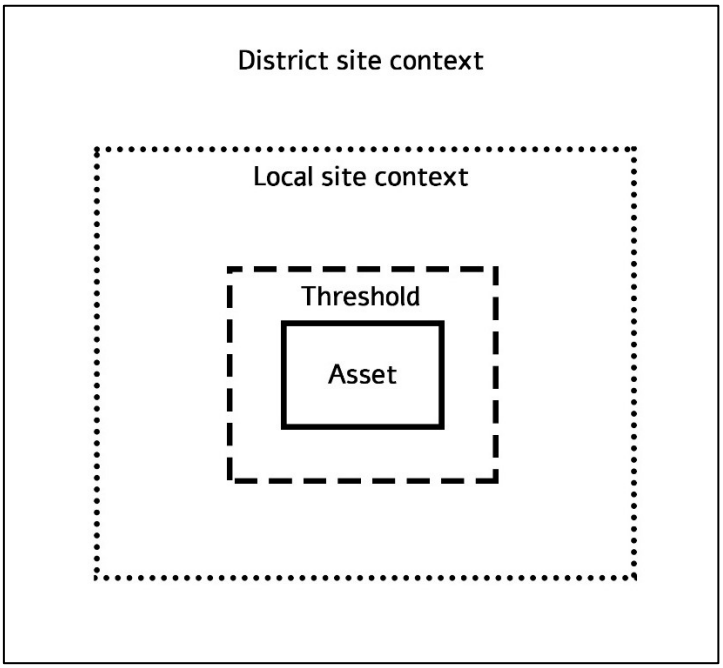

Figure 4: Holistic security with layers surrounding the asset

While holistic planning is a requirement for good design, holistic security is a requirement for a secure design. They must, however, maintain a balance in order for the urban areas to function well[17]. If not, or if compromised, good design fails, and our townscape takes the consequences of being disproportionally designed. This leaves our urban areas either well designed yet reckless and vulnerable, or secure yet frightening and uninviting.

We can now look back at the balance between security and people's mental freedom. To plan forward and counter developing threats without frightening our citizens needlessly, is indeed possible. What makes it possible is urban planning – if it is done holistically and proportionally. We can round off the chapter with a suiting citation:

> "It is essential that architects, planners, strategists, and politicians engage in the questions of how to cater for both security and freedom when the city, its spatial boundaries and borders are to be negotiated." (Coaffee & Newman, 2017, p. 39)

[17] Reference to proportionality being the balance between well-functioning and secure urban areas.

2.2.4 Defining proportionality contextually

To sum up the previous chapters, proportionality is a key that unlocks opportunities for securing our cities in an appropriate, yet secure manner. While this sounds promising, the term needs an elaboration and a contextual definition to show us how. We start with what we know.

Generally, proportionality refers to the quality of correspondence or relating in size or amount to something else. While the term is clearly defined in both mathematics and legislation, the use of it in the urban security context is of a vague character (Harre-Young, 2012).

Proportionality is deeply contextual. Even though it is the essence of threat and risk assessments, no good practice exists for how it is assessed or translated into the design of urban areas (Harre-Young, 2012). Today, proportionality is subject to law and regulations[18]. The assessment of it, is based on subjective interpretation of qualitative data deriving from threat and risk assessments. As a result, proportionality depends on various legislation, incentives, fear, culture and mentality of different decision makers, decision takers and stakeholders. There are unavoidable caveats to all approaches concerning subjective interpretation of qualitative data, and the assessment of proportionality is no exception. Informed decisions might, however, reduce unfortunate consequences as much as possible (Westbrook, 2019).

Proportionality is as much about what you do not do, as what you do. It is essential to know when one ought to act, when selecting and installing urban security measures. To exemplify this, we can look at our citizens' perception of security relating to visible security and urban scenery (Schroeder & Anderson, 1984). While the visible urban security measures deter potential attackers, they also come with a downside: They communicate to our citizens that the measures are there for a reason. This results in a contradictory message telling them that they are currently exposed, even though there are measures in place to protect them.

Another aspect relating to proportionality is society's acceptance of urban security measures. Generally, crowded urban areas are vulnerable to terrorist attacks[19], which means that they have a great potential to benefit from design changes offering deterrence or protection. However, we must not forget their function in our cities. Security must not be allowed to impede how the crowded urban areas function, as they were put there for a reason. Public squares must remain public squares. Thus, whatever design, engineering or management changes that are proposed or implemented, they must be seen as proportional to the ongoing threat of terrorism (Coaffee, Moore, Fletcher, & Bosher, 2008). If not, they will not, and nor should they, be accepted by society.

Proportionality is not all about cost-effectiveness. It has a cost-consequential aspect that is part of its assessment (Harre-Young, 2012). There are positive and negative consequences related to urban security measures that need to be a part of the consideration alongside security's correspondence to the ongoing threats. This completes our elaboration on proportionality. The next step is to define it. Due to proportionality's many aspects, it is beneficial to split its definition into two characteristics.

[18] Reference to the new Security law (Sikkerhetsloven, 2018) and **1.2.1 Status quo**.
[19] Due to them containing a plethora of valuable assets in the eyes of terrorists.

(1) Proportional performance

Proportional performance is linked to the urban security measures' performance, and whether it corresponds to the current threats. It is also constituted by the context's vulnerability to the current threats as well as society's security ambition. It is essential to reveal how much needs to be done. Proportional performance balances on a knife-edge between the over-engineered and obtrusive and the under-engineered and vulnerable (Harre-Young, Bosher, Dainty, & Glass, 2012). Proportional performance should equal the sum of a crowded urban area's vulnerability to occurring threats minus the risk city governments and municipalities are willing to take.

(2) Proportional design

Proportional design takes urban security measures' performance, requirements, and consequences – both positive and negative, into account. It is achieved when the security measures' performance and positive consequences either equal or exceed their requirements and negative consequences (Harre-Young, 2012). It is, also, important to assess the urban security measures holistically, because their design abilities affect one another (Centre for Protection of National Infrastructure, 2014).

While proportional performance entails "doing the job", the proportional design functions as a measure of whether the job is done in a good manner. The common denominator among them is the urban security measures' performance. It is checked for correspondence against to two different features, like the term's alliterate meaning. It is, however, insufficient to assert that urban security measures are proportionate while only one of the characteristics are fulfilled. It must pass both tests. If not, complete correspondence is not achieved. Thus, we contextually define proportionality as follows:

- Proportionality is achieved when the security measures correspond to an urban area's vulnerability to current threats, and its performance and positive consequences equal or exceed its requirements and negative consequences.

Urban security, in most cases, constitutes urban security measures and their performance. The definition should, however, also consider the many cases where crowded urban areas are not sufficiently vulnerable to justify implementation of urban security measures (Fisher, Harre-Young, & Bosher, 2019). Additionally, the contextual definition of proportionality helps determine how appropriate the security measures are (Harre-Young, Bosher, Dainty, & Glass, 2012). This keeps us from adding hostile, inappropriate measures to our crowded urban areas such as diggers and anti-riot trucks[20].

[20] Reference to the examples of gross disproportionality in **1.2 Research problem**.

2.3 Safety and security

Now that we have established a theoretical foundation, we must build upon it. We do so by elaborating on safety and security, and their relationship, before we move on to examining terrorism as a security threat. If we look at the ISR framework, we are now addressing its first three steps[21]. Even though the assessment tool only supplements the second, third and fifth step of the framework, we still need to know about the others.

First comes the relationship between safety and security. There is an understanding that safety concerns the unintentional, such as accidents and natural disasters. Security, on the other hand, concerns the intentional, such as terrorism attacks or warfare (Engen, et al., 2017). In our context, it makes sense to distinguish between the two (Jore, 2018).

We can compare safety and security by looking at Jore, Utland and Vatnamo (2018):

	Safety	**Security**
The nature of the risk	From an organizational perspective, safety risks are linked to the production and economic outcome	Human strategic perpetrator who can alter plans in accordance with implemented security measures.
Type of intent	No malicious intent to harm an organization or the environment	Intentional, malicious, or political intent to cause harm
Types of risk assessment	Quantitative	Qualitative
Possibility of mitigation	Organizations have knowledge about possible risk scenarios and measures	Organizations often lack the knowledge and the means to reduce the threat

Table 1: Comparison of safety and security

The proposed assessment tool is subject to security rather than safety. It will be developed to supplement qualitative frameworks, and must, thus, comply with them. The main reason behind choosing the qualitative is to align it with risk assessments. They differ among the unintentional

[21] Reference to **2.1 Building upon existing literature**: Identify, characterize and assess threats (1), Assess assets and vulnerabilities exposed to specific threats (2), and Determine the risk (3).

and the intentional (Jore, Utland, & Vatnamo, 2018). Why one of them is assessed quantitatively and the other qualitatively, is due to the stochastic argument. This will be explained next.

2.3.1 Safety and security risk assessments

We will now look at safety and security risk assessments and the stochastic argument. While assessing safety risk, we stick to a quantitative risk assessment. What this means, is that we are using a probabilistic method – often based on statistics (Jore, 2018). An example is a 100-year flood, which is a flood that occurs every 100 years – on average. We have historical data that can tell us an expected frequency. There is a 1 % chance of the flood occurring any given year. Exactly when it will occur remains uncertain – but we can expect it to happen at least once every 100 year. Additionally, the flood is affected by various external factors, such as climate change (like more intense rainfall), and maintenance on district drainage infrastructure. These factors influence the chance of flooding within a given interval of time. We deal with them by including them in the quantitative risk assessment. Then, we can start delegating resources. We will use X amount of resources to see to that our concerned area can handle Y amount of water. The amount of resources is tied to the event's 1 % probability of occurrence. There is of course a lot more that can be said about safety risk, but digging deeper into the subject is not relevant to this chapter.

Security risk, on the other hand, cannot be based on probability (Aven, 2015). Frequentist probability is a theoretical concept interpreted as the fraction of time in which an event occurs, requiring that the considered situation can be repeated infinitely. If we use a terrorist attack as an example of a security risk, we will see that frequentist probability is not appropriate. The events' characteristics are unique and cannot be repeated infinitely, and the threats are not deterministic (Amundrud, Aven, & Flage, 2017). This means that security risk is subject to qualitative risk assessment. It cannot be subject of the stochastic argument because a (justified) probability of occurrence cannot be given.

Like any qualitative assessment, security risk relies on contextual interpretation. As a result, security risk management faces many of the same challenges as proportionality[22]. It has become a shared responsibility with many actors in society having a say in its management (Ericson, 2006). Even though there are laws, standards and guidelines in place (DSB, 2014; Nasjonal sikkerhetsmyndighet, 2019), this does not help the issues of incapacity or limited knowledge (Westbrook & Jore, 2020).

[22] Reference to the challenges related to proportionality elaborated on in **1.2.1 Status quo**.

2.3.2 Examining terrorism and targeting of crowded urban areas

Still on the topic of security, we now need to look at its threats. There is one threat in particular that needs elaboration: Terrorism. We need to know why terrorists – organized as groups or individuals – see our cities as attractive targets for causing harm, and why crowded urban areas have been attacked so frequently in the recent decades.

First, however, we must know what it is. Terrorism comes in a vast variety of forms, with many different actors or groups. Adding to this, it is also a contested concept with no agreed upon definition (Schmid, 2011). While this does not mean that there are no relatively clear definitions to be found, it does leave us having to elaborate. Luckily, this has been attempted by some bright minds that we can look to.

One of them is Jo Beall. According to Beall (2007), it is important to think very carefully about which of the many definitions of terrorism to take as point of departure. She points to Jonathan Barker, who is one of many who have defined terrorism in their academic works. Barker (2003) defines it as one out of three:

a) Threatened or employed violence.
b) Violence directed against civilian targets.
c) Threatened or perpetrated violence for political objectives.

(Barker, 2003, p. 23)

Unlike some characterisations, this definition also includes terrorism committed by foreign states (Beall, 2007). The definition also avoids the issue of "one person's terrorist is another person's freedom fighter", suggesting that to call someone a terrorist is to say no more than that someone opposes their cause (Barker, 2003). Barker's definition applies to both governments as well as non-governmental groups and individuals. It excludes, however, nonviolent political acts such as protests, strikes and civil disobedience (Barker, 2003).

Barker's definition of terrorism can be compared to another source. We will use the UK Security Service's (MI5) explanation of terrorism, to check if it is applicable:

> "Terrorist groups use violence and threats of violence to publicise their causes and as a means to achieve their goals. They often aim to influence or exert pressure on governments and government policies but reject democratic processes, or even democracy itself." (MI5, 2020)

The MI5 explanation is more general than Barker's definition. They do, however, adhere to each other. It is reasonable to move forward using Barker's definition of terrorism, and we put our trust in Jo Beall, Jonathan Barker and the MI5 to define and explain terrorism. Now that we know what it is, we can move on to why our cities and crowded urban areas have become its victims. This is, implicitly, a question of what the terrorists want to achieve. We can start with what we know terrorists have done before.

Targeting crowded urban areas is not a new phenomenon. Terrorists began exploding bombs and IEDs there in the late 1800s (Quinault, 2005). Attacks such as the London bombing on an underground train in 1885, the bombing of Haymarket Square in Chicago in 1886 and August

Vaillant's attack on the French Parliament in 1893, are worth mentioning (Burke, 2018; University of Maryland, 2020). The late 1800s attacks on city centres roused public concern and drew debate on how to protect the cities as well as their mass transit systems (Burke, 2018). A debate that is still ongoing and one that we are familiar with.

Terrorism has, however, become more sophisticated since then. Vehicles are turned into rams, and it has never been easier to construct an IED with instructions from the internet (Burke, 2018; Jenkins & Butterworth, 2019). Both the Al Qaeda and the IS have changed the means of terrorism by increasingly lowering the effort to achieve the most possible harm. During the last decade, there were 13 terrorist attacks on European soil causing more than 10 civilian deaths (World Economic Forum, 2016). Eight were performed by either the IS or actors related to them, and 12 of the attacks were either partly or wholly aimed at crowded urban areas or at public transportation systems. With so many significant strikes in "urban settings", there is an inextricable link between terrorism and our cities. This link leads us back to why our cities have become the targets of terrorists in the first place.

To start elaborating on this, we can look to the words of a German police chief, Klaus Klandt, in the aftermath of IS' vehicle ramming attack of a Christmas market in Berlin in 2016. He stated that at the time the attack took place, there were more than 2500 Christmas markets in Germany. In Berlin city alone, there was 60. With the new "low threshold"[23] means of terrorist attacks, such as vehicle ramming, it was impossible to eliminate the risk to all the Christmas markets in Germany (Scally, 2016). The same goes for crowded urban areas.

Any geographical location, such as a city centre or a crowded urban area, is vulnerable to certain threats. Its vulnerability can be expressed as its "attractiveness for an attack" by turning the tables from the mind of a defender to a potential attacker. We try to assess how attractive the crowded urban areas will be to terrorists by looking through their eyes. Thus, we will explore their targeting preferences. Turning the tables is, however, a justifiable move based on the argument of rational choice (Jore, 2018). This argument tells us that attackers tend to be as rational as defenders, and their human and behavioural dimensions must thus be considered (Reznikov, Makhutov, & Akhmetkhanov, 2018).

We call it "attack attractivity" for now. It is a measure of vulnerability, though assessed and expressed differently. While vulnerability is understood to be the inability to withstand, often expressed by weakness, attack attractivity entails targeting preferences. It is, in other words, a measure of what a preferred terrorism target would include. It is, however, important to note that these preferences vary between groups, influenced by their motives and capabilities (Libicki, Chalk, & Melanie, 2007). For example, right wing and Islamic extremists have different ends and means – and this must be part of the assessment.

Elaborating on the targeting preferences is an important step towards providing an answer to why cities and crowded urban areas are such attractive targets. These preferences have already been explored by others. Libicki, Chalk and Melanie (2007) explored how Al Qaeda chose their targets in 2007. They launched four hypotheses on attack attractivity. The hypotheses checked whether Al Qaeda sought to achieve damage, coercion, rally and/or franchising. Damage is

[23] Reference to the increased use of cars and knives as means of terrorism by the IS.

self-explanatory. Coercion is the attempt to force another part to obey, such as getting the US to withdraw their soldiers from Afghanistan (Libicki, Chalk, & Melanie, 2007). To rally means to recruit others to one's cause, and to franchise aims to inspire other groups elsewhere to join the cause, such as sympathizers (groups or individuals) in other countries. While the damage, the coercion and the rally hypotheses passed the test, the franchise hypothesis failed.

Evan et al. (2017) explore terrorist targeting preferences broader than the Al Qaeda. In their research they present "scenario impact assessment factors". These factors apply for terrorism in general and can thus be translated into an urban security context. In this study, the terrorists' preferences are based on achievability. The factors are: Mortality rate, physical damage, media impact, utility, scalability as well as an overall economic impact (Evan, et al., 2017).

