Application of creativity tools to enhance the design of inherently safer urban infrastructure

A thesis submitted to the Imperial College London for the degree of Master of Philosophy

Sasan Y. Aghdam

Supervisor: Prof. Peter Child’s

Department of Mechanical Engineering
Imperial College London
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Declaration

I certify that to the best of my knowledge, the content of this thesis is my own work and all the assistance received in preparing this thesis, including sources have been acknowledged. This research was conducted in the Engineering Design group of the Imperial College London department of Mechanical engineering September 2010 and August 2013. This thesis contains fewer than 27,000 worlds.

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Sasan Yadrandji Aghdam

Design group

Sep 2013
Abstract
The purpose of this research is to explore the construction of a guideline for professionals who make decisions that affect the urban environmental security. The use of creativity tools has become widespread within design sectors but has not yet reached the domain of security design. The strategy here is to find and engage suitable creative idea generation methods that can be used to develop guideline for experts who ultimately used them in the process of designing secure urban infrastructure. In pursuing this goal, this thesis provides a guideline of the fundamental principles of using the application of creativity tools in the development of plausible ideas for crime prevention interventions. The advantage of using such a method or schema is the systematic sorting of potential design solutions. Depending on the criteria required, a design tool (creativity tools) will prompt an urban security engineer to consider potential security weaknesses within an urban design project and offer a wide range of potential solutions for problems. Crime is a social problem in our society that affects people’s lives. The challenge is how to generate more creative ideas to combat crime or how to engage creativity tools within security design to minimise the opportunities for crime to be committed. Existing research demonstrates that creative design in urban infrastructure can minimize the potential for crime in many cases (especially opportunistic crime). Our related research has generated a further host of solutions for potential crime-related problems extending to many areas of urban infrastructure design. The intention here is to demonstrate the implications of using this research within a context of devising creativity tools adequate to implement the results of these findings. Security auditing of urban environment threats and visual mapping of some current security weaknesses is the right approach advocated here to trace the factors behind each crime case. This thesis demonstrates that the use of visual mapping application (issue based information system (IBIS)) can effectively address the problem of data overloading and decision making in the crime prevention domain. The process of collecting data in crime prevention method can be challenging. The experts are usually able to trace one direction of crime cases at a time. The method conducted in this thesis can assist experts to see the full extent of a crime case at the same time. Therefore, they are more likely to be capable of finding the right reason behind a criminal activity. This thesis also further implements a specific approach which is developed for use on large complex security design problems. Visual mapping techniques can be a beneficial tool for security experts as argued in this thesis.
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It can help experts to understand and concentrate on causes of crime, as most cases of crime are interconnected puzzles and experts need to pay attention to details synergistically. For the development of creative ideas against crime, this thesis explores the outcome of a visual mapping model, and then describes the development of creative solutions for particular examples. The specific creativity tools (selected according to the nature of each crime) should be used in order to develop and generate a variety of solutions that can eliminate the opportunities for crime. The process ends when an appropriate form of creativity tool is decided upon for each crime case. A set of creative and innovative ideas was developed to deal with the diversity of potential crime generated by adaptive offenders. This thesis also indicates that a synthesis of creative idea generation methods within security design can represent a meaningful contribution towards effective design of secure urban infrastructure. Depending on the type of threat identified (again with the use of our methods), engineers can then use the particular creativity tools described, to generate several appropriate solutions for these threats. A web-based software program intended to help security engineers to understand and adapt these concepts in their design has also been developed.

Acknowledgment
This M. Phil Report is the result of the work carried out at the Design Engineering group in the Department of Mechanical Engineering at Imperial College London. I wish to express my sincere appreciation to my supervisor, Professor Peter Childs, who agreed to supervise and help me on this research project.

Key words: Creativity, Creativity tools, Innovation, Co-evolution, Crime Science, Crime Prevention, Conjunction of Criminal Opportunity, Design against Crime
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Chapter 1. Introduction

This thesis presents an introduction to the application of creative tools in design against crime. It explains the effect of applying creativity tools in the design of secure urban infrastructure. This research also discusses some recent trends in security design and urban protection, the importance of a rational basis for security strategies and the need for robust creativity tools in order to boost the process of design against crime. From a criminological perspective, creativity has been defined as the production of defensive or provocative ideas and objects that are both novel and worthwhile and appropriate in crime prevention domain as well. To enable a population to behave in certain ways that would result in a positive outcome (or lead to a positive outcome), engagement of a dispositional attribute of creativity is recommended. Involvement of creative tools in security design can facilitate defensive design. Social aspects such as background and general cultural inclinations also have an influential role in the development of crime in societies. Consequently, people display criminal tendencies that have been affected by genetic and social factors of their society.

Creativity in design against crime is a phenomenon that causes a security expert or engineer to ‘think outside the existing solution’, that is, and come up with novel new solutions to tackle crime problems. Without creative solutions in design against crime, secure urban infrastructure would not have progressed from existing designs to the highly developed secure urban designs within which society can feel safe and secure. The overview of previous theories in design against crime describes that there is no universal acceptance in the definition of creative solutions in design against crime, but it is proposed here that the application of creativity tools can improve the effectiveness of designers to deal with crime in more creative ways in combination with processes of design against crime that most of worldwide designers currently employ.

Experts believe that the existing crime science frameworks are not up to the task of supporting innovation. For this reason we considers how creativity tools and crime science frameworks might work together in practice, and addresses some contentious issues. The thesis seeks to alert colleagues in engineering, design and crime science of the need to accelerate creativity and build innovative capacity of our own to counter that of criminals; and to develop a platform from which (in subsequent work) to try out such boosters in practice. Only through generating a wide range of innovative, but theoretically and
empirically plausible solutions to crime problems, can the proposed approach demonstrate its credibility and evolve towards a practicable system.

1.1 Background

The application of creativity tools in security design is relatively new and still unfamiliar to many security engineers. It is proposed here, that the design of secure organizations can benefit from integrating creativity tools within the design stages in order to reduce the costs and increase efficiency of infrastructure security.

The differences in design, implementation, functionality and management among security designers can create conflicts in the security of urban infrastructure. It is proposed that this conflict could seriously affect security and the safety of the public and can be resolved by engaging creativity tools in the design process. The main goal of this research is to address two questions.

- First, how it is possible to optimise a security design in an urban infrastructure
- Second, how it’s possible to use creativity tools to generate more idea in security domain.
- Third, how it is possible to avoid conflict in design of urban infrastructure security.

This thesis provides a comprehensive set of ideas about the usage of creativity tools in design against crime and reviews imperfections and deficiencies in previous systems to combat potential threats and choose appropriate design.

1.2 The need for creative solutions in crime prevention and Problem-Oriented Policing

Problem-Oriented Policing (POP) addresses recurrent problems of crime and disorder usually by tackling their causes through crime preventive interventions. This general approach has been reliably shown to work. concluded that it leads to statistically significant reductions in crime and disorder. Moreover, it was found to be effective across diverse problems in a variety of situations. Likewise the kind of solution most commonly brought to bear on the crime problems in question – situational crime prevention (SCP) – has long been shown to be effective as a generic intervention strategy applicable to diverse problems, places and products (Eck and Guerette 2012). One major spectre haunting SCP – that of widespread geographical displacement – has been broadly dismissed in a further Systematic Review.
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(Guerette and Bowers 2009). Criminals don’t inevitably respond to successful preventive interventions by heading for less-protected territories or targets. However, neither crime prevention practitioners and policymakers nor their academic support echelon can afford to rest on their laurels, for reasons respectively concerning the present and the future.

The average effect on crime demonstrated in the Systematic Review of POP was fairly modest, leaving much room for improvement. The stock of evaluated knowledge, although growing (see the SCP Database at www.popcenter.org/library/scp/), remains limited in relation to the variety and complexity of crime problems ‘out there’ (cf Eck 2003). What we already know to work in crime prevention has been shown moreover (e.g. Pawson and Tilley 1997) to be highly context-dependent: the causal mechanisms underlying successful interventions, often centring on people’s perceptions, decisions and actions, are delicate and tricky to trigger. The circumstances of implementation routinely generate practical tradeoffs (e.g. security requires locks; fire safety, easy escape) or conflicts with other values (e.g. privacy) whose balance and priority vary across time and place. This means that: in the here-and-now, the stock of good and appropriate practice to replicate for addressing new problems and contexts will always be insufficient; replication will always be challenging; and replication will involve some degree of innovation, often substantial.

For the future, we have long been aware (Ekblom 1997) that the stream of changes in political, economic, social and technological domains generates fresh motives and opportunities for crime and terrorism and may disable currently successful security methods or products. Furthermore we face adaptive, creative offenders poised to exploit these changes in a perpetual arms race, to share their new resources for crime as never before via the Internet, and by the same medium to disseminate novel perpetrator techniques to their less-creative fellows. Cropley and Cropley (2013) and Cropley et al. (2010) talk of the ‘dark side’ of creativity including its application for criminal, terrorist or otherwise destructive ends. Crime scientists must understand such dark creativity, the better to disrupt it.

Typical of the arms race is 3d printing and other rapid manufacturing methods now becoming favoured by criminals producing realistic and effective scanning ports to attach to the card slots of cash machines (Krebs on Security 2011). In fact this generic kit, alongside ‘script kiddies’ enabling relatively unskilled criminals to generate effective computer viruses or
trojans, exemplify acceleration of the arms race – of ‘evolution of evolvability’ of the kind that boosted the Industrial Revolution through development of machine tools.

Crime problems are of course an issue beyond the policy and practice of the professional crime prevention world. Equivalent present and future issues arise in this wider domain. This is so whether the public and private organisations concerned are victims of crime; or inadvertent generators of crime opportunities whose harms fall as externalities on third parties, leading them (hopefully) to experience public pressures to mend their ways. Creativity and innovation are required here too.

The principal aim in this thesis is thus to alert colleagues in engineering, design and crime science of the need to accelerate creativity and build innovative capacity of our own; and to develop a platform from which to try out such boosters in practice. In more detail the thesis proceeds as follows. It first identifies strategic requirements for innovation and creativity in crime prevention, finding that these are not currently met within the profession, necessitating a more generic discussion of innovation, creativity and their facilitation. An important aspect here is whether the capacity to innovate is supported by conceptual frameworks that are fit for purpose: it is argued that the standard ones within crime prevention are somewhat constraining and pay only lip-service to innovation. The discussion then discusses newer frameworks designed with creativity and innovation in mind. It continues with a review of generic creativity tools, considering how tools and frameworks might work together.