A third study, performed by Kaewunruen, Alawad and Cotruta (2018), also broadly assesses terrorist targeting preferences. In contrast to the other studies, however, is that the study is suited for an urban security context. Therefore, it contains more detailed assessment factors, listing a total of seven: High fatality possibility, general vulnerability, high local visibility and media impact, accessibility and high traffic population, poor design for mitigating or repelling an attack, ability to damage or destroy the area as well as difficulty for evacuating victims (Kaewunruen, Alawad, & Cotruta, 2018).

To conclude the terrorist targeting preferences, we can set up a table for comparison:

<table>
<tr><th>Libicki et al. (2007)</th><th>Evan et al. (2017)</th><th>Kaewunruen et al. (2018)</th></tr>
<tr><td rowspan="2">Capability</td><td rowspan="2">Utility</td><td>General vulnerability</td></tr>
<tr><td>Accessibility</td></tr>
<tr><td>Rally</td><td>Media impact</td><td>High local visibility and media impact</td></tr>
<tr><td rowspan="4">Damage & Coercion</td><td rowspan="3">Mortality rate &
Physical damage &
Overall economic impact</td><td>High fatality possibility</td></tr>
<tr><td>Poor design for mitigating or repelling an attack</td></tr>
<tr><td>Ability to damage or destroy the area</td></tr>
<tr><td>Scalability</td><td>Difficulty for evacuation</td></tr>
</table>

Table 2: Comparing terrorist targeting preferences

There is quite a bit of overlap between the terrorist targeting preferences. While these preferences tell us what terrorists want to achieve, their level of presence indicates attack attractivity. Wherever attack attractivity scores high, terrorists want to strike.

If we take one step back and look at our cities and crowded urban areas, we see that they comply with the terrorist targeting preferences. The areas, along with the built environment, are accessible and vulnerable (Harre-Young, Bosher, Dainty, & Glass, 2012). While they remain unadjusted for recent changes in threats, such as vehicle ramming attacks, they expose a range of high value assets. Crowds of people, as was present during the Berlin Christmas market, offer

a high possible mortality rate and difficulties for evacuation, causing more consequences. Additionally, cities and crowded urban areas are also highly visible. An attack on them is likely to create desired media impact.

In the eyes of a terrorist or a terrorist group, our cities and crowded urban areas provide attractive targets. Along with the argument of rational choice, this explains why terrorists attack them. While their attractiveness is unlikely to change, we must rather focus on securing our cities and our crowded urban areas accordingly.

2.3.3 Is it secure?

In the previous chapter we dealt with threats and vulnerability. Looking back at the ISR framework, we have touched upon its first two stages[24]. The next will be to supplement the determination of risk. This risk is assessed qualitatively by looking at threats and exposed assets located in areas with a vulnerability to these threats[25]. However, its outcome is only relevant if we know what we need to do about the issues we identify. In regards to proportionality, we need to know when there is correspondence. To do so, we use a so-called "security ambition" – which is the subject of this chapter.

We begin with a look at our existing urban security framework. The NS 5832 requires a security ambition as part of the security risk analysis (Standard Norge, 2014). This ambition (or criterion) functions as a measure of the relation between the current level of urban security and the occurring security risk. In other words, how much must the urban security be altered for it to deal with the occurring security risk? Even though it is not stated explicitly, this is borderline proportionality – related to it as a measure of correspondence.

The NS 5832 does not, however, provide a method of determining the security ambition. Neither do the ISR, the NSM or the DESURB's DSSP tool. They get close by considering risk acceptance, but this is of little help in the assessment of proportionality. If we broaden our scope and look at the FEMA, we find a "chosen level of protection" (FEMA, 2005, p. 3). It is yet another measure of accepted risk. Its determination is based on a template of vulnerability.

There is, however, a generic definition of a security ambition that we can use. It is defined in Forsvarsbygg's Sikringshåndbok (2016). A translation of the definition is:

> "A security ambition is a desired or accepted condition for assets during or after an undesirable action." (Forsvarsbygg, 2016, p. 285)

Its determination is also explained, though only on a general level. It is therefore of a too vague character to provide a basis for the assessment tool (Forsvarsbygg, 2016, p. 48). To get us off the starting blocks, we can exploit FEMA's determination of a chosen level of protection and Forsvarsbygg's definition of a security ambition. We still need a method, though.

A security ambition comes with a lot of responsibility. This might be the reason why its definition remains generic and its assessment is either missing or of a vague character – no one wants blood on their hands. However, a security ambition needs to be determined to

[24] The five stages are explained in **2.1 Building upon existing literature**.
[25] According to the traditional assessment of security risk (Standard Norge, 2014).

measure proportionality. We need to know how much we need to do, for us to know when a crowded urban area is secure, and when it is not. If we do not know this, we cannot compare the performance of various urban security measures, nor apply them correspondingly. As a result, the contextual definition of proportionality fails.

To determine a security ambition for urban security is difficult. Firstly, no one wants to do it because it comes with a lot of responsibility. Furthermore, the stochastic argument cannot be used. Since probability is removed from the security risk assessment, our toolbox for determining a security ambition is limited to the qualitative. It is not justifiable to use common methods for risk acceptance, such as the F-N curves (fatalities/time) or approaches as the "ALARP" or "ALARA" (As low as reasonable practicable/achievable) (Aven, 2015; Melchers, 2001). This is because the F-N curves need the stochastic argument, and the ALARP/ALARA presupposes proportionality[26] (Yasseri, 2013).

As a result, we need to develop a method to determine a security ambition ourselves. A way to do so, is to rely on FEMA and to, through inductive reasoning, see a security ambition as equivalent to risk acceptance. This means that we can assess it on the template of vulnerability, where "accepted vulnerability" functions as the security ambition (Amundrud, Aven, & Flage, 2017). However, for the proposed assessment tool, "accepted vulnerability" is substituted with an accepted level of attack attractivity[27].

[26] Reasonably practicable/achievable and proportionality are interdependent measures. This leaves us with equivalent presupposes that make any equation of correspondence impossible to solve.

[27] Reference to the turn of tables in **2.3.2 Examining terrorism and targeting of crowded urban areas**.

2.4 Urban design strategies

Now that we have explained what we need to do, and why, it is time to discuss how we are going to do it. While we know that the outcome of this thesis is an assessment tool, it would be a good start to look at some well-functioning urban design strategies out there already addressing the security of our cities and crowded urban areas.

There are, in fact, many urban design strategies for terrorism mitigation. Three of the commonly used strategies are the CONTEST (Counter-Terrorism Strategy), and the CPTED and the SCP which have been mentioned briefly earlier in this thesis[28]. These abbreviations contain different principles of countering security threats in the urban environment. The strategies will be elaborated on in this chapter, though in limited depth. Knowing of them, their content and their practical use is important for the assessment tool. However, before moving on to these strategies, we must deal with another aspect that is tied to the use of urban security measures. It is the use of overt and covert security measures, which will come in handy for any urban design strategy.

2.4.1 Overt and covert urban security measures

Overt refers to the visible urban security measures that causes a deflection effect towards potential attackers. They do, however, communicate a paradoxical message (Coaffee, O'Hare, & Hawkesworth, 2009). On the one hand, they make sure that appropriate urban security measures are in place for crowded urban areas. But on the other, they communicate to the area's daily users that wherever they are installed is a potential target that needs protection. This is a recurrent issue with overt urban security measures. It derives from the process where urban security is assessed by city governments and municipalities but consumed by the public. Whenever the assessors are not hands-on, we end up with disproportional obtrusive anti-riot trucks as urban security measures, with our citizens having to deal with the consequences.

There is, however, an ongoing shift towards the use of more covert urban security measures (Nementh, 2010). Covert, in this context, refers to "invisible" or camouflaged urban security measures, such as reinforced street furniture or environmental design changes. While the covert urban security measures ideally maintain urban security, they do not communicate any messages to potential attackers. Instead, they are focusing on reducing opportunities or incentives for the attackers.

There is a delicate balance between overt and covert urban security measures. Which is better is impossible to answer without assessing them in a defined context. It is also possible to combine the two. We can, however, take note of another important lesson from urban security theory regarding overt and covert measures: Any implementation of urban security measures – either overt, covert or in combination, comes with consequences. These consequences must be considered to secure our urban environment proportionally.

[28] The CPTED and the SCP were briefly introduced in **1.1 Background**. They are also mentioned in **2.2.1 Thesis' relevance to urban planning** as a foundation for resilient cities.

2.4.2 CONTEST

CONTEST, or "Counter-Terrorism Strategy", is the UK's official, yet non-statutory, strategy of countering terrorism (British Government, 2018). Although there is no legal requirement to ensure that urban security measures are integrated, CONTEST serves as guidance with major implications for the UK construction sector and thus UK's built environments (Harre-Young, Bosher, Dainty, & Glass, 2012). It provides a response to security threats, and is broken down into an organised, yet comprehensive, framework that consists of four P's:

- Prevent: To stop people becoming terrorists or supporting terrorism.
- Pursue: To stop terrorist attacks.
- Protect: To strengthen our protection against a terrorist attack.
- Prepare: To mitigate the impact of a terrorist attack.

(British Government, 2018, p. 8)

The CONTEST is of a general character. It is comparable to other, national action plans for countering terrorism. For thesis contextuality, we will mention the Norwegian action plan against radicalisation and violent extremism (Norwegian Government, 2014). Though it has no clear links to urban design strategies, such as the use of overt or covert urban security measures, it is relevant to the idea of resilient cities. The two latter P's seek to reduce vulnerability and to recover rapidly from terrorist incidents (British Government, 2018, p. 11). While 'Protect' is about implementing urban security measures in general, 'Prepare' is a step towards designing or building in resilience.

2.4.3 Crime Prevention Through Environmental Design

Crime Prevention Through Environmental Design (CPTED), is an urban design strategy to counter crime. It was developed in the 1970s, alongside Newman's Defensible space (1972). Since then it has been altered and revised. Today, it is one of the more popular design strategies when it comes to countering and mitigating threats without it happening at the expense of townscape aesthetics or urban liveability (Crowe, 2000; Lee, Park, & Jung, 2016).

The CPTED aims to reduce opportunities and incentives for crime through so-called managerial and environmental changes. This means that it goes together with covert urban security measures (rather than overt) and design changes of urban areas. It focuses on a reduction of attack attractivity without deflection, and on urban areas' natural abilities' – such as access control and surveillance, contribution to urban security while also sustaining the general public's perception of security.

The CPTED is based on four design principles:

- Natural surveillance
- Natural access control
- Territorial reinforcement
- Maintenance and management

(National Crime Prevention Council, 2003)

Compared to the CONTEST, the CPTED is a more covert and more "soft" strategy for urban security. According to the CPTED, natural abilities are designed into the built environment by using multi-functional "obstacles", such as greenery or reinforced street furniture, and by providing the urban areas with sight and overview[29]. We can compare this to more overt strategies, such as the ones we have recently seen used by city governments and municipalities in Norway[30]. They would, in contrast, rather block access with parked dumper trucks or excessive concrete urns. We can ask ourselves which one of the two goes more at the expense of townscape aesthetics and urban liveability.

2.4.4 Situational Crime Prevention

Situational Crime Prevention (SCP) shares the same foundation as the CPTED. They both turn tables and add new perspectives[31]. The SCP seeks to prevent crime by reducing the opportunities for offending, rather than aiming to change the criminal tendencies (Situational Crime Prevention: Definition & Strategies, 2017). It is focused on the situation and settings for crime, rather than on those who commit it.

SCP consists of a framework with four components:

- A theoretical foundation drawing principally upon routine activity and rational choice
- A standard methodology based on the action research paradigm
- A set of opportunity-reducing techniques
- A body of evaluated practice including studies of displacement

(Clarke, 1997)

Regarding the assessment tool, there are especially two things to extract from the framework. First is the rational choice argument: People committing crimes and terrorism are rational planners, and their human and behavioural dimension must be taken into consideration. Second is the studies of displacement. When assessing urban security, and especially while altering situational conditions, there is always the possible outcome of displacement. When we secure a crowded urban area, there is a chance that we move the threat elsewhere. This must be an important part of the consideration. However, if we look back at **2.2.3 Holistic planning and security**, we see that displacement is already taken into account.

[29] The CPTED presupposes that the design of an urban environment can influence our behaviour.

[30] Reference to the overt and disproportional urban security measures mentioned in **1.1 Background** and in **1.2.1 Status quo**. This is, however, only a few examples used to build a case. In many settings and contexts, if done right, overt urban security measures can also be the better option.

[31] New perspectives to the traditional approaches. We can see look back at **2.2.1 Thesis' relevance to urban planning** to see that e.g. "targeting hardening" is frequently used throughout its history.

2.4.5 A new philosophy for urban security

There is a number of challenges related to incorporating urban security measures into cities and crowded urban areas. First is the issue of time frames – or specifically, the urban and the built environments' life cycle. The requirements and consequences of incorporating the urban security measures vary over this life cycle. In a new project, urban security measures can be "designed in" from scratch. In an existing situation, they must be retrofitted into the already built environment. As stated by Harre-Young et al. (2012), most crowded urban areas already exist, which means that it is essential that the proposed assessment tool builds on a theoretical basis that takes life cycle into consideration.

Also, even though there are urban design strategies that offer some help along the way, there is still a lack of informed and appropriate guidance on incorporating urban security measures. Urban security has a very limited best practice due to it being deeply contextual (Harre-Young, Bosher, Dainty, & Glass, 2012), and we have already elaborated on its consequences if done wrong, such as the eventual outcome of disproportionality.

Recently, a new philosophy for urban security has been gaining traction. This philosophy deals with the lack of best practice on incorporating urban security measures by establishing and providing design principles. This philosophy is Elliot's (2009) "Planning for protection", later expanded on by Harre-Young et al. (2010).

The new philosophy roots in the growing need of guidance on incorporating urban security measures. When Elliot first presented it, he introduced a set of design criteria for securing the built environment against blast effects (Elliot, 2009, p. 5). According to his philosophy, a building should achieve one, or preferably all, of the following:

- *Deflect* a terrorist attack by showing, through layout, security and defences, that the chance of success for the terrorist is small; targets that are otherwise attractive to terrorists should be made anonymous.
- *Disguise* the valuable parts of a potential target, so that the energy of attack is wasted on the wrong area and the attack, although, completed, fails to make the impact the terrorist seeks; it is reduced to an acceptable annoyance.
- *Disperse* a potential target, so that an attack could never cover a large enough area to cause significant destruction, and thereby impact; this is suitable for a rural industrial installation, but probably unachievable for any inner-city building.
- *Stop* an attack reaching a potential target by erecting a physical barrier to the method of attack; this covers a range of measures from vehicle bollards and barriers to pedestrian entry controls. Against a very large car bomb, in particular, this is the only defence that will be successful.
- *Blunt* the attack once it reaches its target, by hardening the structure to absorb the energy of the attack and protect valuable assets.

(Elliot, 2009, p. 6)

Harre-Young et al. (2010) then kept building on Elliot's philosophy. They altered it to make the design criteria broader so that they applied for crowded urban areas. While Elliot's assets to protect were buildings, the altered version provides a general selection of assets. Noteworthy is its compliance with the ISR framework, the NS 5832 and the NSM guidelines. Also, it takes overt and covert urban security measures into account and complies with popular urban design strategies such as the CPTED and the SCP.

The wording differs little from Elliot's:

- *Deflect* a terrorist attack by showing that the chance of an attack being successful is reduced through the layout, security and defences used.
- *Disguise* valuable parts of a site or building so that an attack fails to make its desired impact.
- *Disperse* potential targets so that an attack could not impact all the possibilities.
- *Stop* an attack from reaching its target through the use of physical measures.
- *Blunt* the impacts of an attack should it reach the target area.

(Harre-Young, Bosher, Dainty, & Glass, 2010, p. 6)

Broader design principles, like the above, provide appropriate and informed guidance towards best practice on incorporating urban security measures.

3 Methodology

The research method consists of a research problem and two research questions. The questions help us answering the problem, which is how crowded urban areas can be secured in a proportional manner. However, since answering the research problem requires the development of an assessment tool for proportionality, the method is not straightforward. This will be explained in this chapter.

3.1 Quantifying the qualitative?

Urban security and security risk assessments are qualitative research matters. While developing a new assessment tool to function alongside and supplement the existing qualitative methods, it makes sense that we too stick to the qualitative (Silverman, 2016). One of the main issues with the existing methods is the reliance on subjective interpretation. Meaning that qualitative reasoning is, in fact, one of its weaknesses. However, replacing it with a quantitative approach is not possible – or at least not beneficial, because:

1) Urban security and security risks are deeply contextual. A qualitative approach helps us adjust our assessment to any context.
2) The assessment tool is supposed to supplement the existing methods. To replace them, and to reform urban security, is too bold a move for a master's thesis.

One solution could be to have the qualitative and the quantitative approaches supporting each other - like in a mixed research method (Bryman, Becker, & Sempik, 2017). The quantitative approach helps us deal with the reliance on subjective interpretation, since it allows us to support reasoning with objective data. The qualitative approach deals with any subjective or contextual data. If done right and proportionally, a mixed method strengthens the research. We will, therefore, not quantify the qualitative. Instead we will fill in the gaps of the qualitative approach with the quantitative.