1.3 Research objectives

The purpose of this research is to produce information that is able to be shared and applied through creativity tools in the design of urban secure infrastructure and help designers to fundamentally change the security design domain. This thesis also includes examples of the deployment and architecture of using advanced security system design in a number of security sectors. None of the existing design against crime approaches, irrespective of the method used, can provide unique design that is universally applicable in the security domain. Security organizations encounter an extremely complex problem in the design of security systems and secure urban infrastructures. For this reason, this research aims to explore how new security structures should be designed. Previous theories do not offer many insights on
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this domain. Literature and theories on creative crime prevention using security design are rare and inconclusive (National Science Foundation June 13-14, 2005, Washington, DC).

Worldwide problems with the performance and implementation failure in crime prevention drive this research to apply creativity tools to improve and generate new ideas for helping security designers to overcome crime presentation issues.

1.4 Thesis structure

This thesis is divided into seven chapters. Figure 1 outlines the structure of the thesis in relation to the overall research methodology which is used here. The thesis includes the following chapters:

Chapter 1, “Introduction” provides a review of the current use of creativity tools in crime prevention and security design. It also outlines the aims and questions, and an overview of the differences between current crime prevention in security design and creative crime prevention design.

Chapter 2, “Literature review”, presents relevant literature for this research including existing theory in crime prevention and environmental security design.

Chapter 3, “IBIS & CCO Framework”, summarizes the overall research methodology proposed and explains the main characteristics of descriptive studies about using IBIS & the CCO Framework in mapping of appropriate creativity tools in conjunction of criminal opportunities.

Chapter 4, “Applied creativity tools in crime prevention projects” presents case studies and suggests further possibilities to undertake a mixture of qualitative and quantitative research about environmental aspects of the CCO framework in the real world such as concealment, surveillance (sight / sound) ‘defensible space’ principles, aiding surveillance, intelligently planned lighting, communicating rules, electronic conflict reduction.

Chapter 5, “Application of creative tools in Crime Prevention data” describes the interpretation of captured data in CCO’s IBIS mapping.

Chapter 6, “Application of mapping and decision rationale with CCO” describes the application of decision rationale with CCO IBIS mapping and recommendations.

Chapter 7, “Conclusions”, describes a research outline for further research and draws together the primary conclusions.
Chapter 2. Literature Review

This chapter reviews the literature in the field of security design that has influenced the research presented in this thesis. The aim of this research is to provide an understanding of what types of creativity tools are suitable for crime prevention and how security design should be subsequently structured. The literature review on creativity tools for security design can be divided into Descriptive and Evaluation Research (see Figure 1).

In the Descriptive Research approach, we are looking to describe crime and criminal activity rates, particularly in United Kingdom, and generally, worldwide. Histories of criminal activity in the United Kingdom and Europe demonstrate that crime is principally but not exclusively associated with poverty or other forms of social deprivation. The main causes of crime according to United Kingdom crime survey are: social (community and family) breakdown; higher unemployment, increased individual freedoms and a decline
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in personal responsibility (Bourguignon, F., Bank, T. W., & Etudes, H. 2001). Poverty itself does not cause crime, but the occurrences of crime are more likely in areas of poverty, especially in combination with poor education.

The past decade has seen a significant change in the number of offences recorded by the police in England and Wales. For example, theft and handling stolen goods per 100,000 of the population was 4,014 in 1986, 5,622 in 1992 and 4,600 in 1996 (criminal statistic 1996: 45, table 2.3). “It is taken as read that there is a clear link between crime and the economy. Some scholars have made more of economic factors than others, but nobody rejects the idea that there is a direct connection between these factors (Beck, Ulrich 2009).

In recent years, crime rates have gone up dramatically in big cities all around the world. People who have migrated from rural areas to big cities have triggered countless security problems. There are numerous reasons why these individuals bring increases in crime; two factors being, lack of education, and changes in values.

Education has become an indispensable part of people's lives; consequently, there are notable connections between education and crime rates. Millions of people who migrate to big cities have difficulty in finding well-paid jobs and meeting their needs. In the United Kingdom the change in unemployment levels is seen to impact certainly on criminal activity and influence it. Investigation on data collected from 42 police force areas indicates that the relationship between economic factors and property crime is correlated (Worrall 2005).

Lack of education constitutes a threat to society in big cities. It plays a leading role in increasing crime rates. Should a government aim to eliminate such issues? Should the government concerned create new laws to stop people migrating from rural areas to urban areas? These key questions are fundamentally important and indicate measures that a government could take to help cities retain low crime rates. When it comes to changes in values, it is an undeniable fact that almost all social and cultural structures have undergone many changes after September 11th (2001). Technological, political and social developments set the stage for such changes in the world. In the United Kingdom and other EU member countries, asylum seekers who have migrated to capital cities have also influenced changes negatively in terms of crime. Cultural and religious values with their hometown have conflicted and they are obligated to keep up with changes in urban cities and consequently face economic difficulties. In this regard, corruption of cultural values has been identified as an inevitable factor. In big metropolitan cities, personal benefits have become more important than cultural and religious values. Individuals begin to turn a blind eye to these values
because of their economical interests. In brief, people who neglect their cultural and religious values are more likely to become involved in criminal activities. It can be assumed that lack of education and economy can be regarded as two of the major causes of increasing crime rates in big cities, and it is apparent that governments are unable to change this situation in the short time, and that other measures should be taken.

In addition to the Characteristics of Criminals study, a number of other studies provide information about characteristics of offenders. For example, one of the most publicized characteristics of sex offenders is a past history as a victim of abuse, and indeed both physical and sexual abuse histories have been noted in many studies of offenders. Family characteristics indicate that 28% of the variance in criminality of children belongs to families with history of criminal activities (W. Buikhuisen 1985).

“A variety of data is presented in support of increasing crime rate theory, which helps explain crime rate trends in the United kingdom 1999-2012. The reality is that some official crime statistics are not simple reflections of ‘facts’, but one of many possible tools for gaining a better understanding of the highly complex and rapidly changing forms of behaviour that can be described as ‘crime’”(Maguire, M : 2006).

The outcome of this descriptive research about crime is that crime has increased and it is necessary for governments to take preventative measures before the situation becomes out of control. Official data releases also include a comprehensive breakdown of statistics for the most violent offences, such as homicides and firearms offences. The figures for 2011/12 are shown in Figure 2.
Figure 2: Ten year crime statistics for the United Kingdom (Simon Rogers 2013 The guardian).

The crime rate can be increased by racism and religious hatred as well as other influences. Figure 3 illustrates the number of racist and hatred attacks among ethnic societies in Europe.

Figures 2 and 3 provide evidence that crime rate is on the rise and governments around the world are not able to cope with the consequences.

Conjunction of criminal opportunity (CCO) is an active approach utilizing public awareness and preventive measures to reduce crime and help government to prepare and plan to reduce crime levels. “The CCO framework is designed as an anti-crime framework which is about reducing the risk of occurrence, and the potential seriousness, of crime and disorder events by intervening in their causes” (Paul Ekblom Oct, 2009). “In dealing with crime problems the first stage of the preventive process is usually to identify patterns of crime risk and then identify the causes that come together to make the criminal events happen” (Paul Ekblom Oct, 2009).

The major purpose of this framework is to integrate theories of crime causation by covering both offender and crime situations in a single schema which avoids confusion and superficial distinctions. Another important aim of the CCO framework is to encourage creative new approaches for tackling crime.

These researches is primarily looking for the possibility of engagement of creativity tools in a CCO framework and thereby increase the capability of this framework to tackle the problem of increasing crime rates. Eleven counterpart principles of CCO seek to block, deflect or weaken causes of crime.
The CCO framework was originally produced to classify several thousand crime prevention projects implemented through the U.K.'s Safer Cities Programme. CCO covered a range of institutional settings and preventive methods, and no single existing framework could handle their complexity in effective mitigation against crime.

CCO uses evidence-based action, where that evidence is available and performance in delivering crime reduction is demonstrated. This includes a wider know-how, a culture of innovation and learning, and a conceptual framework. The CCO framework also can be useful in designing of products, systems and spaces against crime, disorder and terrorism, situational crime prevention, conceptual frameworks for integrating crime science, managing crime prevention knowledge.

A wider environment in CCO framework is the top target to engage the creativity tools and creative ideas in this research. Creative Crime Prevention (CCP) is defined as the anticipation, recognition and assessment of a crime risk and the initiation of creative prevention action to remove or reduce the risk of any criminal activities in urban infrastructure. Increasing of the criminal activities and risk depends on an ecological perspective of human behaviour which examines the correlates of place or geographical location of population in a country. Use of CCP in urban infrastructure design can decrease the risks of crime in populated area.

Use of creativity tools in crime prevention through environmental design are based on the idea that the application of proper creative design and the effective use of the built environment, can lead to a reduction in the incidence and fear of crime. Consequently this change can improve the quality of life in cities (Ronald V. Clarke 1971).

2.1 Definition and scope of security and crime prevention

Before reviewing security design for urban infrastructure, it is necessary to define security. The definition of security depends on one’s perspective; for example the meaning of security for one individual could be different to another within the same organisation. As a general term, it can be a state of being free from danger, assault, damage, fire, fraud, invasion of privacy, theft, unlawful entry and other such occurrences caused by deliberate action. Physical security can be divided into different security aspects as illustrated in Figure 4.
This study mainly focuses on creative design for physical security which describes measures that prevent or deter criminals from accessing urban infrastructure facilities, resources or information systems (Command D, Leavenworth F 2006). Security design can be as simple as multiple layers of security systems or an extreme complex design. The technology used for physical security has changed radically over recent years. Rapid developments in the electronic and chemical science industries have had an extreme impact on security industries.

**2.2 Crime prevention research**

Crime prevention is the technique for attempting to reduce maltreatment of citizens and deter crime and criminals. Crime prevention is mainly applied by governments to reduce public crime, enforce civil law and maintain criminal justice. Sometimes crime prevention design can be enforced by private organizations as well as government (Alliance for Enterprise Security Risk Management 2005). Engineering for crime prevention is also called Design Against Crime and it is the technique of changing the design of urban facilities or products to reduce the temptation of committing a criminal act. Generally to commit a criminal act three principal elements are necessary.
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(1) The desire or motivation for the crime

(2) The skills and tools necessary to commit the crime

(3) An opportunity for committing the crime

The CCO framework attempts to reduce the criminal act by isolating and eliminating one of above elements from public environments to reduce the chance of the criminal act being committed. Security engineers consider an impediment design to minimize the effect of criminals. In recent years, one of the United Kingdom police sub organizations has organised an innovative organization called Secure by Design (SBD) which is “designing out crime” using effective crime prevention and security standards with a range of applications for society and organizations (CPNI 2010). In crime prevention and Design Against Crime, security engineers consider methods and steps for analyzing the security condition of organizations before their final security planning. These steps are considered further in Section 2.3. Criminal psychologists agree that governments must go beyond law enforcement and criminal justice to tackle the risk factors that cause crime because it is more cost effective and leads to greater social benefits than the standard ways of responding to crime. So it can be assumed that tackling crime in early stages benefits the public and it can save taxpayers’ money, significantly. Definitions of crime prevention vary and can be categorized into physiological or physical aspects in design.

Physiological aspects focus on monitoring people, (children and youth in particular), and make sure they never come into conflict with the law. The monitoring and training of the younger generation’s crime and types of crime is critical for future crime reduction.

Physical aspects look at the design of locations and situations which are not yet troubled by much criminal activity. They will make sure that crime never becomes a significant problem in an area (British Colombia criminal justice 2012). In many parts of the world, modernity brings risk in society. The risk of globalization is an important way of linking trends in crime prevention to wider social transformations (Gordon Hughes, 1998). New approaches in crime prevention consider that we are radically revising our approach to criminal offenders. They believe that models of deterrence and retribution towards a preventative system based on scientific principle are the only ways recommended (e.g. behaviour modification with drugs) C R JEFFERY 1977.
2.3 The CCO framework
Conjunction of criminal opportunity (CCO) is an ecological knowledge-based framework which manages the flow of information for design against crime. CCO originated and unifies crime prevention theories and classifies them for diverse practice. CCO can be considered as a conceptual framework for mapping out the immediate causes of criminal events and the corresponding intervention principles that serve to prevent them (Ekblom 2008).

CCO unified the theoretical criminology as a unique framework together and modified and combine them in an appropriate order. CCO also can merge with crime ‘scripts’ and shift from the consideration of crime in general to different kinds of crime risk which can be handled by the Misdeeds & Security framework (Ekblom 2008).

The CCO framework can provide a source of ideas which can stimulate design and help designers to compare with the guidance based on practitioner experience. Most of the intellectual products which contain security guidance are not in the form of user-friendly frameworks unlike the CCO framework (Ekblom 2008).

The CCO framework supplies a map of 11 immediate causal pathways which coincide to cause criminal events to happen, and 11 counterpart principles of intervention which seek to block, deflect or weaken those causes. A major purpose of the framework was originally to integrate theories of crime causation by covering both offender and crime situations in a single schema (Ekblom 2008).

The CCO systematically maps out causes of crime and principles of intervention. It provides a way of considering crime prevention across all institutional settings, both ‘civil’ and justice-based. The CCO framework supplies a rigorous and comprehensive schema and language to help practitioners, policymakers, researchers and theorists to better understand intervention against crime. It also integrates a range of theories including routine activities, aspects of environmental criminology, rational choice, and various other psychological perspectives of offenders, and the expectation for intervention of them (Ekblom 2008). CCO can be used alone or in tandem with other frameworks such as 5Is and M&S (Ekblom Jan 2008). CCO has now been embraced for applications such as organised crime, drugs, terrorism, restorative justice and most recently, Design Against Crime.
2.4 Security design problems

The security of urban infrastructure has become a serious issue for governments and organizations around the globe. This is due to an increasing level of threat from terrorism and local antisocial behaviour. Urban infrastructure can be divided into two main groups:

(1) Public infrastructure (such as airports, hospitals, stadiums and urban infrastructure)

(2) Critical infrastructure (such as energy network and communication networks)

It can be assumed that for terrorists, the most targetable infrastructure is critical infrastructure, particularly urban infrastructures. This is because of the possible catastrophic impact that attacks on this infrastructure would potentially create (The Centre for the Protection of National Infrastructure, 2012).

The purpose of this research is to investigate the use of creativity tools in design of the public infrastructure. This review also provides a framework for understanding design strategy and process considerations to organize architecture and actions which the design of urban infrastructure security. Figure 5 indicates the principal public infrastructure that could potentially be a primary target for terrorists.

![Figure 5: Potential threats](image)

The most important aspect of security design problems in urban infrastructure is listed in following cases:
Application of creativity tools to enhance the design of inherently safer urban infrastructure

Lack of response to an environmental threat (such as riots)

In large and complex urban environments, it is critical for decision makers to reduce the time from detection of an incident to response by officials. It is very important that the information collected by the system supports the human operators during decision making process and building confidence in those decisions.

Lack of distribution of vital data in emergency cases

In emergency cases, vast amounts of information (IP camera video footage, intruder alarm data, RFID ID data and fire alarm data) cannot be controlled. This problem can be solved if the system allows for the dissemination of the right information to the right people at the right time. It is hypothesised here that engaging more intelligent digital techniques for eliminating this problem can be extremely beneficial.

Lack of integrated security design and interactive systems

Integrated security design is a collaborative method for designing security systems which emphasizes the development of a holistic design. The integrated security design process requires multidisciplinary collaboration between police and security design engineers from conception to completion.

2.5 Creativity tools

There are many definitions of creativity and creativity tools. Creativity without any doubt is the most important element in successful design. Scholars have suggested that creativity typically can be defined in terms of novelty and usefulness, an example being "as the process of producing something that is both original and worthwhile" (Csikszentmihalyi, 1999). Creativity can come in many forms. Some scholars describe creativity as a solution that can simply integrate existing knowledge in a different way.

There are three main types of creativity, involving different ways of generating novel ideas:

a) “Combinational” creativity that involves new combinations of familiar ideas.

b) “Exploratory” creativity that involves the generation of new ideas by the exploration of structured concepts (Dr Eleni Sefertzi 2000).
c) “Transformational” creativity that involves the transformation of some dimension of the structure, so that new structures can be generated (Boden 1998).

Creativity is an implicit ingredient of designing and developing a security system in order to realise the concept and overcome and resolve any strictures or constraints. Our understanding of creative processes has steadily extended over the last 60 years and there are a significant number of creativity tools that have been developed and are widely used in the workplace ranging from brainstorming and synectics, to six hats and the theory of inventive problem solving (TRIZ). A framework has been developed called the Conjunction of Criminal Opportunity (CCO) which draws together the major, immediate causes of criminal events from an ecological perspective, and in parallel, the major ‘families’ of intervention principles deployable to block, weaken or divert those causes, thereby preventing crime. This thesis explores the application of creativity tools to the development of plausible ideas for crime prevention interventions using the CCO as a ‘domain knowledge’ framework for their generation, selection and realisation.

Creativity is the production of novel and useful idea in many areas. Here Innovation is the successful implementation of creative ideas within security design domain.

There are several types of creativity tools that able to engage with process of design against crime. These tools are able to improve capability of security designer, to make a decision about how in a short time they can deal with a wicked problem. Creativity in this context can be augmented by the implementation of creativity tools.

On their own creativity and associated new ideas may be of limited use and instead in the context of business, commerce and public services we acclaim innovation. In commerce innovation is critical for sustaining business activity and funding development of future ideas. Similarly within an organisation or in society innovation is necessary for updating and developing the social software that defines behaviours and to resolve the many conflicting and competing requirements that modern living and industrial civilisation impose including those centring on security.
2.6 Innovation and creative problem-solving in crime prevention

Whether we are focusing on public policies and police/governmental crime prevention practice, or considering the crime problems faced by the wider array of public and private organisations within society, only one plausible strategic response exists to the practice-knowledge deficit in the present. That is to give preventers a greater capacity to innovate, trial and adjust their interventions to fresh problems and contexts and to systematically capture, evaluate, consolidate and disseminate that knowledge as it comes in. Regarding the future, the innovative capacity must be sufficiently widespread and efficient to keep up with criminogenic changes and to out-innovate the stream of offender adaptations. A significant anticipatory component is also needed (Ekblom 2002; Armitage 2012), whether through future-proofing current preventive methods, for example against likely changes in offenders’ resources over the product lifespan; or through forecasting new crime problems or contexts, and developing timely solutions.

Solving problems inherently takes practitioners beyond replication of routine responses. But innovation and creativity in crime prevention practice are rarely addressed in depth in the SCP and Problem-Oriented field. A search of the POP website www.popcenter.org revealed few hits for ‘creat’ that were not irrelevant or banal (e.g. ‘creating a disturbance’, ‘created a document’); although it did yield around a thousand for ‘innovation’/innovative’ (‘may report innovative projects’, ‘they also inhibit technological innovations that could provide more security than mandated by the minimum standards’, ‘police looked for innovative ways to tackle emerging and entrenched drug markets’). Further perusal suggests these may all be mentions of the desirability of innovation but without guidance on how to boost it.

The POP process guide Implementing Responses to Problems (Brown and Scott 2007) does refer to conditions (specifically, a blame culture) stifling innovation, but makes no explicit suggestions on how to boost it. The most likely POP guide which might contain explicit guidance on innovation, Enhancing the Problem-Solving Capacity of Crime Analysis Units (White 2008), has one banal mention of creating and none whatsoever on innovation. In the largely material-world domain of POP and SCP it seems, therefore, that an important practitioner capacity has been neglected. The situation is somewhat better in the cyber security field (e.g. Department of Homeland Security 2011) due to the rapidly-evolving nature of crime and countermeasures, the pervasive pursuit of security innovation, and the wider appreciation of innovation in this domain. Likewise in counter-terrorism.
Research on innovation in crime prevention is similarly limited, as Cropley and Cropley (2013) note. (Research on criminal innovation is somewhat better addressed, e.g. the study on stolen vehicles by Tremblay et al. (2001). Exceptions comprise various studies or reviews that are explicitly design or technology-related (e.g. Clarke and Newman 2005; Whitehead et al. (2008); Ekblom 2008, 2012a, b). Here, the focus is on the products of design more than the process, although both are equally important.