3.2 A literature study

A literature study, defined as a study searching for a theoretical basis in already published research (Befring, 2007), is an inevitable part of our research method. The literature study requires a thorough and critical review of existing literature within the research field, as well as comparison among books, articles and papers. Its purpose is to form a thorough theoretical basis that we can use to develop the assessment tool. Also, it charts existing literature to show us what we can build upon. This is very helpful when creating something supplementary and it keeps us from reinventing the wheel.

3.2.1 Deductive and inductive processes

Deductive and inductive processes go together with the literature study (Hyde, 2000). Both processes require a theoretical basis consisting of existing data and literature. The processes help us treat and interpret the data. They lead us to new observations or findings (deductive), or observations that lead to the creation of new theories (inductive). Since our research method is a mix of the qualitative and quantitative, we rely on both processes. The deductive process

comes in handy early in the research while we examine existing data and explore the existing assessment methods' weaknesses. It helps us understand the need of a supplementary assessment tool, and why this thesis is written in the first place.

After we have established a theoretical basis to build upon, we turn towards the inductive process. It is especially useful when we are developing the assessment tool. Since the assessment tool is new and original, the process of developing it takes us into unknown territory. The inductive process is the only possible way to create a link between new theory and the existing, and thus justify the results of the research.

3.2.2 Interviews and participation

Experience can expand and challenge the literature study. It can fill in the gaps between articles and replace them with synergy or help our interpretation of knowledge. Therefore, a part of this literature study will be interviews and discussions on the topic to exploit other bright minds' experiences. These are interviews with relevant field experts such as urban planners, preparedness planners and leading researchers within the field. Using different people with various backgrounds is important to reduce the chance of bias.

Also relevant is to develop one's own experience. I participated in the Stavanger municipality's security risk analysis alongside the "Security in the centre"-group in December 2019. The security risk analysis followed the NS 5832. Present were Stavanger municipality's preparedness planners, urban planners, police and other first responders as well as other decision makers, decision takers and relevant stakeholders. Participation and observation gave me some relevant experience that contributes to the literature study.

3.3 Trial and error

"Trial and error" is an untraditional research method. It is more related to problem-solving than actual research. The method is characterized by varied attempts being repeated until success, or until one stops trying (Young, 2009). While developing a new assessment tool, there will be many attempts. It is both unlikely and naïve to believe that the first sketch will be sufficient. It must be tested and altered – repeatedly – until the outcome is satisfactory.

Trial and error in this research method is, however, not done blindfolded. It is executed on the literature study's theoretical basis which defines a relevant framework and necessary boundaries. The trials are thus focused and have a limited range. A notable aspect of this method is that it is increasingly based on inductive reasoning the further away from the theoretical basis it is being led by the trials.

3.3.1 Testing

Trial and error cannot be done without testing – or there would be no trials. The purpose of testing is to explore the assessment tool's functionality, its limitations and its errors. As part of the method, the assessment tool is tested in two different contexts. There should have been three tests, but the third test was unfortunately cancelled due to the covid-19 situation.

The first test was performed in February 2020. The assessment tool was presented and tested in a lecture in the 4th grade course "BYG640 Resilient cities" at the University of Stavanger (UiS) together with supervisor. 15 M. Sc. students and aspiring urban security planners participated. They used the assessment tool for their proposed urban security measures at the UiS campus.

The second test was performed in March 2020. It was a case study of the main square "Torget" in Stavanger city centre during a worst-case scenario – at its busiest and most vulnerable – during the annual food festival "Gladmat". This test was performed by myself and supervisor.

The third test was scheduled in March 2020. According to schedule it should have been a test of the assessment tool with relevant decision takers and decision makers in Stavanger municipality. It did, however, not get priority during the (first) peak of the pandemic, as Stavanger municipality had their hands full handling the situation. A consequence of the cancellation of the most important test, is that the research method's reliance on the literature study has been increased at the expense of trial and error.

3.4 Reflecting on the methodology

Any research method comes with pros and cons. Awareness of especially the cons, as well as self-criticism, helps to develop a thorough understanding of the research (Choy, 2014).

We start with the literature study, which is considered as a deductive and quantitative process. It comes with certain weaknesses. Research on proportionality in the context of urban security is a rather new subject. Existing literature on the topic is thus of limited extent. Proportionality was put on the agenda about 10 years ago, as a spin off from the early 2000s' call upon resilient design (Pickett & Grove, 2004). As a result, there is a lack of data and resources for executing a large scale, quantitative research. To complete a literature study, the researcher must trust the acknowledged literature that exists on the topic. Since we have a limited store of quantitative data available, there is a risk of limited depth and bias. Interviews are used to overcome this issue and to complete the literature study.

While researching and developing something new, it is essential to work from a solid and verifiable starting point. In this case, the starting point is established on a theoretical basis formed by the literature study. The development ventures into unknown territory. It is thus considered as an inductive and qualitative process, and since it increases as we go, it leads to certain challenges. First, it is difficult to address any qualitative matter objectively (Choy, 2014; Silverman, 2016). Second, how can its credibility be assured? The moment we start our development, we can assure credibility by relying on our theoretical basis. However, as we go into the development, we are slowly leaving our base. What keeps us on course is inductive reasoning that allows us to use theory as a link between our results and starting point. This link grows, however, thinner as we go, and we must therefore not go too far.

Testing and reviews can also help us establish credibility. By testing in different contexts and with various, yet objective participants familiar with the topic, we can make sure that the development does not stray too far. We must also remember the purpose of the research. Whether the assessment tool passes its tests or fails, it still contributes knowledge to the field

and emphasizes proportionality within urban security. Ideally, the assessment tool leads to debates and to further, much needed, research on the topic.

3.5 Graphical overview

The research method starts with the research problem and the two research questions that are illustrated in **Figure 2: Research problem and research questions**. The rest of it, continuing from the thesis, can be illustrated as follows:

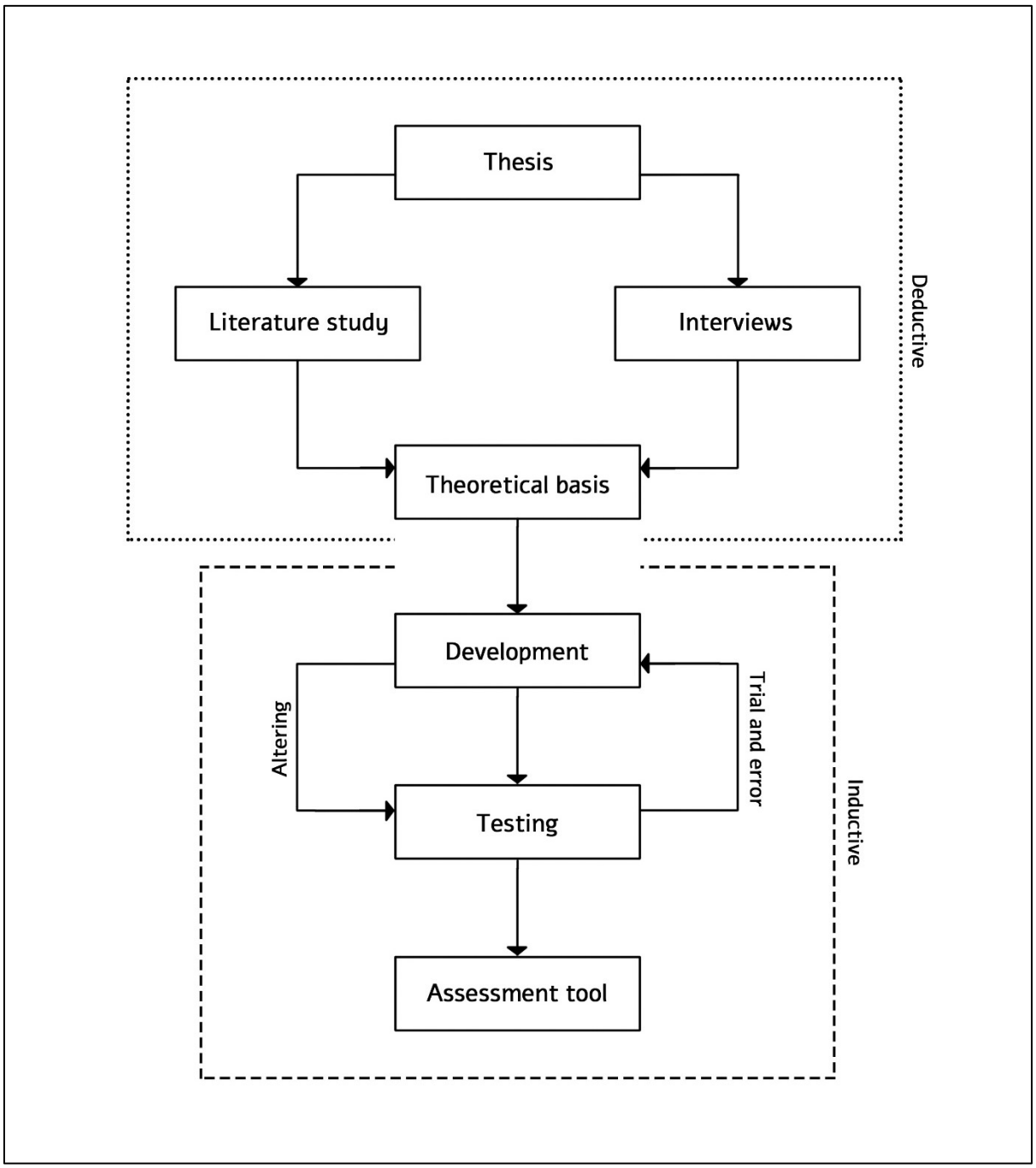

Figure 5: Graphical overview of the research method

4 The Proportionality Assessment Tool

It is finally time to move on to the proposed assessment tool – or the PAT (Proportionality Assessment Tool), which we abbreviate for practical reasons. We start off by looking at the how the PAT supplements the existing framework and explain its role in the context of urban security. Next, we tackle the questions of how we can measure and design proportionality. Finally, we give a step by step walkthrough explaining the PAT.

4.1 Another piece of the puzzle

Threats, vulnerabilities and assets are all deeply contextual matters. The same goes for urban security measures' performance, requirements and consequences. It is unjustifiable to quantify these abilities because qualitative data will be lost in translation. As a result, the PAT's basis is qualitative. This ensures that it matches the existing frameworks, such as the ISR and the NS 5832, and sees to its function as a supplementary and complementary tool. Additionally, the qualitative basis makes the PAT more flexible and able to adapt to new threats.

Our next concern is contextuality. Assessment of urban security is performed in a variety of contexts. Governments, municipalities, universities, private constructors and others, all have a different view on urban security measures' performance and requirements. Therefore, it is important to keep the PAT flexible so that it can be used on both large- and small-scale assessments. While the existing frameworks are suited for the largescale assessments, the PAT seeks to function on any scale. We must, though, keep in mind that the PAT's outcome is increasingly plausible with the participants' interdisciplinarity.

To show the supplementary purpose of the PAT, we can view it next to the existing framework's five linear steps for assessing urban security[32]:

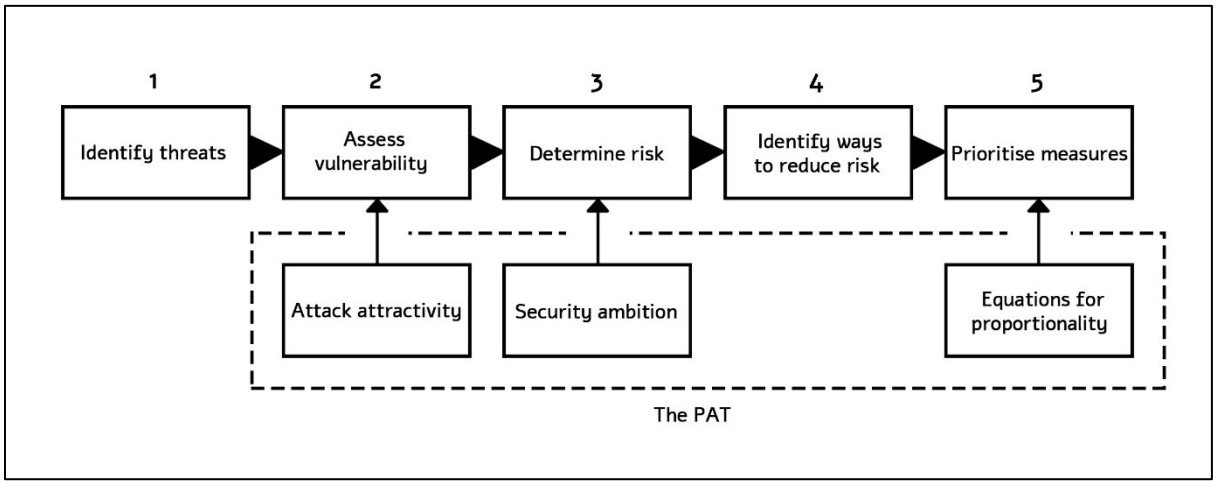

Figure 6: The PAT alongside the five linear steps of the existing framework

We can see how the PAT adds to the puzzle. It contains three different puzzle pieces, each supporting a different step of the existing framework.

[32] Reference to the five linear stages extracted from the ISR framework which were explained in **2.1 Building upon existing literature**.

The three pieces are:

- An attack attractivity analysis to support the assessment of vulnerability.
- A security ambition to support the determination of risk.
- Two equations for proportionality to help prioritise urban security measures.

The three pieces are explained in their respective chapters. On a general note, it is important to stress the PAT's dependency on the existing framework to function. Certain input, such as threat assessments and possible means of attack, must already be put in place. The PAT does also not include any ways to reduce risk outside the scope of urban security. It remains focused upon physical measures as well as managerial or environmental design changes.

4.2 Measuring proportionality

In chapter **2.2.4 Defining proportionality contextually**, we explained the two terms 'Proportional performance' and 'Proportional design'. From these we arrived at a new, contextual definition of proportionality:

- Proportionality is achieved when the security measures correspond to an urban area's vulnerability to current threats, and its performance and positive consequences equals or exceed its requirements and negative consequences.

According to our contextual definition, proportionality is only achieved when both conditions are true. Yet, one important question remains. How should we measure proportional performance and proportional design? Being able to measure them is an essential prerequisite because both are supposed to either equal or exceed corresponding sizes or conditions.

4.2.1 The equation for proportional performance ($P1$)

Proportional performance is a measure of urban security measures' ability to perform correspondingly to an urban area's apparent vulnerability. First, we must determine the corresponding condition. As we know, this is based on vulnerability. However, there is more to it. We must also take society's security ambition into account. Our way of doing it, is to rephrase it to a so-called "accepted vulnerability". Substituting the "accepted vulnerability" from the apparent vulnerability, gives us an indicator of how much we need to do – which is an indicator of how our urban security measures must perform.

Proportional performance is constituted of the following conditions:

- The sum of the urban security measures' performance to a specific threat.
- The urban area's vulnerability to a specific threat.
- The urban area's accepted vulnerability to a specific threat.

Since proportionality is about correspondence, these conditions can be rephrased into an equation. We name it "$P1$":

$$(P1) \quad \sum_{i=1}^{n} M_{P_i} = A - S$$

Where:

- The sum of the urban security measures' performance is indicated by $\sum_{i=1}^{n} M_{P_i}$.
- The urban area's vulnerability to a specific threat is indicated by A.
- The urban area's accepted vulnerability, or security ambition, is indicated by S.

This means that the $P1$ equation is balanced when the performance of the urban security measures is equal to the vulnerability of the area, where we adjust for the level of vulnerability accepted by society. And according to our contextual definition of proportionality, this equation must be balanced for the condition to be true[33].

4.2.2 The equation for proportional design ($P2$)

Proportional design is a measure of urban security measures' performance, requirements and their consequences – both positive and negative. To be more precise, it is the different abilities' relation or correspondence to each other. Proportional design is achieved when the urban security measures' performance and positive consequences either equal or exceed their requirements and negative consequences. It differs from the $P1$ equation in that it does not necessarily seek balance. Performance and positive consequences can exceed requirements and negative consequences because the result is beneficial for urban areas.

While the $P1$ equation compares the urban security measures' performance to something external, such as the needed level of security expressed by vulnerability, the equation for proportional design is focused upon comparison of the urban security measures' abilities. Proportional design is constituted of the following conditions:

- The sum of the urban security measures' performance to a specific threat.
- The urban security measures' positive consequences.
- The sum of the urban security measures' requirements.
- The urban security measures' negative consequences.

These abilities can be rephrased into an equation. We name it "$P2$":

$$(P2) \quad \sum_{i=1}^{n} M_{P_i} + C_{Positive} \geq \sum_{i=1}^{n} M_{R_i} + C_{Negative}$$

Where:

- The sum of the urban security measures' performance is indicated by $\sum_{i=1}^{n} M_{P_i}$.
- The urban security measures' positive consequences are indicated by $C_{Positive}$.
- The sum of the urban security measures' requirements is indicated by $\sum_{i=1}^{n} M_{R_i}$.
- The urban security measures' negative consequences are indicated by $C_{Negative}$.