Chapter 3. IBIS & CCO Framework

In this chapter how Issue-Based Information System (IBIS) as a logical mapping technique can facilitate the CCO crime prevention method is explained. Methods for identification of a problem with logical mapping methods and the way of tackling crime issues are explored. Conjunction of criminal opportunity (CCO) is an ecological guideline which can guide engineers to predict and eliminate crime. To find out the main cause of crime, engineers need to break down each crime case. This cannot be possible unless a logical mapping model of each crime is made with investigation on elimination of these crimes constantly. During a logical mapping of any crime case several problems in crime prevention that end up with contradiction are identified. Solving of wicked problems with contradiction can be much easier if we can use several creativity tools.

3.1 IBIS methodology

The Issue-Based Information System (IBIS) was developed by Werner Kunz and Horst Rittel as an argumentation-based approach to tackle very complex wicked problems (Rittel, H., & Noble, D. 1989). The phrase "Wicked problem" is used in social planning to describe a problem that is difficult or impossible to solve, because it has incomplete, contradictory and changing conditions that are often difficult to recognize. It is also designed to tackle ill-defined problems that involve multiple stakeholders. Issue-Based Information Systems (IBIS) can be used to support planning and processing of political decisions for government. In industry IBIS guides the identification, structuring, and settling of issues by engineers and other professionals to provide information relevant to a dialogue or common problem. It is
Application of creativity tools to enhance the design of inherently safer urban infrastructure

designed for a conventional documentation system which contains elements such as topics, issues, questions, positions, arguments and model of a problem.

Sometimes a government or large organisation can be confronted with a complex problem in planning and decision-making. IBIS can be used as a way to expand coverage on a problem which helps a designer or decision maker to create a transparent design process and allows them to observe as well as participate in tracing back the process of decision-making. The importance of using IBIS methodology in design is that all of the relevant ideas tend to surface and can be examined. There is a stronger chance for the best idea to be more easily adopted than accepting the most common or dominant voice in an organisation. The mappings of decision-making where influences and factors are related to a decision are formed as a visual map and it can have a radical impact on the co-creativity. The IBIS methods organises and focuses everything around a common discussion. IBIS methodology helps engineers to solve or tackle "wicked problems" where the nature of a problem is not clear.

IBIS has been embodied in software developed for aerospace, civil and healthcare (Aurisicchio et al.; 2009 & 2010). It is a graphical method which uses a network of nodes and connecting arcs to capture decision rationale as well as rationale involved in problem diagnosis and requirement capture and deliberation. The basic elements of IBIS notation are an Issue, an Answer, a Pro argument and a Con argument. An issue is generally captured in the form of a question. An answer can be captured in the form of a string of text describing a design solution. Each description can be enriched using the File node to capture graphical data in the form of; for example sketches, graphs, photographs and written notes. A basic IBIS structure applied to problem diagnosis is illustrated in Map 1.
Application of creativity tools to enhance the design of inherently safer urban infrastructure

Map 1: Illustration of IBIS Methodology (Introduction to Compendium - Version 1.3.4)

Depending on the design sophisticated methods can be applied in the description of a design solution using a design discourse indicated in Table 1. There are several computer programs that can help engineers to capture knowledge with IBIS methodology. Compendium and DRed are examples of IBIS software that provide a graphical interface for the recording of rationale. People from a wide range of backgrounds and organizations regard Compendium as a highly promising approach for solving difficult wicked problems. Compendium is a computer program that facilitates the mapping and management of ideas and arguments in visual graphical mode. The software provides a visual environment that allows engineers to structure and record teamwork data as they work through common "wicked problems".
<table>
<thead>
<tr>
<th>Purposive:</th>
<th>Crime reduction and protecting householders against security threats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance:</td>
<td>Quantitative crime reduction with reduce burglary in area by 10%</td>
</tr>
<tr>
<td>Mobilization:</td>
<td>Implementation of intervention method</td>
</tr>
<tr>
<td>Constructional/instructional:</td>
<td>Right methods of manufacturing, implementation and operation against crime</td>
</tr>
<tr>
<td>Reverse-causal:</td>
<td>focusing on the crime causes and divert the affect of crime</td>
</tr>
<tr>
<td>Ideal Final Result:</td>
<td>solution-oriented descriptions against crime impact</td>
</tr>
<tr>
<td>Problem-oriented:</td>
<td>Embark upon specific problem such as pick pocketing in specific area.</td>
</tr>
<tr>
<td>Reverse-purposive’:</td>
<td>Frustrating criminals and disrupting their plans</td>
</tr>
<tr>
<td>Technical/structural realization:</td>
<td>solution-oriented through a practical procedure or product</td>
</tr>
<tr>
<td>Mechanistic:</td>
<td>Theoretical intervention against crime and disorder</td>
</tr>
<tr>
<td>Delivery:</td>
<td>Targeting of interventions and prevention methods</td>
</tr>
</tbody>
</table>

Table 1: Design discourses (developed from Ekblom 2012a)
Application of creativity tools to enhance the design of inherently safer urban infrastructure

Compendium offers innovative strategies for tackling several of the key challenges in managing knowledge (Introduction to Compendium - Version 1.3.4):

- Improving communication between disparate communities tackling ill-structured problems
- Real time capture and integration of hybrid material (both predictable/formal, and unexpected/informal) into a reusable group memory
- Transforming resulting resource into a right representational format for different stakeholders.

Compendium enables groups to collectively elicit, organize and validate information required by a particular community for a particular purpose. It also provides a flexible visual interface for managing the connections between information and ideas. Compendium places few constraints on how engineers organise material and data. Compendium has myriad applications for information-intensive and intellectual work and is open source.

The Design Rationale editor (DRed) Program was originally developed for large Aerospace Corporations and help designers to record their rationale in each stage of design. It was recognised that there is a great potential for this software tool to improve the design process provided it could fit naturally with the working methods of designers, and not impede them (Bracewell, R., Wallace, K., Moss, M., & Knott, D. 2009).

3.2 Application of IBIS mapping to CCO

One of the branches of the CCO framework is design against crime which involves urban planning with integrated crime prevention in urban planning development. In design against crime engineers combine traditional techniques of crime prevention with newly developed theories and techniques. One of these techniques is using creativity tools for planning a security design of urban infrastructure, and tackling urban security problems. There is a great opportunity for creative thinking within this area with indications that applications of these are effective in reducing crime rates (The Alliance for enterprise security risk management, 2005). Applying creativity tools in crime prevention would be different from traditional methods, where effort tends to be used in dealing with the damages instead of preventing them in the first place. It can be assumed that some organisations such as insurance companies could pay more attention to creative thinking in the area of crime prevention. This can offer benefits. Map 2 illustrates the principle of using creativity tools in crime prevention.
Application of creativity tools to enhance the design of inherently safer urban infrastructure

Map 2: IBIS map Illustrating use of creativity tools in crime prevention.
3.3 Process of choosing right creativity tools for CCO framework

The process of choosing suitable creativity tools for CCO’s framework is difficult and time consuming. It starts with a deep understanding of the 11 radials of CCO’s framework. We must find which types of creativity tools are suitable for generating an idea for each specific radial in a crime prevention framework. This novel research is also looking to assess the creativity support tools which are suitable for specific areas of the crime prevention design domain, in general.

The complexity of using the right creativity tools in CCO’s framework and crime prevention design leads this research to define a five-dimensional category. These categories are illustrated in Table 2.

<table>
<thead>
<tr>
<th>Types</th>
<th>Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Condition/motivating/organizing techniques</td>
<td>These techniques which facilitates the removal of various mental blocks, unleashes natural creativity</td>
</tr>
<tr>
<td>2 Randomization</td>
<td>The techniques are forcing an individual to make more random attempts to solve a difficult problem in short time</td>
</tr>
<tr>
<td>3 Focusing technique</td>
<td>The technique which specially help an individual to focus on one issue at a time and avoid frustration.</td>
</tr>
<tr>
<td>4 Systems</td>
<td>A system contains a set of focusing or random steps to be followed in a specific order.</td>
</tr>
<tr>
<td>5 Pointed techniques</td>
<td>Techniques which offer single or multi-step recommendations about experience or documented knowledge.</td>
</tr>
</tbody>
</table>

Table 2: Classification of creativity tools (Zusman and Zlotin 1999)

The use of creativity tools appropriate to each category helps us to provide a more sophisticated method for generating an idea in the crime prevention domain. Proposed creativity tools can help engineers in a process of design decision making that can be explored on multiple levels. It can also improve the enhancing of security design development.

The first radial in CCO’s framework indicates immediate causes of criminal events. The criminality (predisposition to offend) is about longer-term psychological features of the
offender which includes aggression, antisocial attitudes, criminal self-image or reputation, habits and drug addiction. After careful consideration we decided that certain types of creativity tools can be useful in this area, because most of the issues in this radial are related with a sociological aspect of crime problems (Paul Ekblom 2008). The research undertaken here that these sets of creativity tools (Causal Mapping, CATWOE, TRIZ-Trends of evolution, Fishbone Diagram, Delphi, Osborn's Checklists) are probably the most suitable ones to generate new idea in crime domain and trace a cause of any crime problem. The proposed set of creativity tools are the most appropriate ones for any sociological or psychological problems. They can be useful in modification of deterrent methods which can confront a crime process. The proposed creativity tools are able to help a transition from a loose divergent thinking about crime in general to a focused convergent thinking on an actual cause of crime. With the application of creativity tools in security design we are able to understand the behaviour of criminals and generate several novel ideas, while we are tracing the root and cause of problems. There are several rationales which have been considered for a particular type of creativity tools classification for each of the CCO radials. A logical and systematic decision-making process for choosing each useful creativity tool has been designed in a way that we can consider the functionality of each tool in a creativity taxonomy chart and then choose the right one. Choosing the right creativity tools in first radial of CCO’s framework helps security engineers to address the critical elements that result in a good design decision. Map 3 illustrates interconnectivity of decision for certain useful creativity tools in the first radial of the CCO framework.
Application of creativity tools to enhance the design of inherently safer urban infrastructure

First radial of the CCO framework

1. Criminality (predisposition to offend) Long-term psychological features of offender including
   - Drug addiction
   - Criminal self-image or reputation
   - Habits or standing decisions
   - Anti-social attitudes
   - Aggression

Immediate causes of criminal event

Criminality (predisposition to offend)

Reducing criminality through:
   - Early developmental intervention: testing risks and protective factors
   - Remedial intervention: (corrective measures) at various levels especially

Tools useful to identify complexity of issue and interrelationships of parameters

Method designed for technological aspect

Tools useful to find complexity

Method designed for sense tasks

Tools useful to identify complexity of issue and interrelationships of parameters

Method designed for technological aspect

Compendium map 3: IBIS map and Inter connectivity of decision rationale for the first radial of the CCO framework
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The second radial in the CCO framework is about lack of resources to avoid crime. For this radial we have developed other combinations of creativity tools such as active crisis generation, context modifying, causal mapping, CATWOE, TRIZ-contradiction matrix, Delphi, Osborn's checklists, six hats and fishbone diagram. These sets of creativity tools are probably the most suitable ones to generate new ideas to tackle lack of resources for avoiding crime. Map 4 illustrates the interconnectivity of applied creativity tools for the second radial of the CCO framework.

Map 4: IBIS map and Inter connectivity of decision rationale for the second radial of the CCO framework
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Map five illustrates the IBIS interconnectivity of applied creativity tools in the third radial of the CCO framework. The justification for a given tool can be based on the type of application, previous evidence of the usefulness of the tools in other domains, validation of the usefulness of the tools.
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Map six illustrates IBIS interconnectivity of applied creativity tools for the forth radial of the CCO framework.

Map 6: IBIS map and Interconnectivity of decision rationale for the fourth radial of the CCO framework
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Map seven illustrates IBIS interconnectivity of applied creativity tools for the fifth radial of the CCO framework.

Map 7: IBIS map and Interconnectivity of decision rationale for the fifth radial of the CCO framework
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Map eight illustrates IBIS interconnectivity of applied creativity tools for the sixth radial of the CCO framework.

Map 8: IBIS map and interconnectivity of decision rationale for the sixth radial of the CCO framework
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Map nine illustrates the IBIS interconnectivity of applied creativity tools for the seventh radial of the CCO framework.

**Seventh radial of the CCO framework**

Map 9: IBIS map and interconnectivity of decision rationale for the seventh radial of the CCO framework
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Map ten illustrates the IBIS interconnectivity of applied creativity tools for the eighth radial of the CCO framework.

Map 10: IBIS map and interconnectivity of decision rationale for the eighth radial of the CCO framework
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Map eleven illustrates the IBIS interconnectivity of applied creativity tools for the ninth radial of the CCO framework.
Map twelve illustrates the IBIS interconnectivity of applied creativity tools tenth radial for the CCO framework.

**Tenth radial of the CCO framework**

- Boost preventers' presence, competence, motivation/responsibility
- Extra surveillance of enclosed and wider environments
- Ads for preventers - alarms, CCTV
- Cultivating/protecting witnesses and informants
- Informal social control
- Formal control
- Self protection and avoidance
- Emotional training

Factors which Alert

- Inform
- Motivate and
- Empower preventers (with knowledge, skills, tools, eg forensic kit, CCTV and permex)
- Directed them (objectives, standards, regulations)

Tools useful to control complexity in human behaviour

The use of the tenets qua is not immediate and might take some time

Tools useful to find complexity

Method designed for technological aspect

Methods useful to find complexity

Technique suited to be used in social sorted modeling

It could be ineffective due to the unreadiness of junior to deal with seniors

Technique suited to be used in social sorted modeling

It could be ineffective due to the unreadiness of seniors to deal with junior

**Map 12: IBIS map and interconnectivity of decision rationale for the tenth radial of the CCO framework**
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Map thirteen illustrates the IBIS interconnectivity of applied creativity tools for the eleventh radial of the CCO framework.

Map 13: IBIS map and interconnectivity of decision rationale for the eleventh radial of the CCO framework
Chapter 4. Application of creativity tools in Crime Prevention projects

4.1 VCA in monitoring of perimeter security (Fences / borders)

After September 11, 2001 almost all organisations, which deal with urban security infrastructure, have begun to change their security policies and most of them have now improved. These changes initiated with training in security awareness proposed by organisation themselves in different ways. Some organisations such as the Design Against Crime Institute announced formal security awareness trainings for citizens. This type of training educates security engineers on various and appropriate ways of how to protect citizens against any security threats (M.E. Thomson, R. von Solms, 1998).

At the same time the cost of security has rapidly increased according to the United States homeland security, by reaching a level well over a trillion dollars. Most of these costs sharply increased in the area of airport security, power plants and national infrastructure high-tech security systems. By 2011, US homeland security spending reached to $69.1 billion, nearly twice as high as spending in 2001 (Dancs, A. 2011). Figure 6 illustrates the cost of US security during 2001 and 2011.

Figure 6: illustrates fiscal year from 2001 to 2011 demonstrating security spending with the supplemental spending included (Dancs, A. 2011).
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One of the highest proportions of costs associated with added security in any organisation is the cost of perimeter security including physical structure such as fences, barriers, gates and digital structure monitoring device (electronic detecting devices, laser detection systems and other movement monitoring devices).

In this section how engagement of creativity tools in perimeter security design can help security engineers to create new designs for safer and secure infrastructures will be described. Map 14 illustrates an IBIS map for decision making in perimeter security system using creativity tools to explore the design space.

Map 14: Illustrative IBIS map for decision making rationale for perimeter security

Map 14 explains capture of knowledge in human face recognition improves understanding of the problem and challenges that engineers are face with.

In recent years one of the most effective systems to tackle unauthorised access problems has been fibre optics intruder detection. Fibre optic detection is based on detection of the change in the polarisation state of light occurring when the multimode optical fibre gets bent by an
Application of creativity tools to enhance the design of inherently safer urban infrastructure

intruder. This type of system, as illustrated in Figures 7 and 8 sends a laser beam along the fibre optic cable which is attached to the fences or buried a few centimetres around important sites (F., Ave, H., & Nuys, V. 1998). Fibre optic detection calculates the return signals and senses any change in light intensity along the cable. Fibre optic sensor technology can deliver precise location of any movement or fence climbing.

Figure 7: Fibre optic detection principles (FFT Secure Link™, 2009)

Laser fibre technology detects and locates any intrusion and third party interference anywhere along fences before possibility of any damages to the protected area. This type of system is generally used by governmental premises and critically important sites such as atomic power plants and prisons, where precision of detection is essential. Installation of this type of system

Figure 8: A fibre optic detection loop system (FFT Secure Link™, 2009)
is extremely costly and can generate lots of false alarm which costs security officer time and energy. Figure 9 illustrates a fibre optic laser technology sensor system installation.

Figure 9: A generic fibre optic laser technology sensor system (FFT Secure Link™, 2009)

Usage of creativity tools for solving multi-dimensional problems, such as in the security domain, guides engineers understanding to tackle core of problems by allowing them to see a solution for problem in different dimensions. For example; to decide how to reduce the expensive cost of electronic systems or how to increase precision in detection of threats with an offer of a solution, are some of those problems that engineers have to confront. Recognition of a problem at this stage of decision making is vital for engineers. For example; how they can achieve the same or better security result with minimum cost or how they can reduce numbers of false alarms and other obstacles, if they reduce one of the key aspects of system (such as costs). By using creativity tools such as the TRIZ contradiction matrix and morphological analysis, engineers can offer many solutions for existing perimeter security problems.

A solution for perimeter security problems is analysis of video signals in a similar manner to the way a human operator would undertake this function. Analysis of video signals to determine any temporal events, not based on a single image has now been proven to be highly effective. This technology is called VCA. Video content analysis (VCA) is the capability of automatically analysing video to detect and determine temporal events. In this method, video artificial intelligent algorithms can be implemented as software on general
purpose machines which is able to control different functionalities such as video motion detection and human face recognition (Sezan, Nevenka Dimitrova IEEE 2002). The more advanced functionalities for VCA could be tracking an object or person in a CCTV network and reporting the location of the target to a police officer or security staff at any time, if it has become visible to the system (Murè, S., & Demichela, M., 2009). Figure 10 demonstrates video content analysis for locating and tracking an object or a person in an urban CCTV control room. Figure 11 demonstrates the Process diagram for video content analysis.

Figure 10: Demonstration of video content analyses’ in city monitoring (Contral Security, 2010)
One of the most spectacular creative solutions for reducing the cost of perimeter security is using augmented reality combined with VCA in security of premises. VCA powered by augmented reality represents one of the most cost-effective and creative ways of improving perimeter protection since 2011. This type of facility has created a unique system with multiple functions suitable for a whole range of security applications. Rather than using traditional methods of unauthorised entry detection such as physical sensors attached to fences, this system monitors any object or person and continuously analysing their movement till a security officer take an action.

Figure 12 illustrates perspective compensation in practise in an application of physical or virtual barrier (an un-crowded environment) where an object or entity is trying to cross the barriers and has been detected. When the subject is moving toward a fence, he is firstly marked in the screen with a green box (just for the attention of an operator). Further approaching of the object towards the fence will activate virtual trip wire and the system switches the green box to a red box and fully activates the alarm. It will constantly warn the security operator that someone or thing is trying to climb the fence. This system can monitor and track several intruders at the same time. Nuisance alarms are mainly caused by nature. Historically perimeter security systems have unnecessarily generated false alarms as sensors cannot differentiate the signals caused by animals.

For example; in the case of birds sitting on a fence or flying across an area which is monitored, larger size of birds are detectable. However it is too small to trigger an alarm. Therefore with a combination of virtual trip wires, tracking objects and perspective
compensations system insures those false alarms do not occur. VCA powered by augmented reality such as virtual boundary helps the security designer to implement more accurate and economical systems for monitoring an organisation’s perimeter security. The second problem in urban security is monitoring movements of people and their belongings. Security alerts are mostly and unnecessary caused by unattended and suspicious items left in a public area which will stop the day to day traffic flow.

Figure 12: A person crossing an imaginary digital trip wire next to the fence causes the alarm to be raised.

This will trigger an investigation by a security attendant which will consume time and money. Unattended baggage means inconvenience and frustration for individuals and security officers. Disruption in public transport which is caused by terror alerts can cost organisations millions every year. For example; recently United Kingdom airlines had to deal with a tougher security measures after police announced a possibility of terrorist attack (Dan. Milmo
Application of creativity tools to enhance the design of inherently safer urban infrastructure

Sep 2011; the Guardian). This announcement could lead to delays, extra costs for the airline and compensation claims. Monitoring people movements with VCA powered by augmented reality will result in vast amount of information that can highlight unusual behaviour of passengers in public transport sector and solve this problem. As part of this trend, security engineers are looking for a unique system to improve and monitor movement of people in cities too.