Meaning that a positive difference between the urban security measures' performance along with positive consequences – and the requirements along with negative consequences – indicates that they perform and contribute more than they require and/or withhold.

[33] Sums like $\sum_{i=1}^{n} M_{P_i}$ ranges over the performance M_P of the n different urban security measures.

4.2.3 The prerequisite of equal importance

Though we have yet to elaborate on the equation's abilities, there are two things that need to be dealt with first. Those are the prerequisite of equal importance and the use of qualitative scales to represent abilities. Otherwise, we cannot justify the use of the equations.

First, the $P1$ and $P2$ equations, and thus the measurement of proportionality, are mathematical expressions based on sums which contain a set of abilities. By summing these abilities, we explicitly state that all the abilities play equally important roles for the total expression. This is a so-called prerequisite of equal importance.

The first argument to justify the prerequisite, is that the abilities used in the PAT's equations are carefully selected and supported by a solid theoretical basis. In this case, we rely on our literature study[34]. Also, regarding the selection of abilities, is that they are selected above others because they are of a comparable nature. Another argument is holistic security and planning. Interdependency among physical urban security measures is essential for securing urban areas efficiently. As a result, it makes sense to see the measures' performance, requirements and consequences as a totality. We do so by adding them and their subset of abilities together. This paints a holistic picture of the urban security.

4.2.4 Qualitative scales

Currently, there are no such things as the $P1$ and $P2$ equations. The same goes for our contextual definition of proportionality which takes both proportional performance and design into account. While developing the PAT we thus venture into inductive territory because we are both looking for and defining new theory. Yet, we cannot use our findings in the equations unless it is defined in a way that can be implied quantitatively.

To use the $P1$ and $P2$ equations, we must express our findings as numbers. To "quantify" qualitative data is, however, out of the question[35]. Instead, the PAT uses numbers as quantitative references. It is done by characterizing the qualitative data by its "degrees of presence", and then divide it into categories.

The use of qualitative scales is according to the existing framework[36]. In the PAT, the qualitative scale consists of six steps ranging from 0-5:

0	1	2	3	4	5
None	Very low	Low	Moderate	High	Very high

Table 3: The abilities' six degrees of presence

[34] Reference to **3.2 A literature study**. Its content is elaborated on throughout **2 Theory**.
[35] This issue is explained and concluded in **3.1 Quantifying the qualitative?**
[36] In Norway, the NS 5832 has associated supervision guides that use qualitative scales. An example is DSB's supervision guide for risk assessments in Norwegian municipalities (DSB, 2014).

4.3 Attack attractivity analysis (A)

The first stage of the PAT is an attack attractivity analysis. The analysis supplements vulnerability assessments in the urban context. The outcome is a measure of an urban area's attack attractivity (A). It is the A that is used in the $P1$ equation. It does differ from ordinary vulnerability assessments. The attack attractivity analysis inverts the defensive point of view, meaning that in the A, vulnerability is assessed through the eyes of potential attackers. The A therefore takes the rational choice argument into account and complements the existing frameworks' assessments of vulnerability.

The A is constituted of five abilities[37]:

- Asset value
- Availability
- Compliance
- Suitability
- Fragility

To turn the tables and assess an urban area's vulnerability from an attack point of view is untraditional. Yet, it is a way of estimating the likelihood of an attack while avoiding the stochastic argument[38] (Aven & Krohn, 2014). Terrorist attacks and intended, undesirable human-induced actions, are not stochastic events and cannot be subjects to the stochastic argument. The A therefore allows us to deal with them without any ties to probability.

4.3.1 The A abilities

We move on to explain the A abilities. As an example, picture a crowded urban area – located anywhere. This crowded urban area is in some degree vulnerable to one or more threats. This vulnerability is the crowded urban area's attack attractivity to one or more threats and is expressed by the A value. The A value is composed of five abilities: Asset value, availability, compliance, fragility and suitability. It is calculated as follows:

$$(Attack\ attractivity)\quad A = \sum_{i=1}^{5} Abilities_i$$

The abilities are scored 0-5 according to their degree of presence[39]. They are also carefully selected. In the context of attack attractivity, the abilities are extracted from terrorist targeting preferences. Even though these preferences vary among groups, depending on motives and capability, there is still compliance among them (Libicki, Chalk, & Melanie, 2007). We can, furthermore, argue that the compliance is sufficient for a theoretical foundation that allows us to derive five abilities for the PAT's A by looking at the three studies' overlap and compliance, and then scale it for an urban context[40].

[37] The abilities are purposely sorted by their compliance with terrorist targeting preferences.
[38] The stochastic argument is explained in **2.3.1 Safety and security risk assessments**.
[39] By using qualitative scales as explained in **4.2.4 Qualitative scales**.
[40] The three studies are Evan et al. (2017), Kaewunruen et al. (2018) and Libicki et al. (2007). They are elaborated on in **2.3.2 Examining terrorism and targeting of crowded urban areas**.

A	Terrorist targeting preferences		
Availability	Capability	Utility	General vulnerability
			Accessibility
Compliance	Rally	Media impact	High local visibility and media impact
Asset value	Damage & Coercion	Mortality rate & Physical damage & Overall economic impact	High fatality possibility
Suitability			Poor design for mitigating or repelling an attack
			Ability to damage or destroy the area
Fragility		Scalability	Difficulty for evacuation

Table 4: Compliance matrix for the A abilities

4.3.2 Description of the A abilities

- **Asset value** is a measure of a specific threat's possible impact on an urban area's assets. For instance, a high density of people at predictable times of the day is a high asset value for attackers targeting with mortality and/or fatal consequences in mind. For more symbolic attacks, such as an attack on a church or a mosque, the presence of such a building within the urban area increases the asset value (Australia-New Zealand Counter-Terrorism Committee, 2020). Even though asset value is assessed for one threat at a time, it is not limited to one asset. One threat can impact a range of assets.
- **Availability** is a measure of an urban area's accessibility linked to the attackers' means of attack and capability. An inaccessible or deflective urban area is not an attractive target because it increases the effort. The same goes for urban areas where managerial or environmental changes affect the opportunities and incentives for an attack[41]. An important note is that availability is scored on the attacker's perception of availability. Another part of availability is public visibility and available information for planning an attack. This also goes for the ability to visit an urban area during a planning phase to obtain insight and information that results in a successful attack.
- **Compliance** is a measure of the urban area and its content's match (or compliance) with the attacker's motive. While a Mosque meets the requirements for right-wing extremists, the Twin Towers were a better fit for the Al Qaeda for the "9/11" attack. For others, urban areas with dense crowds of people to predictable times of the day are targets that comply with their motives – for instance mortality or obtained media effect. We need to know who we are dealing with, and their means of attack.

[41] Both overt and covert urban security measures contribute to availability.

- **Suitability** is a measure of the present urban security measures currently addressing a specific threat, and their ability to stop it. Urban security measures' ability to stop a specific threat is, however, limited to the means of attack. This means that while retractable bollards are efficient against hostile vehicles, they cannot stop a drone attack. Suitability is also influenced by other features. Street geometry, traffic patterns and existing slopes are, for instance, all relevant against hostile vehicles. To assess suitability for an urban area we must analyse it holistically.
- **Fragility** is a measure of the additional consequences that occur when an attack takes place. The ability is tied to target hardening[42]. If the urban area is prone to a bomb threat, glass facades on adjacent tall buildings increase the consequences from the blast, because there is a risk of falling glass. Another factor is difficult evacuation which would maximize the time assets are exposed to a threat – or it could cause a stampede.

The A abilities derive from terrorist targeting preferences and are influenced by different urban design strategies[43]. The strategies' effect on the abilities is best illustrated with a figure:

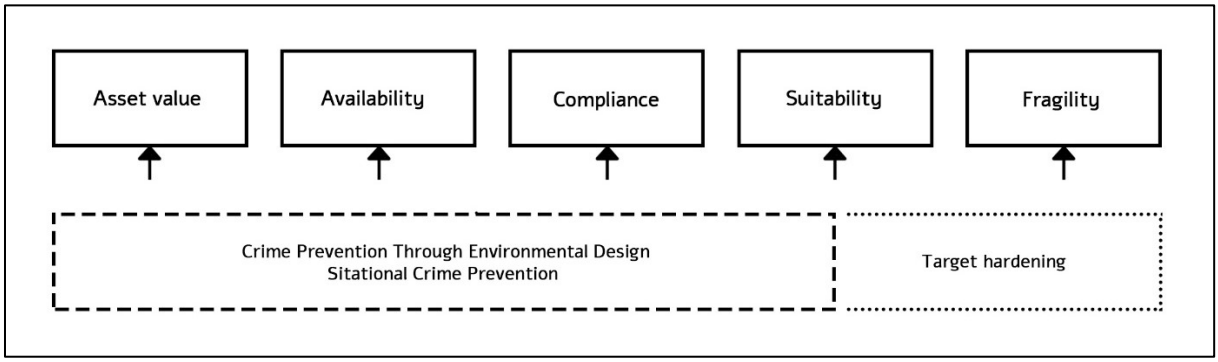

Figure 7: Urban design strategies' impact on the A abilities

The abilities are scored 0-5 according to **4.2.4 Qualitative scales**. Their sum constitutes the urban area's attack attractivity A and is used in the $P1$ equation.

(Example) The assessment tool is of little use unless we can show and communicate its practical use. We therefore introduce an example that shows us how the PAT functions. This example is applied whenever we are elaborating on the equations or their abilities.

We use the imaginary city Exampleville. It has a public square that hosts various markets, food festivals and other popular events throughout the year. Its content attracts many people and the square is considered as a crowded urban area.

Regarding threat assessments, we work with a case where our threat is vehicle ramming performed by extreme Islamic terrorists targeting people.

[42] Fragility is tied to the CONTEST's «Prepare» and Elliot's «Blunt» as explained in **2.4.2 CONTEST** and **2.4.5 A new philosophy for urban security**. These abilities imply target hardening.
[43] Reference to the different strategies presented in **2.4 Urban design strategies**.

The city's layout is illustrated in **Figure 8: Exampleville**.

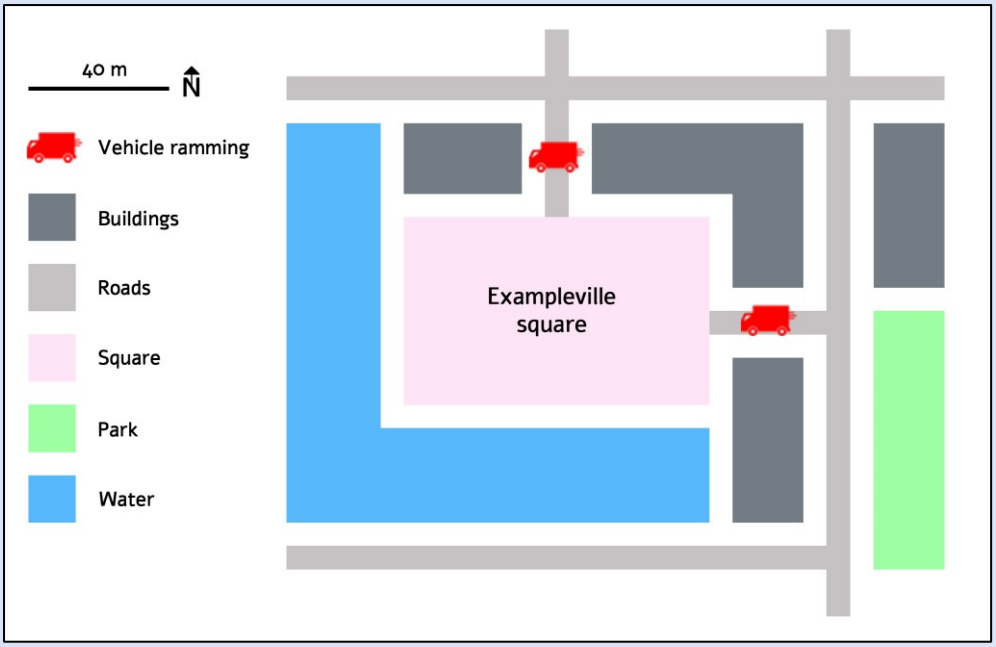

Figure 8: Exampleville

We score the A abilities accordingly:

- 'Asset value' is considered very high (5) because there are many people present at predictable times of the day. We are also in the city centre of Exampleville. We must therefore assume that the square has additional qualities and values.
- 'Availability' is considered high (4) because the square is accessible for vehicles from two roads that have no change of angle or geometry to reduce velocity.
- 'Compliance' is considered very high (5) because people are likely to be in crowds or clusters which makes them the perfect target for vehicle ramming. Also, they are in a symbolic area that is likely to cause headlines on a national or international level.
- 'Suitability' is considered moderate (3). Even though there are no urban security measures addressing the vehicle ramming threat, the possible velocity while coming from the east is limited by acceleration distance. Also, a two-way traffic pattern might interrupt the acceleration while coming from the north.
- 'Fragility' is considered very low (1) because there are few conditions present that add to the consequences of a vehicle ramming attack. The square is large and legible, and evacuation on foot is easy.

We calculate the A with our abilities as input:

$$A = \sum_{i=1}^{5} Abilities_i = 5 + 4 + 5 + 3 + 1 = 18$$

This leaves us with an $A = 18$ (out of 25). This indicates that our crowded urban area has a rather high level of attack attractivity for vehicle ramming.

4.4 Security ambition (S)

Now that we know how we can assess an urban areas' attack attractivity, we can move on to explaining the PAT's security ambition S. The security ambition is a measure of the level of vulnerability that a society is willing to accept. It contributes to proportionality because it is part of the equation that tells us how much we need to do.

As we explored in **2.3.3 Is it secure?** the current (generic) security ambition is helpful for definition purposes but otherwise of little practical use[44]. Instead, we look towards the US framework's "chosen level of protection" (FEMA, 2005). This approach for determining a security ambition is more applicable for the PAT and allows us to base it on the attack attractivity analysis. It also makes the PAT more consistent and easier to use. The PAT thus rephrases the "chosen level of protection" into an "accepted level of vulnerability" and uses it as a security ambition (S). Its relation to theory is as illustrated:

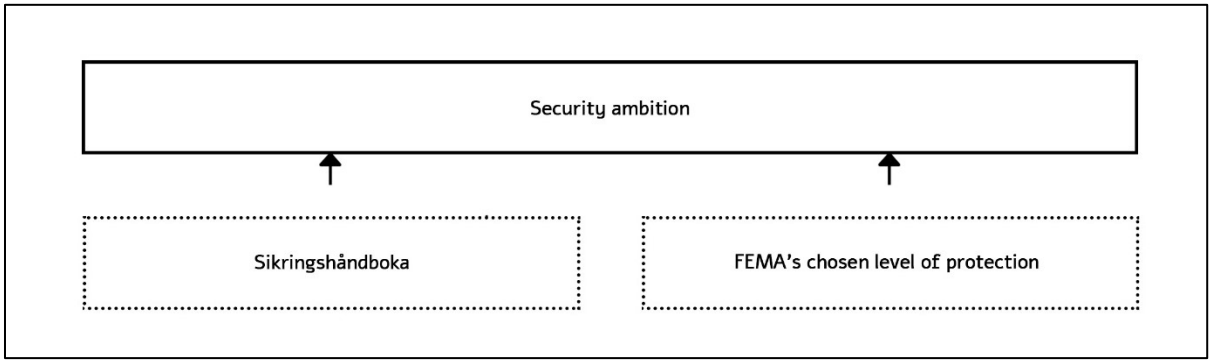

Figure 9: The security ambition's theoretical foundation

The S is determined by whole numbers ranging from 0-25. It is equivalent to the sum of the A abilities. It is divided into six categories to allow the assessors some wiggle room[45]:

0	1-5	6-10	11-15	16-20	21-25
None	Very low	Low	Moderate	High	Very high

Table 5: Six categories for the security ambition

The S also comes with a mathematical relation to A:

$$S \leq A$$

The S is, however, not supposed to be calculated. Its mathematical relation to A serves no other purpose than to show that it cannot exceed A. The S is rather assessed "bottom-up" by looking at the A abilities. From them, we can decide upon acceptable degrees of presence for each ability. These degrees derive into a sum and lead us (back) to the six categories.

[44] Reference to the security ambition that is described in Sikringshåndboka (Forsvarsbygg, 2016).
[45] This saves the decision makers, decision takers and stakeholders some detail. The PAT is qualitative and supplementary, and to allow them to choose a category rather than a number eases the process.

As a result, it is up to decision makers, decision takers and stakeholders to decide upon a security ambition. It is reasonable to expect that whoever assesses urban security also determines the S while using the PAT. It is important to stress that the more ambitious the security ambition is, the more demanding it will be to fulfil it. The A and the S are, after all, indicators which tell us how much we need to do to proportionally secure an urban area.

The PAT's way of assessing the S bypasses the stochastic argument. It is a way of determining "risk acceptance" without using probabilistic or presupposing criterions[46]. It does, however, not bypass the delegation of (potential) blood on hands. Just like someone is responsible for urban security in our society, someone must also "own" the security ambition (Vinnem, 2010). This is inevitable while handling security risk. Since there are few, suitable competitors to the task, the PAT leaves it to the city governments and municipalities.

As a final note about the security ambition, it is important that it avoids becoming a mechanical measure (Aven, 2015). It is more than a category or a number. By assessing it bottom-up and based on the A, essential qualitative and contextual aspects are not left out. Only then can the A and S give us a corresponding measure for proportional performance.

(Example) We can round off the chapter by expanding upon our vehicle ramming example in Exampleville. We have an $A = 18$. This means that Exampleville square has a high attack attractivity. In our example we place ourselves in the shoes of the decision makers, decision takers and the stakeholders. We propose a security ambition $S = 10$. This means that we accept a low degree of risk. In our case, the S is evenly divided on the A abilities.

Let us set up a table with the A abilities, their scores (A_i) and their accepted scores (S_i):

A	A_i	S_i
Asset value	5	2
Availability	4	2
Compliance	5	2
Suitability	3	2
Fragility	1	2
SUM	**18**	**10**

Table 6: Attack attractivity and a security ambition

We now have the required input to solve the right side of the $P1$ equation. Thus, we know how well we need the urban security measures to perform. We can fill in for A and S:

$$(P1) \quad \sum_{i=1}^{n} M_{P_i} = A - S \quad \Rightarrow \quad \sum_{i=1}^{n} M_{P_i} = 18 - 10 = 8$$

[46] The use of F-N curves and approaches such as ALARA/ALARP are mentioned in **2.3.3 Is it secure?**

4.5 Urban security measures' performance (M_P)

The next step is to explain how the PAT assesses urban security measures' performance (M_P). This is the only thing left for solving the $P1$ equation. There are two conditions that serve as a basis for the abilities that constitute performance. These are:

- The urban security measures' performance must be able to "mirror" the urban area's vulnerability – being the A. Since the M_P, the A (and the S) are all parts of the same equation, their abilities must be possible to compare.
- The urban security measures' performance abilities must fit the PAT's framework. There are five of them, and they are scored 0-5 according to their degree of presence[47].

4.5.1 The M_P abilities

Abilities that fulfill the two conditions for urban security measures' performance are derived from Elliot's philosophy "Planning for protection"[48] (Elliot, 2009). Elliot introduced five abilities for so-called protection design for buildings, that are later rephrased and put into the urban context by Harre-Young et. al. (2010). Now they are put into the PAT.

The M_P abilities are:

- Deflect
- Disguise
- Disperse
- Stop
- Blunt

While Harre-Young et al. (2010) redirected Elliot's abilities (2009) from terrorist attacks targeting buildings to crowded urban areas, the PAT takes them one step further. In the PAT, the abilities are focused upon the urban security measures themselves, or more accurately, their performance. The M_P is thus a measure of how well the urban security measures perform and their efficiency against specific threats – such as vehicle ramming or a VBIED.

Like the A and the S, the M_P is also expressed as a sum of five abilities, and its abilities are scored 0-5 according to their degree of presence. An aspect of the M_P abilities' degree of presence that is worth noting, is that an urban security measure can perform very well against one threat but be useless against another. For instance, retractable bollards will manage to stop hostile vehicles from entering a crowded urban area, but they are of little use against attackers on foot armed with knives or firearms. This is one of the main reasons why the PAT's equations assess one threat at a time. The other main reason is that assessing multiple threats simultaneously would be very complex. However, while we assess the same threat, we can add different urban security measures' performance together. Often a combination of urban security measures, like reinforced street furniture and greenery, is the better option.

[47] The M_P abilities are, like the A and the S, also subjects of both **4.2.3 The prerequisite of equal importance** and **4.2.4 Qualitative scales**. Otherwise they would not fit the PAT framework.
[48] Reference to **2.4.5 A new philosophy for urban security** where the abilities are introduced.

4.5.2 Description of the M_P abilities

- **Deflect** is a measure of the urban security measures' ability to show potential attackers that their attack is likely to be unsuccessful due to layout, defences and present security. This ability is about preventing attacks from happening - not about mitigating or stopping attacks once they happen. Deflection prevent attacks by reducing the urban areas' 'Availability'[49] (Norman, 2010). Key to scoring high on deflection is to use overt urban security measures. We must, however, keep in mind the overt security measures' paradoxical message that we investigated earlier[50].
- **Disguise** is a measure of the urban security measures' ability to mislead attackers so that they do not achieve their desired consequences. It is quite the opposite of deflection. Key to scoring high on disguise is to use covert urban security measures. They seek to surprise and disrupt attackers during an attack by severely and suddenly changing circumstances and expectations. Another aspect of disguise is available information – e.g. conscious public misinformation about urban security.
- **Disperse** is a measure of the urban security measures' ability to spread out the assets it seeks to protect. It is the counterpart of 'Asset value'. Disperse seeks to scatter assets in an urban area to make it a less attractive target. Thereby, disperse is both capable of reducing the opportunities for an attack as well as reduce its eventual consequences. While aiming to disperse, we must keep in mind the possibility of displacement[51].
- **Stop** is a measure of the urban security measures' ability to stop an attack from reaching its desired assets or destination. It is tied to an urban area's 'Suitability'. While aiming to stop an attack, we are considering that the attack happens despite environmental or situational conditions reducing opportunities or incentives. There is, in other words, an attack incoming and we need physical urban security measures to stop it. To efficiently stop an attack, it is important to assess urban security through a holistic lens. The urban security measures perform better as a layer-based system, where their interdependencies are utilized for their benefit.
- **Blunt** is a measure of the urban security measures' ability to reduce the consequences of an attack once it has happened. It is thus a question of target hardening. Key to scoring high on blunt is to build in resilience in the built and urban environment. The ability counters the urban areas' 'Fragility'. On a general note, blunt is also increased by limiting the assets' exposure to the threat over time.

The abilities are scored 0-5 according to **4.2.4 Qualitative scales**. The sum of them makes up the urban security measures' performance M_P and is used in both equations for proportionality ($P1$ and the $P2$). While the A and the S tell us how much we need to do, the M_P tell us how much our proposed urban security measures actually do.

[49] Deflection impacts the A ability 'Availability'. If an urban area looks secure it is a less attractive target.
[50] Overt security measures' paradoxical message is related to citizens' perception of security where security measures communicate that certain urban areas need to be protected. The issue is looked into in **2.4.1 Overt and covert urban security measures**.
[51] Displacement is elaborated on in **2.4.4 Situational Crime Prevention**.

The M_P abilities are affected by urban design strategies. Since they are the A's counterpart, they are subjects of the same strategies. One difference though, is that target hardening plays a slightly bigger role for urban security measures' performance.

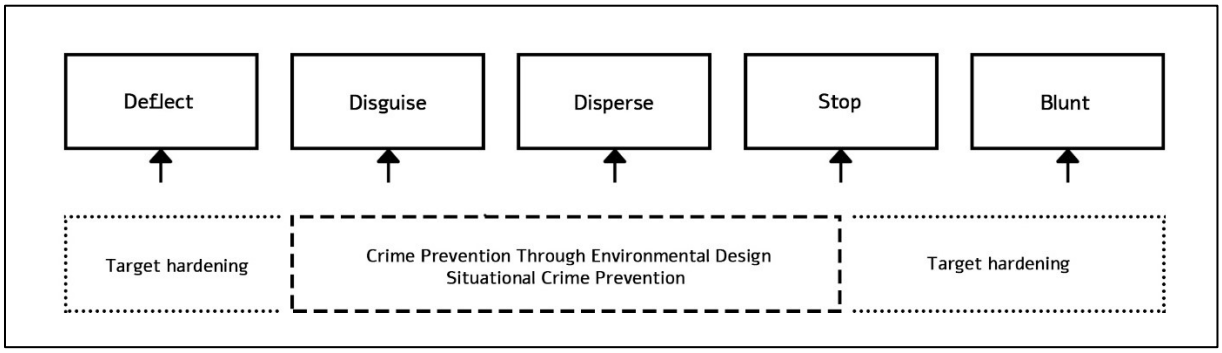

Figure 10: Urban design strategies' impact on the M_P abilities

(Example) We can put M_P into context by having yet another look at our vehicle ramming example in Exampleville. If we solve the right side of the $P1$ equation, we get '8':

$$(P1) \quad \sum_{i=1}^{n} M_{P_i} = A - S \quad \Rightarrow \quad \sum_{i=1}^{n} M_{P_i} = 18 - 10 = 8$$

This '8' is borderline combinatorics. It can be put together in many different of ways, each giving us '8' ($8 = 7 + 1 = 6 + 2 = 5 + 3$ etc.). And for now, no combination is better than the other. To balance out the $P1$ equation for proportional performance, the M_P only needs to equal '8'. We will, however, see that some urban security measures score better than others when we also consider proportional design (the $P2$ equation).

Our next step is to propose urban security measures that have a performance (M_P) that equals '8' to the vehicle ramming threat. We propose two measures:

- 3 retractable bollards (m_1):
  Retractable bollards are bollards that can telescope down into inground receivers when they are unlocked. They are usually made of steel. They are equipped with a gas movement system that can be activated with remote control.
- 2 reinforced benches (m_2):
  Reinforced benches are benches with a concrete foundation. This makes them heavy and resistant to impact. If the benches are of another material than concrete, it must be one that cannot be shattered into "projectiles" if rammed into.

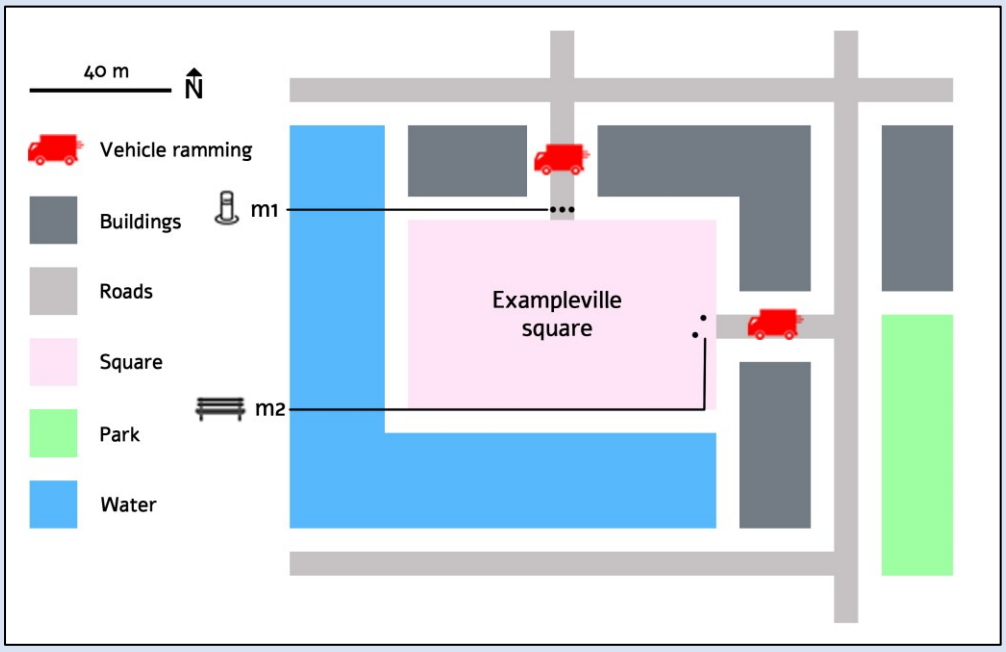

Figure 11: Proposed urban security measures in Exampleville

We score the M_P abilities accordingly:

- 'Deflect' is considered as low (2) for the retractable bollards (m_1) and none (0) for the reinforced benches (m_2). Retractable bollards communicate to potential attackers that the Exampleville square is protected. They do, however, only see to one of the square's two entrances, and are therefore not scored higher.
- 'Disguise' is considered none (0) for the retractable bollards (m_1) and low (2) for the reinforced benches (m_2). The reinforcement of the benches is covert. It is thus able to disrupt or surprise attackers that underestimate them.
- 'Disperse' is considered none (0) for both measures.
- 'Stop' is considered moderate (3) for the retractable bollards (m_1) and none (0) for the reinforced benches (m_2). Retractable bollards only see to one of the entrances and have a chance of tailgating. They are thus not scored higher.
- 'Blunt' is considered none (0) for the retractable bollards (m_1) and very low (1) for the reinforced benches (m_2). The benches splits crowds evacuating towards east.

We calculate the M_P with our abilities as input:

$$\sum_{i=1}^{n} M_{P_i} = \sum_{i=1}^{2} M_{P_i} = (2+0+0+3+0) + (0+2+0+0+1) = 5+3 = 8$$

This means that if we propose retractable bollards and reinforced two benches, we have urban security measures that perform proportionally:

$$(P1) \quad \sum_{i=1}^{n} M_{P_i} = A - S \quad \Rightarrow \quad 5+3 = 15-10 \quad \Rightarrow \quad 8 = 8$$

We have now solved the $P1$ equation.

4.6 Proportionate design

The $P1$ equation tells us how much we need to do to achieve a proportionate level of urban security. But for our cities, proportionate performance alone is not sufficient. We must also see to that what is done, is done in a good manner. This is where proportionate design comes in.

Proportional design is determined by solving the $P2$ equation:

$$(P2) \quad \sum_{i=1}^{n} M_{P_i} + C_{Positive} \geq \sum_{i=1}^{n} M_{R_i} + C_{Negative}$$

The equation uses the urban security measures' performance (M_P), requirements (M_R) and their positive ($C_{Positive}$) and negative ($C_{Negative}$) consequences as input. It determines proportional design. For it to be valid, the urban security measures' performance and positive consequences must exceed or equal their requirements and negative consequences.

4.6.1 Exceed or equal?

Since proportionality is about correspondence to something else, it is illogical to allow a value to exceed another, such as in the $P2$ equation. However, the urban security measures' performance is already tested for correspondence in the $P1$ equation. If this equation is balanced, we know that our proposed urban security measures perform as needed. What we do with the $P2$ equation is to test our proposal against a set of requirements and consequences. We must make sure that the urban security measures perform as needed without going at the expense of cities' townscape aesthetics or urban liveability.

Even though the $P2$ equation uses the same M_P, it does not concern the urban security measures' performance correspondence to vulnerability. It checks for correspondence to the measures' "design properties"[52] and consequences, such as costs or impact on the built or the urban environment. It is thus disadvantageous to limit the M_P to equal. Such a limitation would punish well-functioning urban security measures with positive consequences and few requirements. What is important for proportionate design, is that the M_P and the positive consequences are not surpassed by the M_R and the negative consequences. And so we stick to exceed or equal ($\geq$). If urban security measures perform more than they require, and the consequences does not topple the equation over, they are proportionally designed.

[52] The requirement abilities are explained in **4.7 Urban security measures' requirements (M_R)**.

4.6.2 Proportional design's theoretical roots

There are few thorough studies that assess the performance, requirements and consequences of urban security measures. Every urban area is different. It is also exposed to different threats. This leaves us with a deeply contextual subject, which makes it difficult to provide applicable research. There is, however, one study that goes through a variety of urban security measures used for protecting urban areas. This study is Steve Harre-Young's doctoral thesis: "The Relative Performance and Consequences of Protecting Crowded Places from Vehicle-Borne Improvised Explosive Devises" (Harre-Young, 2012), and it is used as a basis for the PAT's approach to proportionate design. The PAT does, however, not settle with the findings. It goes one step further by putting them up against each other in an equation. And for it to do so, the findings are supplemented with qualitative, scorable abilities. To put the abilities up against one another, and to use sums and consequences, is according to another assessment method for urban security. It is adapted from Nunes-Vaz, Lord and Ciuk's framework for urban security in-depth (Nunes-Vaz, Lord, & Ciuk, 2011). A noteworthy contribution is the idea of using mathematical approaches for determining the efficiency of security measures. Combining proportional design's theoretical roots, the PAT uses Harre-Young's abilities and Nunez-Vaz, Lord and Ciuk's mathematical methodology.

We can illustrate the theroetical foundation as follows:

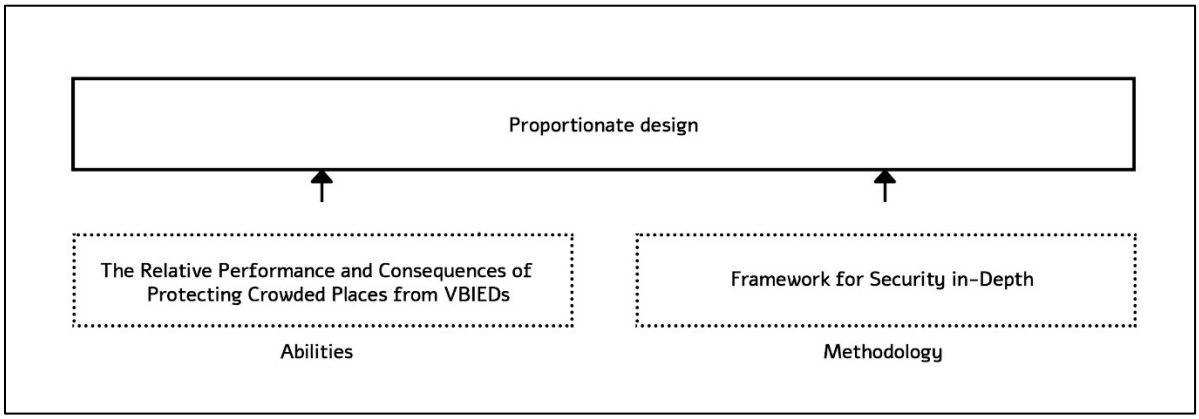

Figure 12: Proportionate design's theoretical foundation

Now that we are familiar with proportionate design's theoretical foundation, we can start building on it. As we know, the PAT uses the $P2$ equation to determine proportionate design.