Current methods of visual surveillance depend on highly trained personnel to detect suspicious activity. However, the attention of most individuals degrades after 20 minutes of evaluating monitor-screens. Therefore, current surveillance systems are subject to failure. The actual reason behind unattended items alert is that security officers cannot trace each individual in crowded places due to several factors. One of the most important factors in this failure scenario is human factors and failures. Human failures are not random; they have different causes and influencing factors such as unintentional and intentional errors. An automated VCA was developed in order to build a reliable visual surveillance system to track any threat.

4.2 Creative case study in security design

Over time human factors has changed according to statistics (P. L. Clemens, 2002) However, as previously mentioned the attention of most individuals degrades after 20 minutes of evaluating monitor-screens. Therefore, current surveillance systems are subject to failure. Figure 13 illustrate the level of human failure probability on monitoring.
Humans can get easily distracted when they are tired, hungry and socialize in the office. Case studies in crowded places such as an airports or a shopping centre demonstrates that security offices can get distracted without being aware and it could eventually result in unreliable situations. In one debate on security a situation was highlighted where a fight was initiated to distract a security officer. At the same time an unidentified individual placed an item (such as a suitcase with explosives) undetected by the same officer in a different location of the airport. The new generation of unique tracking software allows the security officers to be alerted continuously until the threat has been detected and the security officer notified. Using artificial intelligence in this software provides an ability to track down the person and their belongings. Any individuals or groups who appeared in the CCTV monitor will be immediately detected, tracked and automatically assigned with a number. If an individual enters into the CCTV frame carrying an items or objects, the software will automatically verify the person and his/her items with separate numbers and marked them with individual boxes for person and their items. Furthermore, if the person leaves his luggage or object on the floor and walks away to a certain distance, only then the software will highlight the distance between the person and his/her suspicious belonging by alerting an officer. In the meantime the software will trace the owner of suspicious item everywhere along the monitored area to help the security officer to trace the subject in concern.
The creative purpose of this software is to help and assist the security officers to easily monitor any suspicious person or group of persons and their belonging at any time. An automated object detection and tracking was developed in order to build a reliable visual surveillance system. Object detection is performed by means of a background subtraction technique known as Wronskian change detection (Ruth Aguilar-Ponce 2007).

The other feature of this system can be detecting removed objects from an existing feature of a site or work place. The area of application ranges from the detection of removed objects of art in museums to the monitoring of areas where objects must not be placed, such as emergency exits, road sections. (e.g., it occasionally happens that in public places criminals steal charity boxes; with this technology if someone removes a charity box object from its place the system immediately warns security officer to deal with this issue). The initialization of new targets is based on the motion information obtained from the object classification. Only classified objects are tracked. Figure 14 illustrate tracking objects (luggage) and people in an airport.

*Figure 14. Tracking results for a Gatwick Airport surveillance system.*
Chapter 5. Application of creativity tools in Crime Prevention design

A daily print of the Financial Times covers more information than an average 18th century person was likely to come across in his/her lifetime. Our world is rich with facts and data, experiencing rapid growth when compared to previous centuries. A vast amount of information is present in our lives without making much of an impression. A challenge is how to present such facts and data within boundaries and, to transform it into useful information instead (Mountford, S. 1990). Most commentators agree that rates of crime in cities are high and increasing; as a result, security engineers must address this problem and threat. Recognition and process of relevant issues within urban security is demanding crime professionals and academics to share their information. Creativity would simply mean producing ideas and constructive design would be the result of a selection process. Creative thinking is a skill and not an individual talent. One of the important aspects of any creative idea in security domain is that this idea must have constructive value. Experts believe in their own creativity, although some engineering activity involves the implementation of procedural steps, albeit with care and rigour; whether the output by this can be classed as creative can be questioned. In our normal logical thinking we can only generate some ideas which make sense and fit to our experience. By using creativity tools and thinking approaches, we can put ourselves in a different intellectual level which allows us not only to think beyond our normal thinking capacity but it will open up our minds to new ideas in relatively constructive way.

The consensus within the crime prevention method requires engineers to address the risk factors associated with urban crime phenomena. To understand security risk factors in metropolitan cities, engineers must pay attention to several interconnected crime related issues at the same time. This approach requires an analytic understanding of various related documents or data which is related to each issue. Creativity tools and the IBIS design method can help security engineers to process and understand actual reasons behind a crime case. Creativity tools can assist engineers in finding quicker solutions or ideas within crime prevention domain simultaneously allowing them to eliminate most of the crimes. Consequently, crime prevention becomes a suitable domain for the application of systematic creativity tools. Creativity tools described within this thesis could benefit security engineers in understanding linked areas of decision rationale and enable them to select unambiguous ideas for further consideration.
The CCO frame work methodology that helps to ease crime prevention complexity. To find the right creativity tools in crime prevention domain we need to develop a lot of viable ideas. With implementation of creativity tools engineers are able to increase the capability of a new idea which helps to design an urban infrastructure according to the crime prevention method. More recent developments in CCO have sought to emphasise the complex system dynamics of the interactions between the agents (offenders, preventers, promoters) and entities (target, environment, enclosure, tools and other resources for offending etc) through use of crime scripts (Cornish 1994) and script clashes (Ekblom 2012a) such as ‘surveill versus conceal’, ‘use force versus resist force’. It is these clashes, effectively contradiction ‘primitives’, that designers and engineers must focus on in tilting the balance to favour the ‘good guys’. The integration of creativity tools to tackle specific aspects of CCO is described in Chapter 6.

5.1 Suggested creativity tools

One means for augmenting innate generative activity is to use tools which developed for that purpose. Most such creativity tools can be used at any stage in a problem solving process and tend mainly to be focused on problem exploration, idea generation, and concept evaluation. Creativity tools in expert hands are as important as are the surgeon’s tools to the saving of life. Used recklessly they can be dangerous and counterproductive, yet without them there is scant chance of success.

Creativity tools can certainly be of assistance in developing the quantity of ideas and if a process of convergence and divergence is followed as in the creative solving process (CPS), they will involve evaluation, refinement and refinement of the ideas considered as a means to improve quality (Isaksen and De Schryver (2000)).

Creativity tools can be significant value in enabling the design space to be explored systematically for each step of the idea in order to overcome challenges and issues inherent in idea realisation.

The conditions for creativity to occur include the combination of expertise, sponsorship, motivation, and good communication skills. Table 3 provides some useful creativity tools in crime domain.
### Application of creativity tools to enhance the design of inherently safer urban infrastructure

<table>
<thead>
<tr>
<th>Creativity Tools</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘Post-it’ and ‘Grid’ brainstorming (Osborn, 1963; Michalko, 2001)</td>
<td>In ‘Post-it’ participants record ideas on Post-it notes and these are collected, reviewed and analysed. In ‘Grid’ a participant records some solutions to a problem on a grid that is completed by other members of the group. These tools encourage simultaneous generative activity but some participants may remain reluctant to share an idea for fear of ridicule or loss of ownership. This latter concern may be addressed by implementation of IPR protocol.</td>
</tr>
<tr>
<td>Checklists (Osborn, 1963)</td>
<td>A series of brief questions and statements is used to stimulate creativity when it’s proving difficult to think in original ways. Can be used for idea generation and evaluation but is a systematic method that may not appeal to all personality traits.</td>
</tr>
<tr>
<td>Lateral thinking (de Bono, 1970)</td>
<td>Solutions are proposed by looking at a problem using random associations, provocation, challenging current solutions and divergence. Requires both curiosity and confidence and encourages a wide range of alternative solutions. Robust evaluation of ideas is necessary to identify worthwhile concepts to develop.</td>
</tr>
<tr>
<td>Mind mapping (Buzan and Buzan, 2006)</td>
<td>Connections between associated pieces of information are emphasised by clustering the information on a visual map: this can stimulate creativity. Some people are hesitant to reveal a perceived weakness in sketching but this can be overcome with practice.</td>
</tr>
<tr>
<td>Six hats (de Bono, 1999)</td>
<td>Parallel thinking process in which team members wear coloured hats representing data, creativity, positivity, feelings, criticism and control. The approach can minimise conflict, encourage participation and consideration of a problem from a wide range of perspectives.</td>
</tr>
<tr>
<td>Morphological analysis (Zwicky, 1969; Childs, P., 2004)</td>
<td>A matrix-based technique in which a problem is broken-down into component parts and a range of approaches suggested for each of these elements. Encourages combinations of features that otherwise might not have been considered but large quantity of combinations generated means that good ideas can be overlooked. Weighting criteria should therefore be used to guide selection of solutions.</td>
</tr>
</tbody>
</table>
| Synectics (Gordon, 1961) | Exploits our capacity to connect apparently irrelevant elements to spark new ideas and solutions. The approach helps participants break existing
<table>
<thead>
<tr>
<th>Mindset/Tool</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>TRIZ (Altshuller (1984))</td>
<td>Russian acronym for the Theory of Inventive Problem Solving. Provides a framework and toolbox for systematic, inventive problem solving but is sometimes viewed as complicated and difficult to use; this can be overcome by sustained use and practice.</td>
</tr>
<tr>
<td>CATWOE (Checkland &amp; Scholes, 1990)</td>
<td>CATWOE’ is a mnemonic for a checklist for problem or goal definition. CATWOE is an acronym for ‘Customers of the systems’ (C), ‘Actors’ (A), ‘Transformation process’ (T), ‘World view’ (W), ‘Owners’ (O), ‘Environmental constraints’ (E). This tool, using each of the six processes, is applied to the system which contains the problem, issue or solution, rather than to the problem or goal itself.</td>
</tr>
<tr>
<td>Fishbone Diagram (Ishikawa, 1982)</td>
<td>The Fishbone Diagram tool helps to structure the process of identifying possible causes of a problem. It encourages the development of an in depth and objective representation and discourages partial or premature solutions, and shows the relative importance and inter-relationships between different parts of a problem.</td>
</tr>
<tr>
<td>Delphi (Ratcliffe, 2000)</td>
<td>The Delphi technique was developed by the RAND Corporation in the 1950s as a non-analytical, and hence subjective, method for gathering information and making decisions about the future. It is based on soliciting and aggregating individual opinions and judgements from selected experts in the matter investigated or people directly concerned. Its main disadvantage is its high administrative overhead and large output when used to survey and prioritise concerns. When used to address a single, well defined problem, the outcome may be easily summarised.</td>
</tr>
<tr>
<td>Scenario Building (Slaughter, 1996; Ratcliffe, 2000)</td>
<td>A scenario describes a possible state of affairs or development over time. It can be very useful to communicate speculative thoughts about future developments to elicit discussion and feedback, and to stimulate the imagination. Scenario Building helps decision-makers identify and explore a range of potential and alternative opportunities so as to clarify present actions and subsequent consequences, and make company</td>
</tr>
<tr>
<td><strong>Creativity Tools</strong></td>
<td>Description</td>
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<td>---------------------------------------------------------------------------------</td>
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<tr>
<td><strong>Alphabet Brainstorming (Childs, P., 2004; Buehl, 2009)</strong></td>
<td>This technique helps structure brainstorming by asking participants to generate an idea that begins with each letter of the alphabet in turn. Alphabet Brainstorming can be done by an individual or a small group, or as a whole class activity. It provides a good method to help a group to widen their horizons and develop a large range of options to explore.</td>
</tr>
<tr>
<td><strong>TRIZ-Trends of evolution (Gadd, 2011)</strong></td>
<td>The TRIZ (theory of inventive problem solving) Trends of Evolution tool examines previous developments to help users identify the likely next step and development of products, industries and processes and can provide a clear future projection for successful systems.</td>
</tr>
<tr>
<td><strong>TRIZ-contradiction matrix (Gadd, 2011)</strong></td>
<td>The TRIZ- contradiction matrix is a 39 by 39 matrix built by analysing thousands of patents and invention disclosures. Each matrix axis is made up of 39 Technical Parameters, representing the most widely used characteristics of technical systems, which tend to improve or worsen if a compromise solution approach is taken. This tool guides the users to a selection of relevant principles based on previous experience to solve the particular technical contradiction.</td>
</tr>
<tr>
<td><strong>TRIZ-40 Principles (Gadd, 2011)</strong></td>
<td>The TRIZ 40 principles represent the 40 approaches that are consistently identified to resolve technical challenges in previous inventions. The 40 Inventive Principles represent simple solution triggers to prompt ideas to solve particular contradictions. These powerful solutions trigger then need to be turned into practical ideas using relevant technical knowledge to produce practical solutions.</td>
</tr>
<tr>
<td><strong>TRIZ Resources (Gadd, 2011)</strong></td>
<td>The TRIZ Resource tool involves a systematic approach to identifying relevant physical or non-physical resources that provide a means for fulfilling a requirement.</td>
</tr>
<tr>
<td><strong>SCAMPER (Eberle, 1997)</strong></td>
<td>SCAMPER is an acronym for Substitute, Combine, Adapt, Modify, Put to other uses, Eliminate, Reverse. The tool provides an easy to remember series of prompts that can be readily applied in problem solving.</td>
</tr>
<tr>
<td><strong>Vulnerability Analysis (Bertone, 1993)</strong></td>
<td>The technique identifies the pillars which the company is based on and analyses the possible actions to be undertaken in response to the events which might damage the pillars. This tool enables analysis of these pillars.</td>
</tr>
</tbody>
</table>
Application of creativity tools to enhance the design of inherently safer urban infrastructure