This equation contains four abilities:

- Performance (M_P)
- Positive consequences ($C_{Positive}$)
- Requirements (M_R)
- Negative consequences ($C_{Negative}$)

The $P2$ equation is formulated as an inequality (exceed or equal) and its joints are added together. We can thus draw up the four abilities and get four quadrants. The four abilities all "pull" proportionate design in opposite directions. The outcome of this is that we have one proportionate quadrant and three disproportionate ones. The proportionate one has a positive

result. It thus "exceeds"[53]. The three disproportionate ones are negative. Origo indicates complete balance among the abilities and "equals" proportional design.

The abilities can be drawn up like this:

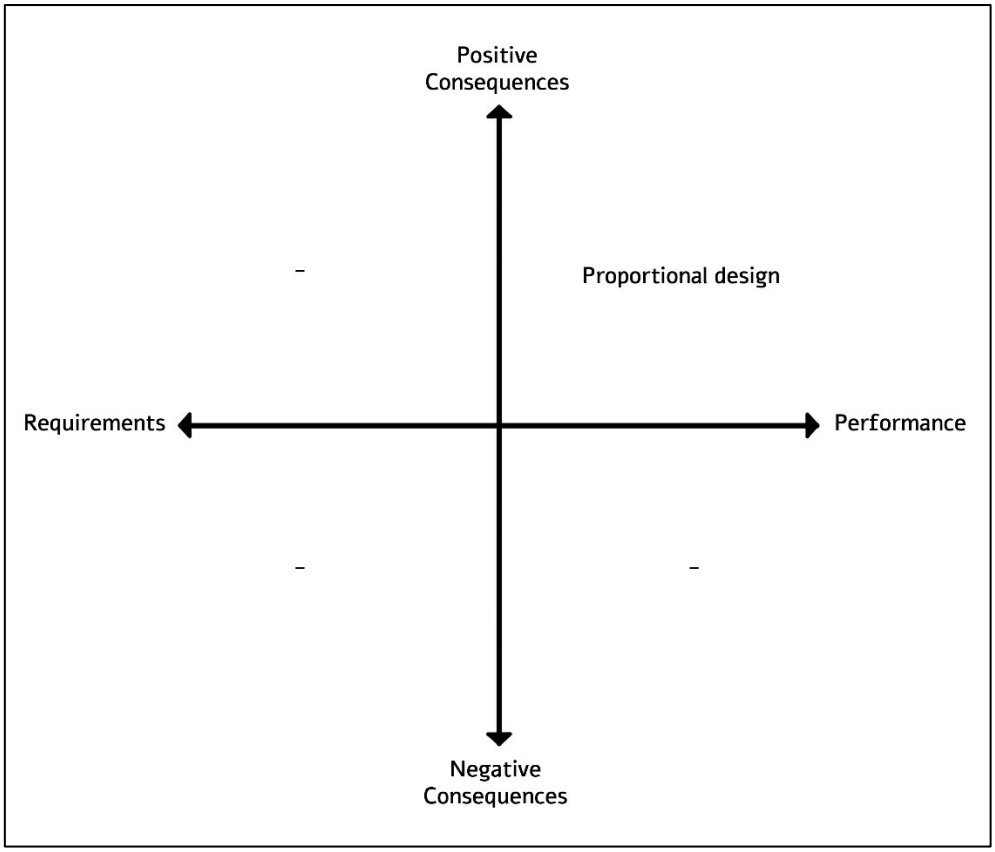

Figure 13: The quadrant for proportional design

There is one final note to the quadrant for proportional design. The $P2$ equation implicitly states that the urban security measures' M_P and M_R equal each other. The same goes for the $C_{Positive}$ and the $C_{Negative}$. This does, however, not show the whole picture. First, both abilities consist of five abilities each. These abilities are scored 0-5 based on degrees of presence and thus contribute to proportionate design. This gives the M_P and the M_R a total (sum) range of 0-25. Second, the consequences are not supposed to overdo the M_P nor the M_R. If they did, it would defeat the purpose of the $P1$ equation. They are, therefore, limited to a range of 0-10. As a result, the M_P and the M_R have – in most cases – more impact on proportional design than the positive and negative consequences.

[53] Reference to **4.6.1 Exceed or equal?** Meaning that the further into the proportionate quadrant we go, the better is the proportionate design. Every negative outcome is disproportionate.

4.7 Urban security measures' requirements (M_R)

Urban security measures' requirements (M_R) follow the same procedure as their performance (M_P). Two conditions serve as basis for the abilities that constitute requirements:

- The urban security measures' requirements must be able to "mirror" their performance. Since they are both part of the $P2$ equation, they must be possible to compare.
- The urban security measures' requirement abilities must fit the PAT's framework. There are five of them, and they are scored 0-5 according to their degree of presence.

4.7.1 The M_R abilities

Abilities that fulfil the two conditions for urban security measures' requirements primarily derive from Harre-Young's "The Relative Performance and Consequences of Protecting Crowded Places from VBIEDs" (Harre-Young, 2012). The abilities are found and extracted from in-between the lines of the study, meaning that they are not explicit findings.

The M_R abilities are:

- Competence
- Cost
- Implications
- Monitoring
- Seized space

Though they are primarily derived from Harre-Young (2012), the abilities also have other theoretical roots. The Official Police Security Initiative (SBD) has developed the "Resilient Design Tool", along with the CPNI, the NaCTSO[54], Loughborough university and others (Official Police Security Initiative, 2020). This tool expands upon the CPNI's key design principles[55] and introduces a focus on cost and return of investment. By looking into the tool, we see that it complies with both the 'Cost' and 'Implications' abilities. Commenting on proportional design, they also ask the question of how we can see to the quality of urban security measures.

Another source is the acceptability of resilient design found in "Resilient design for community safety and terror-resistant cities" (Coaffee, Moore, Fletcher, & Bosher, 2008). As we know, city governments and municipalities – decision makers, decision takers and stakeholders, see to the installation of urban security measures today[56]. If acceptability fails, they will not be applied. Acceptability is relevant to all the M_R abilities. As for the measures' cycle of life, 'Competence' for use, 'Monitoring' and 'Seized space' are especially relevant.

Finally, the NS 5832 demands that the security measures' cost and requirements are part of the assessment. It does, however, not define the other requirements. Its relevance for the M_R abilities is thus, apart from cost, on a more general basis.

[54] Abbreviation of the UK National Counter Terrorism Security Office.
[55] The same key design principles that we elaborated on in **2.2.2 Key design principles**.
[56] Reference to **1.2.1 Status quo** where we looked into today's assessments.

Like with the other abilities, the M_R is also expressed as a sum of five abilities. The M_R follows the PAT's framework, meaning that the abilities are scored 0-5 according to their degree of presence. However, some of the M_R abilities are slightly less contextual. Abilities, such as 'Cost' and 'Seized space' can be scaled to fit a municipal budget in a relevant currency or an urban area's size can be defined in square meters.

4.7.2 Description of the M_R abilities

- **Competence** is a measure of the competence required to implement the urban security measures. It is the prerequisite knowledge level the executing part/owner of the measures must have for them to achieve their full potential. This requirement is applicable to highly technological security measures that require much competence to use and monitor. Generally, less complicated measures require less competence.
- **Cost** is a measure of how much the urban security measures cost to implement and maintain. It can be scaled to fit the city governments' or the municipalities' urban security budget. While assessing cost it is essential to look at the whole life cycle of the proposed security measures.
- **Implications** is a measure of installation requirements. It is the sum of all difficulties that cannot be priced. This can be regulatory challenges, infrastructure dependencies, trade-offs with ground owners and any other implications related to installing/retrofitting urban security measures into either the built or the urban environment. Adding to this, 'Implications' also affect acceptability among assessors and external stakeholders. This assessment thus requires a thorough spatial analysis.
- **Monitoring** is a measure of the urban security measures' maintenance friendliness and implications applying to their lifecycle. Although the maintenance cost is covered by 'Cost', some measures still require regular inspection and testing to see that they are functioning and up to date. Monitoring is particularly relevant to both surveillance (CCTV) and multifunctional urban security measures that are active (and worn) daily.
- **Seized space** is a measure of the urban security measures' spatial occupation. Both urban areas and the built environment come with a high societal value. Comprehensive urban security measures seizing space in either of the two can cause conflict and trade-offs with existing qualities. Just like 'Cost', this ability can be scaled quantitatively by defining categories for seized space or area (m^2 or m^3). In terms of urban planning, this requirement is an expression of land use.

The abilities are scored 0-5 according to **4.2.4 Qualitative scales**. Their sum makes up the urban security measures' requirements (M_R) and is used as input in the $P2$ equation.

(Example) We continue to draw upon our example of Exampleville from the $P1$ equation. Our two proposed measures – retractable bollards (m_1) and reinforced benches (m_2) – perform proportionally against the vehicle ramming threat. This means that they do the job, according to the $P1$ equation. Our next task is to make sure that they do it in a good manner.

We therefore use the $P2$ equation:

$$(P2) \quad \sum_{i=1}^{n} M_{P_i} + C_{Positive} \geq \sum_{i=1}^{n} M_{R_i} + C_{Negative}$$

We can fill in with what we know so far:

$$(P2) \quad 8 + C_{Positive} \geq \sum_{i=1}^{n} M_{R_i} + C_{Negative}$$

Our first step is to score the requirement abilities for the retractable bollards and the reinforced benches. In Exampleville, the M_R is scored:

- 'Competence' is considered low (2) for the retractable bollards (m_1) and none (0) for the reinforced benches (m_2). Retractable bollards have a gas movement system with remote control that requires some competence.
- 'Cost' is considered high (4) for the retractable bollards (m_1) and very low (1) for the reinforced benches (m_2). Cost and installation cost for retractable bollards are estimated to be to 100 000 NOK (Urbaco, 2008), and maintenance cost to about 25 000 NOK per year. The reinforced benches are estimated to cost 10 000 NOK.
- 'Implications' is considered none (0) for both measures.
- 'Monitoring' is considered low (2) for the retractable bollards (m_1) and none (0) for the reinforced benches (m_2). The retractable bollards need at least a quarterly inspection (FEMA, 2007).
- 'Seized space' is considered very low (1) for the retractable bollards (m_1) and none for the reinforced benches (m_2). The retractable bollards require 10 m^2 of the street north of the square. The reinforced benches replace existing benches.

We then sum up the two measures' abilities for a M_R value:

$$\sum_{i=1}^{n} M_{R_i} = \sum_{i=1}^{2} M_{R_i} = (2 + 4 + 0 + 2 + 1) + (0 + 1 + 0 + 0 + 0) = 9 + 1 = 10$$

Now that we know the M_R, we can put it into the $P2$ equation:

$$(P2) \quad \sum_{i=1}^{n} M_{P_i} + C_{Positive} \geq \sum_{i=1}^{n} M_{R_i} + C_{Negative} \quad \Rightarrow \quad 8 + C_{Positive} \geq 10 + C_{Negative}$$

Apparently, the urban security measures require more than they perform. But it is too soon to draw any conclusions. The $P2$ equation is only part solved, and we must first assess positive and negative consequences before determining proportional design.

4.8 Urban security measures' consequences

Every action has consequences, and installing urban security measures is no exception. An important question to ask, however, is whether or not the consequences are beneficial. Urban security measures can enhance urban areas if we design them right. They can also increase townscape aesthetics and urban liveability. Fortunately, there are a few urban design strategies in place to help us along the way[57]. Having the consequences' potential in mind, we see that they are an essential part of the assessment of proportionality.

The consequences are divided into two main categories:

1. Positive consequences
2. Negative consequences

We then further divide these two main categories into subcategories:

- Fabricated consequences
- Contextual consequences

The fabricated consequences are extracted from the CPNI's integrated security guide. This guide provides a set of design principles that are transmittable to represent consequences which can be used in the PAT (Centre for Protection of National Infrastructure, 2014; Official Police Security Initiative, 2020).

The idea of using contextual consequences are based on findings from three urban security studies: Steve Harre-Young's "The Relative Performance and Consequences of Protecting Crowded Places from VBIEDs" (2012), Jon Coaffee et al.'s "Resilient design for community safety and terror-resistant cities" (2008) and Ksenia Chmutina et al.'s "Integrated security and resilience framework" (2014).

The contextual consequences are there to fill in one of the PAT's shortcomings. The PAT is based on qualitative scales for it to compensate for being a general tool. The scales make it possible to adjust the PAT to any context and thereby see to its general utility. However, they do not help us deal with contextual consequences. This is because the assessment of consequences is "binary" based on presence[58]. It therefore requires a complete list of eventual consequences to function. Since every context is unique, it is unlikely that such a list can exist.

This leaves us with two main categories for consequences with two subcategories:

	Fabricated	**Contextual**
Positive consequence	Category 1	Category 3
Negative consequence	Category 2	Category 4

Table 7: Consequence categories

[57] Strategies like the **2.4.3 Crime prevention through environmental design** and the **2.4.4 Situational Crime Prevention** provide us useful guidelines for urban security. If we follow them and stick to **2.2.3 Holistic planning and security**, we have a solid base for good design.

[58] If a consequence is present it scores 1. If not, it scores 0.

4.8.1 Consequence pools

The consequences are assessed for a complete picture of urban security. This means that the consequences are only valid for the sum of the proposed urban security measures. The argument is that the measures are matters of holistic security and planning. Because they interact and interfere with one another, their consequences must be assessed accordingly.

To help us select the consequences, the PAT uses two "pools" – one for fabricated consequences and one for contextual consequences. Each pool has one positive side and one negative side. Whoever is using the PAT then selects consequences from these pools, based on which consequences are present, for the totality of their proposed urban security measures.

There is one exception that we need to deal with: A consequence might be present for some of the urban security measures, but not for all. Let us say that measures m_1 and m_2 both has consequence C, and that m_3 has not. How should we score consequence C? We cannot do this unless we determine a condition for when a consequence is present ($C_{Presence}$). We can express the condition as an inequality. If we let $l_C(m_i) = 1$ when a measure m_i has consequence C and $l_C(m_i) = 0$ if it does not, then we have:

$$C_{Presence} > \frac{1}{2} > \frac{1}{n}\sum_{i=1}^{n} m_i \cdot l_C(m_i)$$

This means that whenever a consequence is present for more than the average, it is scored. If it is either tied or lower than the average ($\leq$) it is not.

We can now move on to the consequence pools. While using the PAT, all present consequences are selected from the pools. Every present consequence (positive and negative) scores a +1 on its respective side of the $P2$ equation. Meaning that if there are three positive consequences and two negative consequences present:

$$C_{Positive} = 1 + 1 + 1 = 3 \quad and \quad C_{Negative} = 1 + 1 = 2$$

Fabricated and contextual consequences are of equal importance. The maximum score for consequences is, however, limited to 10 to ensure that consequences do not overrule the urban security measures' performance, nor their requirements[59].

This means that:

- The positive fabricated consequences (category 1) are scored 0-5.
- The positive contextual consequences (category 3) are scored 0-5.
- The negative fabricated consequences (category 2) are scored 0-5.
- The negative contextual consequences (category 4) are scored 0-5.

[59] This issue is mentioned in **4.6.2 Proportional design's theoretical roots**. If consequences were to overrule the urban security measures' performance and requirements, they would defeat the purpose of the $P1$ equation concerning proportional performance. The $P1$ and the $P2$ would then not be entirely comparable, and the contextual definition of proportionality would be invalid.

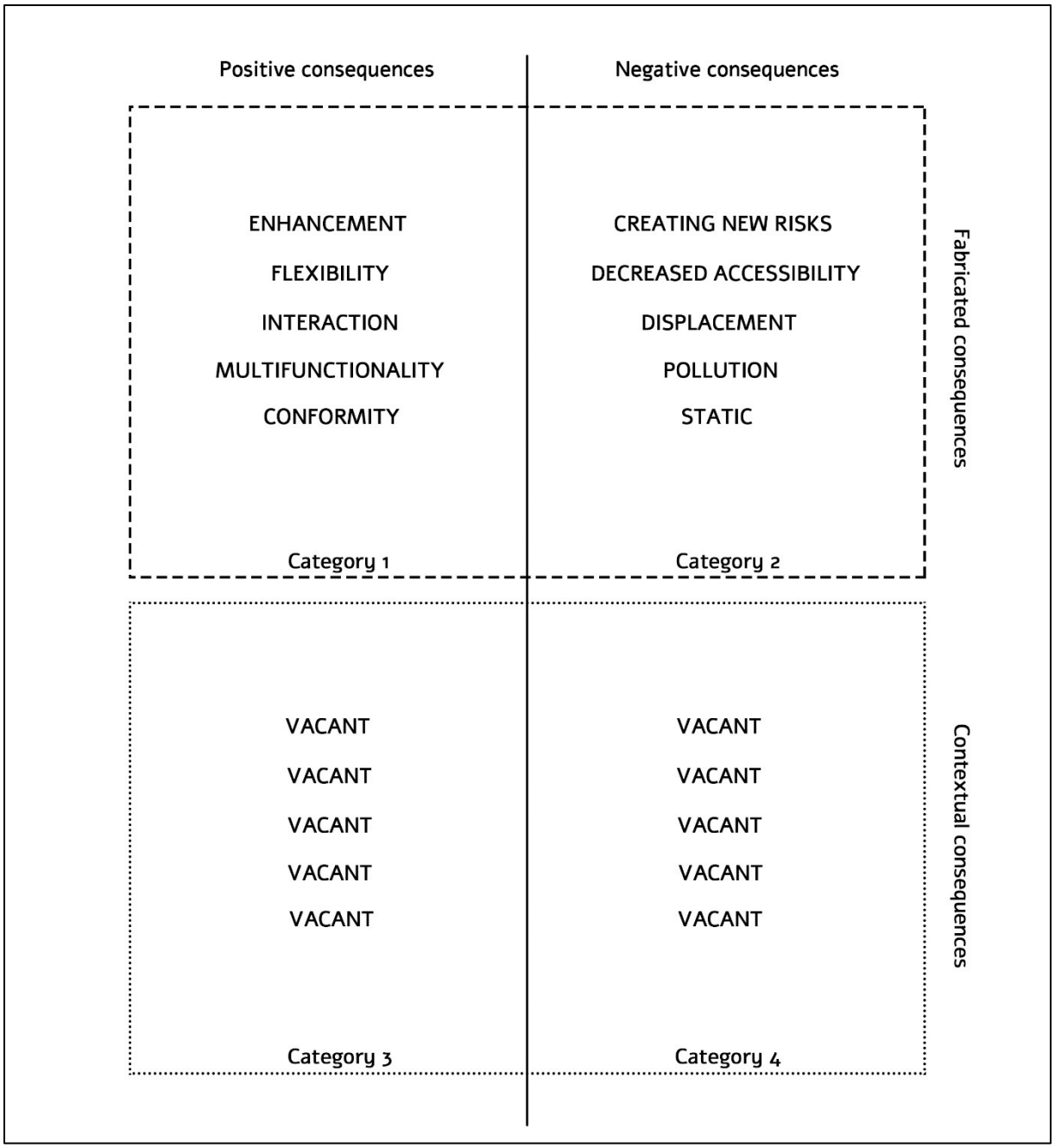

Figure 14: Consequence pools

4.8.2 Fabricated consequences

The fabricated consequences are described accordingly. Even though some of the positive and negative consequences are counterparts, both can be present simultaneously.

Category 1: Positive consequences

- **Enhancement** of the setting is a consequence that is present if urban security measures enhance the setting that they are installed into. Enhancement is linked to both townscape aesthetics and functionality, and helps us sustain urban qualities.
- **Flexibility** is a consequence tied to the urban security measures' ability to be either activated or deactivated, or to adjust to changes in the threat assessment. It is also present when the urban security measures are temporary.
- **Interaction** with other urban security measures is a consequence related to layered urban security. The most efficient measures interact with each other to create interdependency and synergies that optimize their design and efficiency.
- **Multifunctionality** is present when urban security measures function to protect an urban area, while simultaneously having one or more additional functions. It is key to return investment for urban security. The measures' functionality is also expanded remarkably when they are contributing to the urban environment on an everyday basis.
- **Conformity** is a consequence related to the CPTED design principles. Urban security measures that contribute to natural surveillance make urban areas' easier to get an overview of. This leaves potential offenders with a perception of being caught (National Crime Prevention Council, 2003). Thus 'Conformity' affects the incentives and opportunities for crime in the daily.

Category 2: Negative consequences

- **Creating new risks** is a consequence that occurs when the urban security measures create a new risk or make the urban areas more vulnerable to other threats.
- **Decreased accessibility** is present when the urban security measures seal off entrances, roads or other infrastructure that provides access to and within urban areas. Decreased accessibility conflicts with safety and security in a city's daily life, such as access for first responders or universal design.
- **Displacement** is present when the urban security measures redirect an attack to somewhere else that might be even more vulnerable and/or valuable.
- **Pollution** of the setting is the counterpart of enhancement. It is present whenever the urban security measures pollute the setting they are installed into, in most cases either the urban area or the built environment.
- **Static** is the counterpart of flexibility. Static urban security measures fail to adjust to change in threat assessments and cannot be moved nor activated or deactivated swiftly.

4.8.3 Contextual consequences

Contextual consequences are, as their name indicates, contextual. In theory, a contextual consequence can be anything. The PAT therefore cannot provide a "pool" for them because the list would be infinite. This pool is thus left with vacant slots. Even though the PAT leaves room for contextual consequences in the $P2$ equation, assessing them is up to the assessors. This requires them to know their urban area's contextuality. They are, however, still limited to the PAT's framework. The contextual consequences are scored like the fabricated consequences, which gives them the two following conditions:

- There can be a maximum of five positive contextual consequences scoring 0-5.
- There can be a maximum of five negative contextual consequences scoring 0-5.

This means that they cannot exceed the vacant slots in **Figure 14: Consequence pools**.

(Example) We can now finish our example from Exampleville.

We left the $P2$ equation with filling in for the M_R:

$$(P2) \quad \sum_{i=1}^{n} M_{P_i} + C_{Positive} \geq \sum_{i=1}^{n} M_{R_i} + C_{Negative} \quad \Rightarrow \quad 8 + C_{Positive} \geq 10 + C_{Negative}$$

Meaning that we rely on positive consequences for proportional design. Our next step is to assess the consequences for the proposed measures (m_1) and (m_2):

	Fabricated					**Contextual**
	Positive			Negative		Positive
Consequence	Enhancement	Flexible	Multi-functional	Decreased access	Static	Leisure
m_1	Yes	Yes	Yes	Yes	No	No
m_2	Yes	no	Yes	Yes	Yes	Yes

Table 8: Assessed consequences

The retractable bollards are multifunctional. They enhance Exampleville city centre by regulating traffic and freeing space for pedestrians. They are also flexible because they can be telescoped into ground receivers if necessary. They do, however, decrease access for delivery vehicles to the city square.

The reinforced benches enhance Exampleville city centre by providing more seating and street furniture. As a contextual consequence, they are installed in an area with a current lack of leisure opportunities. But they do also decrease access. The benches are two more obstacles that make the square harder to manoeuvre with wheelchairs or baby strollers.

Now that we have all input, we can fill in the $P2$ equation. The consequences must be present for both urban security measures to be applied in the equation, and this leaves us with 'Enhancement', 'Multifunctional' and 'Decreased accessibility'.

We fill in the consequences in the $P2$ equation:

$$(P2) \quad \sum_{i=1}^{n} M_{P_i} + C_{Positive} \geq \sum_{i=1}^{n} M_{R_i} + C_{Negative} \quad \Rightarrow \quad 8 + 2 \geq 10 + 1 \quad \Rightarrow \quad 10 \geq 11$$

The $P2$ equation is not true: '10' does not exceed or equal '11'. This means that the proposed measures are not proportionally designed. On the other hand, we know that the $P1$ equation is true and that we must look at both equations to determine proportionality.

Our proposed urban security measures give us the following equations:

$$(P1) \quad 5 + 3 = 18 - 10 \quad \Rightarrow \quad 8 = 8 \quad and \quad (P2) \quad 8 + 2 \geq 10 + 1 \quad \Rightarrow \quad 10 \geq 11$$

This means that our proposed measures do the job that we assigned them to, but they do not do it in a good enough manner. They are disproportionally designed because they require more than they perform, and this is not compensated by the consequences. As a result, we cannot claim them proportional according to the contextual definition of proportionality – even though they are very close.

We should therefore rethink our selection of urban security measures. Perhaps the retractable bollards with their high requirements should be reconsidered?

4.9 A summary of the PAT

We have now been through the PAT step by step. Since it is a quite heavy topic, we must expect that some information might have been overlooked while reading it. The key points are, therefore, repeated in a summary.

4.9.1 Another piece of the puzzle

We started with a new definition of proportionality. Then we used our new definition to create the $P1$ and the $P2$ equations for checking whether urban security measures were proportional. The $P1$ equation checks for proportional performance and the $P2$ equation checks for proportional design. Together they allow us to prioritise urban security measures.

$$(P1) \quad \sum_{i=1}^{n} M_{P_i} = A - S$$

$$(P2) \quad \sum_{i=1}^{n} M_{P_i} + C_{Positive} \geq \sum_{i=1}^{n} M_{R_i} + C_{Negative}$$

The two equations are built on sums like the attack attractivity (A), the security ambition (S), the urban security measures' performance (M_P), requirements (M_R) and their consequences ($C_{Postitive}$ and $C_{Negative}$). Every sum consists of five abilities, with each being qualitatively scored 0-5 by their degree of presence:

- None (0), Very low (1), Low (2), Moderate (3), High (4) and Very high (5).
- Every consequence that is present has a value of '1'[60].

4.9.2 Abilities

Attack attractivity (A) is a measure of an urban area's vulnerability. It consists of the area's 'Asset value', 'Availability', 'Compliance', 'Suitability' and 'Fragility'.

Security ambition (S) is the level of vulnerability that a society is willing to accept. Even though it is easier to assess it as a sum, it can also be based on the same abilities as the (A).

Performance (M_P) is a measure of the urban security measures' efficiency against a threat. It assesses whether the measures "do the job". It consists of the urban security measures' ability to 'Deflect', 'Disguise', 'Disperse', 'Stop' and 'Blunt'.

Requirements (M_R) is a measure of what the urban security measures need to function. Up against the (M_P) it assesses whether the measures "do the job" in an appropriate manner. It consists of the abilities 'Competence', 'Cost', 'Implications', 'Monitoring' and 'Seized space'.

Finally, there are the urban security measures' consequences. They are selected from the respective consequence pools – one for fabricated and one for contextual consequences.

[60] If the condition of $C_{Presence}$ is fulfilled. The condition is explained in **4.8.1 Consequence pools**.

5 Discussion

We have now ventured into unknown territory and developed an assessment tool for proportionality. We have also put our trust in a literature study and more alternative research methods, like trial and error. Even though we have interpreted the material to the best of our ability, we must still be critical of the findings. It is optimistic to believe that the PAT is performing perfectly after only six months of development and with limited testing opportunities. It is more likely that it needs to go through more trial and error, and then revise it accordingly. This does, however, not mean that the study has not met its requirements. In this chapter we will discuss the PAT's practical use, its uncertainty and its utility. But first, we will reflect on the research's purpose and whether we have accomplished what we intended.

5.1 Success or failure?

We started off with a top-down research approach. We laid our foundation with a research problem, two research questions and a purpose. We will now discuss us through them.

5.1.1 Purpose

Our purpose consists of three minor purposes: We wanted to create the PAT, to contribute knowledge to the field of urban planning and security, and to emphasize proportionality. The discussion now is whether we have managed to do so and succeeded.

Regarding the creation of an assessment tool – we now have the PAT. Although it is not optimal, we can argue that it works – if we stick to its 'Guidelines for use'[61]. What we cannot do, however, is to leave it there. There is more to it, and we must elaborate. We have, for instance, yet to touch on how it works regarding the background of the thesis.

Throughout the thesis, there has been a recurrent issue tied to city governments' and municipalities' incapacity for dealing with urban security. This issue is important in regards of urban planning, because disproportional security measures both seizes space and influence the lives of citizens (Sennett, 2018). Looking at the mentioned examples from Oslo[62] and Arendal in 2017, we see that they ruin urban qualities. They also negatively influence liveability as they affect our perception of security[63] (Coaffee, O'Hare, & Hawkesworth, 2009).

The question now is how the PAT can help with incapacity. Even though there are five linear steps of assessment before anti-riot trucks and diggers are put into the urban environment as security measures, we must deal with the root of the problem – the assessments. If done right, they will tell us what is proportional and what is not. The PAT helps us with this – it helps us prioritise the urban security measures. It also allows us to compare and measure what is today left to subjective interpretation. Therefore, it provides us a much-needed tool.

Whether this solves the issue of incapacity is, however, another question. On one hand, the PAT requires a cabinet of interdisciplinary assessors to deliver credible results – just like the ISR

[61] This is explained in its own chapter **5.3.4 Guidelines for use**.
[62] Reference to the example in **Figure 1: Anti-riot trucks in Karl Johan, Oslo, in 2017**.
[63] Reference to overt security measures' consequences in regards of our perception of security. This is explained in **2.4.1 Overt and covert urban security measures**.

or the NS 5832. On the other, it gives the assessors a new framework and a "common language" for their assessments. This strengthens decision making and helps make the process more efficient. We can thus argue that it impacts incapacity, even though it is implicitly.

Another mention on the topic is the PAT's ability to shift focuses that have positive consequences for urban planning. There are two shifts that needs elaboration: Attack attractivity and proportional design. Attack attractivity helps us assess vulnerability more thoroughly and gives us a better understanding of threats. This is especially useful for striking a balance between urban liveability and security, which sees to that we can secure crowded urban areas without necessarily go at the expense of other urban qualities. Proportional design impacts urban planning by pushing us towards well-developed urban design strategies[64]. It shifts our focus from strategies of the past, like target hardening. To achieve proportional design, we must rather look to strategies like the CPTED and the SCP. These are focused on changing opportunities or incentives for crime, and urban security measures directed to them are supposedly covert and multifunctional. They can, therefore, come with additional positive consequences for the urban environment while also seeing to that the areas are secure (Crowe, 2000; Lee, Park, & Jung, 2016). As a result of this, we can argue that the PAT contributes to the assessors' capacity and helps us rid our cities of disproportional security measures.

Our next main purpose was to contribute knowledge to the field. In our development process we have elaborated on knowledge and theory related to urban planning and security. We chose to rely on a literature study and built the PAT upon existing literature. To use a literature study and then build upon it, contributes knowledge itself. The only exception would be if the PAT is falsified and proven reckless. In any other outcome we can argue that we have contributed knowledge to the field. However, exactly how much we have contributed depends on the academic reception of the PAT. It is therefore too soon to determine.

There is an additional point to the contribution. As we have explored, the thesis has repeatedly crossed the line to societal security. Even though the PAT is primarily developed for urban planning and security, it still intersects with other academical fields. This is a good thing because it helps us to "build bridges" between disciplines that take part of the assessments. Urban security is a common responsibility for society. It affects everyone, and there are many different actors from various disciplines that have a say in its assessment. Since the PAT has a potential of filling in the gaps between these intersecting disciplines, its ability to contribute knowledge to the field benefits a broader audience.

Finally, we aimed to emphasize proportionality. Even though we have shown examples and referred to bad practices, proportionality remains qualitative and contextual. There is no way around that. Defining it and making an assessment tool for it, cannot ensure that proportionality's importance is emphasized in future urban security assessments. It is out of our hands. The only way the thesis can fulfil this purpose is if the PAT is applied and used in the future – and there is no guarantee that that is going to happen. We can get our hopes up, but no victory can be taken in advance. This purpose is therefore too soon to conclude.

[64] Reference to the strategies elaborated on in **2.4 Urban design strategies**.

5.1.2 Research questions

In the background, we raised two research questions to help us deal with the thesis' research problem. Now that we have reached the discussion, it is in due time to try answering them – before we move on to the research problem.

First, we asked the following two questions:

- How can proportionality be measured in an urban security context?
- How can urban security measures be proportionally designed?

To answer them we must start with our contextual definition of proportionality[65]. We split it into two characteristics that are equivalents to the research questions. There is one for "measurability" and another for design. Proportional performance – measurability – allows us to measure proportionality in an urban security context. It does so because we built the term on a set of abilities that we can measure qualitatively based on their degrees of presence. Therefore, to answer to the question, we use proportional performance as a measurement.

For the other question, we have proportional design. It ensures that the urban security measures are, in fact, proportionally designed. Yet again we have built the term on a set of measurable abilities that strike a balance between performance, requirements and consequences. In regard to how they all are linked together and used in practice, we must look at our two equations for proportionality[66]. They see the practice through.

Therefore, we can answer the two research questions with the $P1$ and the $P2$ equations. They each provide and answer to their respective research question.

5.1.3 Research problem

Another step up from the research questions, we have our research problem:

- How can crowded urban areas be secured proportionally?