<table>
<thead>
<tr>
<th>Tool Name</th>
<th>Description</th>
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<tbody>
<tr>
<td>Casual Mapping (Vicari, 1998)</td>
<td>This tool assists in identifying the cause and effect relations between market natural development and its decisive factors. The decisive factors are not considered as isolated forces but as a set of relations that affect a specific phenomenon in a systemic way. It identifies the whole groups of forces and gives an overview of all interacting causes that hinder or promote development.</td>
</tr>
<tr>
<td>Active Crisis Generation (Vicari, 1998)</td>
<td>Active Crisis Generation allows a company to reach a position of 'creative imbalance'. The aim is the generation of crises, discrepancies as events which are not coherent to the company's expectations, in order to trigger a change process for the survival of the company.</td>
</tr>
<tr>
<td>Super Heros (Mycoted, 2012)</td>
<td>This is a fantasy-based version of Rolestorming similar to other boundary-stretching techniques. Each participant pretends to be a fictional superhero and use their 'super' characteristics to trigger ideas. It is useful for creating an atmosphere of light-hearted fun in which energy is high and fantasy and metaphor are acceptable.</td>
</tr>
<tr>
<td>Context Modifying (Foster &amp; Kaplan, 2001)</td>
<td>This tool uses four different approaches that can be used to explore modifications to the context: Social Context Modifying; Physical Context Modifying; Reversed Thinking; Zoom in – Zoom out.</td>
</tr>
</tbody>
</table>

Table 3: Some example creativity tools

A common characteristic of problem solving is that in trying to improve one desirable parameter or property, another desirable property gets worse. This characteristic of problem solving can be viewed as a trade-off (Ekblom 2011) or contradiction. TRIZ methodology was originally developed to resolve technical contradictions, so the terminology requires some generalisation and interpretation in order to make it accessible to security applications and this will form part of the research activity in this programme. Resolving contradiction in security solutions through design by adaptation and application of the Theory of Inventive Problem Solving (TRIZ) represents a highly promising area for exploration of solution opportunities for criminal events. Some limited suggestions for how to use TRIZ in crime prevention are in Ekblom (2012a). As a first illustration, contradictions in the crime prevention world have several modalities. On the one hand is the ‘intrinsic’ conflict between...
being ‘user-friendly and abuser-unfriendly (Ekblom 1997, 2012a) in terms of favouring the ‘honest guy’ side of script clashes. On the other is the conflict between the policy value of security versus other values such as inclusion or sustainability (Armitage and Monchuk 2009) (for example in practice between security lighting and reduction of energy consumption). As a second illustration, the TRIZ concept of ‘Ideal Final Result’ expressed in functional terms, offers a new take on the tension between traditional solution-oriented approaches to crime control by the police (e.g. send in the burglary squad, run (yet another) ‘lock it or lose it’ publicity campaign) and problem-oriented ones (First identify the crime problem and then design the solution to fit problem, evidence of what works, and context – see Goldstein 1979). An expression in Ideal Final Result terms might be ‘a solution which reduces the risk of burglary whilst not exacerbating fear or inconvenience, jeopardising aesthetics, sustainability and inclusion or requiring disproportionate expenditure.’ Ekblom (2012a) takes the deliberate exploitation of different discourses for prevention further.

The intention of this chapter is to present an idea within the context of the crime prevention design process which will facilitate a choice of appropriate techniques for choosing accurate combination of creativity tools in design against crime at three levels. Usage of suggested creativity tools in a practical way helps a security engineer to tackle crime, and enforces urban structure designer to generate more innovative ideas to deal with resourceful criminals, and ultimately provide guidance on development of design against crime. Implementation of appropriate creativity tools can also simplify a process of innovation and strategically effect the transformation of existing crime prevention methods.

The convenience of using creativity tools in generating new idea is acknowledged by many researchers. Many tools and techniques have been established to support process of creating new concepts in diverse field, but not in the crime prevention domain.

The deficiency of having new idea in crime prevention will affect security of our cities in the future. To discover a reasonable solution for this problem we need to comprehend what is our security threat or how we can confront this problem, and as a final point how we can implement appropriate solution for this issue.

Many creativity tools have been established to help or generate new ideas in design field and some in non-design activities. The main challenge is, what kind of creativity tools are more suitable for generating new idea in order to promote creative idea in crime prevention and sustain the output of good ideas within CCO frame work. Figure 15 illustrates an approach for finding the right creativity tools for generating new idea in crime prevention domain.
The process of choosing a suitable creativity tool requires an understanding of crime as a deeply interconnected subject. Complexities of understanding the crime and reasons behind it, lead this research to use of several mind mapping methods to decode the wicked problems.

By using compendium software, an IBIS mapping method, data can be gathered to validate the possible causes of crime until the true cause is identified. Idea generation techniques, with using appropriate creativity tools, can then be used to identify a solution to remove the true cause and ensure that permanent solution is adequate.

The following creativity tools (Figure 16) suggest and illustrate the first sets of tools which will be examined in an actual crime cases. With this study we will validate and develop more accurate creativity tools for CCO framework, we will also recreate more useful and valuable tools for design against crime in following chapters.
There are many other creativity tools which may be useful in the CCO framework but the tools mentioned represent a suggestion suitable for crime and disorder events.

5.2 Identification of crime trends

In this phase of research crime trends and interconnectivity of crime reasons are explored and identified. The ‘ratchet effect’ in crime and how designers can diminish the crime true mitigation of criminal’s with creative idea are examined. An examination of a crime trends in a bike theft can help security engineer to understand how we can engage creativity tools in design against crime. In the United Kingdom a bicycle is normally taken for one of three reasons highlighted below:

* For the thief’s personal use

* As a temporary means of transportation

* The thief can sell the bicycle or its parts as a source of money

Primarily in this case study bike theft crime is explored with an IBIS mapping diagram and then appropriate creativity tools for generating new ideas to tackle this issue are suggested and applied.
Application of creativity tools to enhance the design of inherently safer urban infrastructure

To recreate a bike theft crime model we need to demonstrate accurate information about this type of crime. For this reason we demonstrate bike crime interconnection effects and side effects with the following IBIS map. This map demonstrates that most crimes are directly or indirectly connected to each other by the attempt to find mental satisfaction or physical need.

In this case to eliminate bike theft we have to investigate a source of crime and directly prevent this crime by illuminating the causes. Map 15 illustrates the causes of interconnection and the ratchet effect of crime.

Map 15: Illustrates the interconnection causes of crime and the ratchet effect
Application of creativity tools to enhance the design of inherently safer urban infrastructure

For examining the causes and consequences of crime and exploring confrontation strategies, engineers have to address the source of the crime problem with several design methods. One of these approaches is to use creativity tools to generate useful ideas which can eliminate the crime from the root.