It asks how we can secure crowded urban areas, but also implicitly how we can prove eventual urban security measures as proportional. Our strategy so far has been to rely on the research questions to first deal with proportionality. According to them, we can make sure that crowded urban areas are secured proportionally if we implement urban security measures with a proportional performance and design. In other words, they tell us to the PAT. However, since we rely on the PAT as our solution, we must stress that it is only a valid answer to our problem if it is used according to its purpose and in line with its 'Guidelines for use'. The reason why is a combination of the tool's uncertainty and utility. Since we have yet to elaborate on this, we must first discuss a few more topics before we conclude our research problem.

[65] The definition that were put in place in **2.2.4 Defining proportionality contextually**.
[66] The $P1$ and the $P2$ equations for proportional performance and design.

5.2 Uncertainty

First off is uncertainty, and it is quite an extensive theme. We will go through the different aspects with a critical eye and ask questions about both the research methods and the results.

5.2.1 Reliance on trial and error

For the development part of our research method, we chose to go with trial and error[67]. It was the only appropriate method available, and since we developed a qualitative tool in unknown territory, we had to rely on inductive reasoning to advance. The question we will discuss now is whether we can rely on trial and error as a research method.

The short answer is that we cannot rely on it. It is more of a problem-solving method than actual research. The long answer is a bit more complicated. First, we must not forget that trial and error comes in a variety of formats and with different conditions. In our case, it is not done blindfolded. Instead, it is executed within a strict scope defined by our literature study's theoretical basis. While this does not mean that we are sure to hit the bullseye with our attempts, it does mean that when we miss, we are not completely off target. This helps us stick to directed trials with a limited span.

Another note is the fact that the method is increasingly inductive the further away we go from our theoretical basis. The key to cope with this issue is to test it regularly – and to do so in relevant contexts. It is, therefore, unfortunate that the scheduled test with Stavanger municipality was cancelled due to the covid-19 pandemic. This limited the trial and error to two "official" tests, which has two important consequences. One of them is that the research runs a higher risk for being more biased than initially planned. The other is a result of the first. When we cannot entirely rely on trial and error, we must put our faith elsewhere. Based on our options, the only reasonable place to put it is the literature study.

The long answer is thus that we cannot entirely rely on it. Although it gives us results, we must assess them carefully. However, an important note to this, is the research's purpose. We sat out with a goal of creating a supplementary assessment tool, because it was too bold to go for a "revolutionary" one. It is, therefore, possible to compare the PAT's outcome with the existing methods. This corrects some of our uncertainty related to the trial and error method. As a final note, the trial and error has helped us develop a new assessment tool. It would not have been possible without it. Also, we face the fact that there are not that many other options available.

[67] The whole methodology is illustrated in **Figure 5: Graphical overview of the research method**.

5.2.2 The selection of abilities

Next is uncertainty tied to the selection of abilities. As we know from the research questions, we chose to build our two equations for proportionality ($P1$ and $P2$) on a set of measurable abilities. The question to discuss now is whether we have chosen the right abilities.

Just like in the previous answer, we cannot know for sure. Currently, there is no answer to which abilities are correct to use. What we can do, is to argue and reason for the selected abilities. Every set of abilities, such as the A, the S, the M_P, the M_R and the consequences, are tied to a minimum of two or three existing, credible studies or equivalent literature. They all have solid theoretical roots which are elaborated on in the respective chapters. Also, the same abilities are both tied to and influenced by acknowledged urban design strategies. Even though they are new, they are certainly not taken out of the blue.

Also, the selection of abilities must fit the boundaries that are put in place by our contextual definition of proportionality. Proportionality is defined by two abilities, performance and design, that are used as sums in equations. Thus, the abilities must be comparable. This means that they must be of the same format while also being equally important. Otherwise, the equations would either fail or make no sense. The same applies if the abilities should be proved unequally important. Then we cannot add them together[68].

There might be other abilities that would fit the PAT – and even make a better comparison than the proposed ones. If that is the case, the PAT would be better off exchanging its abilities. For now, it uses the proposed abilities because they remain as the best available option.

5.2.3 Dealing with contextuality

Quantitative tools have a limited use for dealing with urban security and proportionality. This is because there are many contextual qualities and aspects that we need to consider in regards of holistic planning and security. We can argue that the PAT is a general tool because it is an assessment tool that should be able to address proportionality for any (crowded) urban area. It is, however, not general because it is quantitative. The reason why it applies to general use is because it is qualitative – it is thus able to adapt to different contexts.

While doing qualitative assessments we must set boundaries. Otherwise, our assessments will be either infinite or reckless. In regard to the PAT, our boundaries are put in place by our contextual definition[69]. This is our foundation for measurement, and what we use to derive into our two equations for proportionality. Proportionality itself remains deeply contextual, but we can measure it qualitatively by using our contextual definition. Whether this is the best way of measuring proportionality is a whole other question. With our approach, we put our trust in the definition. We therefore rely on its credibility, which leads us back to its theoretical roots in the literature study. It is, though, our best available option for dealing with contextuality.

[68] This issue is elaborated on in **4.2.3 The prerequisite of equal importance**.
[69] Contextual definition of proportionality – see chapter **2.2.4 Defining proportionality contextually**.

5.2.4 Contribution to urban planning

We have now been through uncertainty related to the research method, contextuality and the selection of abilities. We know that we must use the PAT carefully and objectively, and that we must quality control its outcome. Also, we must not forget that the PAT is a supplementary tool and is therefore supposed to function alongside other methods.

The PAT's outcome and use in urban planning can be split in two: Process and results. Regarding process, the PAT has an additional use that we have only briefly touched upon. We can argue that the PAT helps us to bring whoever is concerned about urban security to a common table. It contributes to the urban security process because it needs interdisciplinary assessments. The relevant disciplines must be present and able to communicate with each other. As a result, we can claim that the PAT gives them a reason for doing so, and that it has a significant contribution to the process – even though it might seem a bit backwards.

Regarding results, the PAT's outcome should not be treated as a blueprint. It should rather be used as an indicator for proportionality. Meaning that even though the tool's two equations indicate when we have a proportional level of urban security, we must not let them overrule other relevant assessments. In fact, the only time the PAT should overrule other assessments is when it indicates gross disproportionality[70].

Also, the assessors should be advised to use an "acceptance interval" to the PAT's equations. Since the PAT is built on mathematical equations, there is little or no room for guesswork. We can argue that this is a downside when dealing with qualitative input. An acceptance interval leaves outcomes that are nearly proportional up to discussion and not to immediate rejection. It thus allows for some guesswork. Necessary delineations for an acceptance interval beyond the outcome of PAT's equations are left to the assessors.

It is difficult to provide an unambiguous answer to what extent we can use the PAT's outcome in urban planning. We can argue that the PAT's extent is unlimited whenever it contributes to the process, and its outcome is treated as an indicator with some wiggle room. This is, however, unlikely the case in most Norwegian city governments and municipalities[71]. For the ones with capacity, the PAT's extent is unlimited. For the others, it is limited. As a general note, we can say that the PAT's contribution increases inversely with the assessors' incapacity.

[70] Gross disproportionality occurs for urban security measures that are far from being proportional. Put in context of proportional design, we can say that urban security measures are grossly disproportionate if they have >3-4 times higher requirements than performance.

[71] Reference to **1.2.1 Status quo** and the issue of incapacity for dealing with urban security.

5.3 Utility

The next topic for us to discuss is utility and the PAT in practice. An important part of it is the tool's limitations and requirements for use. Just as with uncertainty, there are a few of them too. We will go through the utility by looking at one topic at a time.

5.3.1 Interdisciplinary cooperation

We have already elaborated on how urban security is subject of various disciplines, and that it requires interdisciplinarity for it to deliver credible results. Regarding the PAT's utility, we must discuss this "reliability". We can do it by asking how interdisciplinarity in urban security assessments affects the PAT's outcome.

The short answer is that it is very much affected. In fact, we can argue that the PAT is depending on interdisciplinary cooperation to function at all. Otherwise, its outcome is likely shallow with little credibility. Interdisciplinarity is therefore a necessity for utility.

The long answer circles to urban security. Since urban security affects everyone[72], there are many different actors from various disciplines that have a say in its assessment. There are the different decision makers, decision takers and stakeholders. Getting them into the same room is a challenge on its own (Coaffee, 2016). Thus, urban security is a "tug of war" with different assessors pulling in opposite directions. Assessors tend to make decisions wherever they strike balance – either because of votes, democratic decisions, trade-offs or other compromises. If the participants are not completing each other's experience, knowledge or professions, their decisions are not likely to be proportionate. More so, they can be grossly disproportionate and have negative consequences for our cities. If, for instance, firefighters are overly represented during a security assessment, we might expect the outcome to be largely focused upon arson. While arson is an important aspect of urban security, we cannot expect to be secure by only focusing on fire-proofing every part of the city. This will only take away resources from other threats, leaving us just as vulnerable as we were to begin with. The key is thus to keep the participants balanced and interdisciplinary.

This is, however, not an issue that is unique for the PAT. It is no different from how the ISR and the NS 5832 are used today, if we look to the UK and Norway (Chmutina, Bosher, Coaffee, & Rowlands, 2014; Standard Norge, 2014). The assessors are therefore familiar with the issue and we can argue that they know how to cope with it. This means that yes, interdisciplinary cooperation affects the PAT's utility – it is required for making informed decisions. But, thankfully, we already have the required experience and know how to deal with it.

[72] Even though "everyone" seems like an exaggeration, we can argue that people living in rural areas are also affected by urban security via their districts or municipal policies.

5.3.2 Additional work and incapacity

Now we will discuss the issue of capacity. Whether the PAT helps city governments and municipalities with their assessments without giving them too much additional work. The latter would leave us with the same incapacity issues that we have been touched on before.

On one hand, the PAT does not require more than the existing framework. This is because it follows the same linear steps as the ISR and the NS 5832[73]. On the other, the PAT requires a stricter framework. While it remains qualitative, it depends on the assessors' experience, knowledge and professions, and we could argue that the PAT's requirements vary from one context to another. However, regardless of context, the need for a stricter framework remains.

The need of a stricter framework is related to the determination of a security ambition (S), and there is no way around it when using the PAT. The security ambition requires that someone takes this responsibility. That someone must own the decision and stand for its eventual consequences. As a result, we cannot argue that the PAT helps with the issue of incapacity for the assessments. Instead, we must focus on the outcome of the assessments, and that proportional urban security measures impacts wherever they are installed over their life cycle. This way we justify the additional work that comes with using the PAT over time.

5.3.3 Limitations of framework and design

There are three limitations that we need to be aware of when we use the PAT. These limitations are directly related to the PAT's framework and design.

The first limitation is that we are assessing one threat at a time. Since crowded urban areas can be exposed to many threats concurrently, the PAT is less efficient where the complexity is on the higher end. The reason why we cannot assess a range of threats simultaneously with the PAT is because of the attack attractivity (A). This type of analysis takes both a threat actor and their means of attack into consideration – where the means of attack is singular.

For instance, a drone attack has different conditions than a VBIED. What if we had both threats? In the PAT we must first assess one of them. Let us start with the drone attack – the order does not matter. We begin with an assessment of attack attractivity (A) for the drone threat and decide upon a security ambition (S). We then propose proportionate urban security measures addressing the drone threat by seeing to their performance (M_P), requirements (M_R) and consequences. After we have dealt with the drone threat, we move on to the VBIED threat. We assess the A once more, but this time for a VBIED. We have now changed the conditions for our crowded urban area. The already proposed urban security measures addressing the drone threat affect the crowded urban area's A. They must thus be taken into consideration. Even though 'Suitability' remains the same[74], our measures may have changed the other A abilities.

Though assessing one threat at a time is a limitation in terms of efficiency, we would argue that it is beneficial for in-depth urban security. This way, nothing slips through our scope and we

[73] The PAT follows the ISR framework and extends three its steps: 'Assess assets and vulnerabilities exposed to specific threats', 'Determine the risk' and 'Prioritise risk management measures'.
[74] Since we have such different threats there is unlikely a severe change of 'Suitability'.

are always able to assess urban security in a holistic manner[75]. But for crowded urban areas that are exposed to, let us say >10 threats concurrently, we should think twice before using the PAT because it would be an extensive task.

The next limitation is also related to complexity. It is the limitation that comes with using maximum scores. While the PAT only assesses one threat at a time, it allows urban security measures to perform against more than one threat. For example, retractable bollards can mitigate vehicle ramming while also ensuring a stand-off distance for a VBIED (Barriers Direct, 2020; Joint CT Assessment Team, 2020). While this is beneficial for holistic urban security, it is also a limitation when the maximum value for abilities is sat to '25'[76]. This means that we cannot have an unlimited amount of urban security measures because we will exceed '25' with either M_P or M_R. We can of course ignore this limitation by increasing the maximum value. But if we do so, we must also adjust the A and the S accordingly.

The final limitation is related to the intersection between security and safety[77]. The PAT is for urban security. Its equations, abilities and consequences are thus all related to the security side of the intersection. However, the urban environment is not that simple. Wherever we go, there are interfaces with safety. This should be part of our consideration because safety impacts urban security – and vice versa. For instance, we cannot design multifunctional water features as urban security measures without taking natural hazards such as urban flooding into account. On the other hand, we might see urban security measures conflict with drainage paths, leading to blockage of drains and new risks. To cope with this limitation, we must again stress that the PAT is a supplementary tool that should not be entirely relied upon. Safety threats are just as relevant as security threats for our cities – even though they are not part of the PAT's framework. Focusing only upon security has an inevitable trade-off with safety.

[75] According to **2.2.3 Holistic planning and security**.
[76] Every sum consists of five abilities that are scored 0-5. This leaves us with a range from 0-25.
[77] We looked into the intersection between safety and security in **2.3 Safety and security**.

5.3.4 Guidelines for use

Throughout the thesis we have argued that the PAT is generally applicable. Theoretically, we can assess proportionality for any urban area, anywhere in the world. However, based on the discussion up to now, there are one or more things that we must keep in mind. Our topics have concerned what comes out of the PAT. We have elaborated on its practical use and whether we can trust it. From what we have discussed it would seem too bold to unconditionally claim that the PAT as applicable for any (theoretical) context.

Therefore, we need to make sure that the PAT is used as initiated. To do so, let us introduce the 'Guidelines for use'. The guidelines are the key points from our discussion.

Guidelines for use:

1. We must treat the PAT as a supplementary tool.
2. We must remain open minded and welcome constructive feedback and improvements.
3. We must remember that the PAT relies on the contextual definition of proportionality.
4. We must discuss the PAT's results before we approve or reject them.
5. We must ensure that our assessments are holistic and interdisciplinary.
6. We must ensure that responsibility is clearly delegated.
7. We must keep in mind the PAT's limitations regarding complexity.

If the 'Guidelines for use' are followed, the PAT is generally applicable.

6 Conclusion

The thesis is based on urban security and how we can secure our cities without it being at the expense of townscape aesthetics and urban liveability. The research problem limited the scope by asking; "How can crowded urban areas be secured proportionally?". Hence, we chose to focus on crowded urban areas and limited us to security.

In the thesis' theory we started off with a wider look at the topic, and went through urban design, planning and security in more detail. We elaborated on proportionality's role as part of the assessment. Then, we decided on a research method that took us through developing the PAT. With our methods, we were able to use relevant theory as a foundation for development. We also provided a link between our results and the available literature on the field to increase our findings' credibility and testability.

The development of the PAT had its delineations. It took us from a broad theoretical basis to a more narrow niche of urban design, planning and security at the conjunction with societal security. In the process, we also ventured from the deductive to the inductive, because nothing beyond our starting blocks can be known or proven to be true. There was, however, no way around it when developing the PAT, and we had to argue for our choices through a critical and thorough discussion. In that discussion, we went through the issues related to the research methods, along with the PAT's uncertainty and requirements for use. As a result, we got the PAT's 'Guidelines for use'. Finally, this led us back to answering our research problem by using the PAT accordingly.

The thesis gives us the PAT to function alongside existing frameworks such as the ISR and the NS 5832. It provides us with an assessment tool for urban security and helps city governments and municipalities manage the increasing threat of terrorism targeting cities and crowded urban areas. With it, we will be able to distinguish between proportional urban security measures that contribute to security, townscapes and quality of life, and disproportional measures that goes at their expense. It helps us substitute frightening anti-riot trucks and diggers with multifunctional urban design solutions, and thus shape our cities toward a sustainable design with positive consequences for citizens.

The PAT also comes with an addition regarding research. We have provided the academic field of urban security with a new, contextual definition of proportionality, and this definition comes with a mathematical and qualitative approach for assessment. Even though it has certain uncertainties and issues, we argue that it is well developed enough to make informed decisions – on the condition that it is used according to its purpose and guidelines for use.

One final question to ask ourselves, is what could have been done differently? There are no quick answers to this question. Everything could have been different – the selection of research methods, theory, the definition of proportionality, the mathematical model, the qualitative approach and the selection of abilities. We did, however, act to the best of our ability throughout the research with the tools we had available. A concluding suggestion is to keep on researching proportionality and testing the PAT, developing it further, revising and altering it. For now, though, we must use what we have.

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