In this method we will design a crime scenario (such as bike crime theft) with an IBIS map and only then use this map to find actual reasons behind the crimes. After understanding the reasons behind each crime case, we can explore the CCO frame work so we can locate an immediate causal pathway which coincides to cause bike theft events to happen. After careful consideration we found that the most useful creativity tools which will help us to use in design against crime is a limited selection that we suggested, and we can use combination of this tools to generate new idea when possibility of generating new idea is limited. With the help of selected creativity tools we will be able to generate idea to counterpart, intervene or weaken a bike theft.

The outcome of using IBIS map in bike theft case study demonstrates that there are several reasons to commit this crime. The most important one, in the London area, is committed on impulse, out of rage or fear, adrenaline rush when successfully carrying out a bike theft, need for mental satisfaction and finally a need for physical satisfaction (physical relief with using bike money to buy drugs). The current operating police force is not capable to handle imminent crimes with satisfactory percentages. This research proposes an alternative solution so we will be able to tackle a crime with creative design ideas by reshaping urban infrastructure.

The second strategy to eliminate the crime is to engage selected creativity tools for generating new valuable ideas which will offer an engineering solution to block any criminal act by changing their environment. In this method we did consider and accept a reality; it is impossible to totally eliminate all causes of the crime, so engineers have the tendency to physically block criminals by changing urban infrastructure with secure design and protect public property. Map 16 illustrates the IBIS methodology for engaging creativity tools in design against bike theft.
The outcome of bike theft research with IBIS methodology indicates several concerns which should be considered if we want to eliminate bike theft with physical design. The first concern is the design of the bicycle stand. Complicated designs will create fear among bike thieves. Bike stand design should not only embody a fear in thieves but also need to increase theft time too. Particular designs can make it almost impossible for a criminal to steal a bike due to the complex removal process from the stand. The second concern whether a design is economical and affordable for civil implementation. This includes the decision to choose...
strong and affordable materials, production process for the stands and product aesthetics. Figure 17 illustrates three existing bike stand with practical and unpractical design.

Figure 17: Three types of bicycle stand design and their principal differences (Design Against Crime 2008 UAL)

Using TRIZ contradiction matrix led us to design a new bike stand that unlike the leaning type of bike stands this design can save lots of space for urban space. A particular feature is
the adjustability of the hooks, which includes 2 bike mounts (holds max 4 bikes), quick release designed for height adjustment and compatibility with any bike geometry. The padded hooks are able to support bike frames without any damage. Figure 18 illustrate the concept design of space bike stand.

**New design for Anti-theft future bike stand**

![Secure bicycle stand save space for 4 bikes](image)

*Figure 18: Secure space bike stand*

### 5.3 Creativity against crime (survey)

Crime statistics in general are not always accurate. They only reflect some numbers of crime or incidents which really happened in society. The question is how does a crime become statistic? We have to remember that statistics are social constructions which involve social process, negotiations and decision making. For a crime to be recorded by a police officer a full examination of crime area has to be processed by various professionals and an official crime report will be made from all individual subjects involved. Maybe there are many good reasons not to report a crime by victims such as fear of involvement with official procedures or fear that offenders will create bigger problems for victims in their future. Sometimes it can
involve a victim who participated in an illegal activity but now is seeking legal protection from a fear of consequences. Some of the crimes committed in our society never appear in the official recorded crime statistics. The compelling reason behind this survey is overall understanding of actual numbers of crime, their types and the closest crime reality portrait in United Kingdom. With a close result of statistics, we can set the right strategy for design against crime in urban structure. This survey (Creativity against crime (S.Aghdam 2013)) provides a unique opportunity to examine the extent and nature of crime, fear of crime and possible functionality of design against crime in United Kingdom. Another purpose of this survey is to collect information about sources of crime and public approaches towards design against crime. The information is collected by interviewing individuals and filling out survey forms by members of public and police officers. It is important to finding out about crimes they experienced, asking their views about the level of crimes in United Kingdom and how much they trust in design against crime. This will include reports that may not been detailed in home office crime surveys (Home Office survey 2008). With the outcomes of this survey we are able to explain how we can construct relationships between creative idea and design against crime. The objective of this survey is to present research related to the crime and reasons behind increase or decrease of crime in our society, in particular, to investigate what kind of sociological aspects can affect the crime rate in our society. This survey also aims to identify the main reasons behind changing crime rate which need to be addressed and where future research is heading. This survey is different from other attempts because it reviews the most recent literature and presents it according to the theoretical approach to the subject. Thus, it can be useful to academics and policy makers who are interested in understanding how and why design against crime can impact the society. This is a survey conducted by 100 students and members of society. The survey was run as part of the research reported in this thesis. This survey shows that overall 60 percent of people have developed a fear on the subject of crime in large cities like London, while 38 per cent of people had an incident which has taken place in different area of London city. Table 4 below indicates a profile of fear related to crime in the London city.
Application of creativity tools to enhance the design of inherently safer urban infrastructure

<table>
<thead>
<tr>
<th>Gender</th>
<th>Feeling not safe in London</th>
<th>worried about being physically attacked</th>
<th>Trust in police to act in time when they call</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mail</td>
<td>8%</td>
<td>30%</td>
<td>2%</td>
</tr>
<tr>
<td>Female</td>
<td>30%</td>
<td>9%</td>
<td>8%</td>
</tr>
</tbody>
</table>

*Table 4: Proportions of alcohol-related violent incidents (2000 BCS)*

A concern with the current questionnaire was that some respondents may have been personally offended by the explicit questions associated with crime and fear of crime. The result presented here will form a basis which will be used to select the right and useful set of questions, and reflect public fears about crime levels and how we can reduce crime with creative design against crime in the future. Analysis of conducted survey demonstrates that our questionnaire produced higher estimated prevalence rates than home office categories. For example; the proportion of people who had been victims of domestic crime was 23.3 percent higher than other home office crime surveys (dark side of crime).

Citizen’s trust in their government officials is a vital element of a well governed society. Figure 19 reveals that a staggering 56% of our respondents have no trust in our government to eliminate the crime problems. Just 18% believe that government can reduce crime in the coming years, although 26% of our respondents have no idea or at least they don’t want to express their views about this subject at present. Notable changes in public opinion within United Kingdom occurred after the September 7 bombing. The trust in government as a whole significantly decreased. Many had doubts whatever they can handle the protection of their country against crime. Public support for spending tax payer’s money to address issues such as crime redundancy will be greater if the government institutions can regain public trust (homeland security FBI 2006). With implementation of Design Against Crime the government can potentially significantly reduce crime which will rebuild public trust in United Kingdom.
Application of creativity tools to enhance the design of inherently safer urban infrastructure

Faith in government quotes

Figure 19: Level of trust of the government to reduce crime

5.4 Implementation of creativity tools in CCO

The crime rate in large metropolitan cities is expected to increase for many reasons (population and poverty increase) in the future. Urban security engineers have the opportunity to use creativity tools in crime prevention methods to ensure security of citizens. The CCO framework is one of the most effective crime prevention methods which can deter crime and retain security of citizens. The growing rate and type of creative crimes in large metropolitan cities such as London are going to be harder to solve. Complexity of human behaviour in criminal activities also makes the CCO framework on its own too feeble to mitigate the crime. For this reason we believe that using creativity tools in design against crime, in particular in conjunction with the CCO framework, can be an alternative answer to constantly changing threats from criminals. Integrating creativity tools in the CCO framework as part of design against crime is as important as policing in society. In the future the urban infrastructure designer will be faced with massive changes in population rate. The population of big cities will continue to grow along with increasing crime rates. The concept of ‘urban environmental design against crime’ is pushing urban security designers to offer new creative substantive designs and a new management process for minimizing crime impact in principal cities. To tackle crime issues related to growth of population engineers must provide new ideas in urban infrastructure design which will have an ability to change an entire landscape against future crime. Creativity tools, at the heart of design against crime,
Application of creativity tools to enhance the design of inherently safer urban infrastructure

can be used to improve all areas of CCO (11 methods) with constant creative feedback to tackle crime.

Most successful criminals are thinking outside the box which can drive them toward more original dishonesty (Gino & Ariely, 2011). Therefore, working with traditional crime prevention methods alone is no longer effective for solving crime problems created by a new generation of intelligent or intelligent and technology enabled creative criminals. Consequently, we need to tackle this problem by modernizing our existing crime prevention methods with new creative solutions. The main drive of constant creative solutions in the CCO crime prevention method is reliable and suitable creativity tools which will help security engineers to generate new ideas. The effectiveness of choosing the right creativity tools and crime prevention method will depend on the nature and a level of understanding of the crime.

The reasons behind a human failure in criminal activities must be primarily researched and only then we will able to determine the right tools for generating new solutions with in this area. For each specific crime issue we have to locate the route of this failure. The following IBIS map 17 illustrates this strategy.
Use of creativity tools in crime prevention methods not only bringing new constructive ideas, but also can help engineers to fight inventive criminals with their own method.

In map 17 the author demonstrated that capture of crime causes and breakdown of reasons behind any criminal activity can facilitate understanding of the crime. In the next stage of this process then we are able to use creativity tools to generate new idea against this crime.

The survey conducted revealed a strong believes that the implementation of design against crime within our environment will gradually reduce criminal’s activities. Without effective ideas, the implementation of design against crime is not feasible. There is a great need to engage suitable creativity tools which will enable engineers to eliminate the core of a crime. To have an effective idea in crime prevention through environmental design (CPTED), we have to conduct research on human behaviour and reasons behind their failure.
Application of creativity tools to enhance the design of inherently safer urban infrastructure

There has been relatively little effort dedicated to the important task of capturing and articulating decision rationales (or logic models) of preventive action. Knowledge capture and transfer have been limited and in some cases severely criticised (Bullock and Ekblom 2011). This particularly applies to design against crime and to the field of Crime Prevention Through Environmental Design (CPTED) (Ekblom 2012b, 2011b).

CPTED is a design strategy for a few simple changes to existing design areas or a reassessment of plans for new areas. During planning new neighbourhoods, the developers should consider security measures directly into the design process. Taking crime prevention into consideration in infrastructure design can include the provision of strategic lighting, design for areas where offenders may not hide or gain unobserved access to homes.

CPTED is based on the principle that most of the crimes are opportunistic and related to lack of appropriate design in the area. Unintentionally, irritating criminal behaviour can be encouraged by poorly planned and designed space which can lead to actual opportunities for criminal activities as well as increased levels of fear in the neighbourhood. Undoubtedly, innovating in a field where causation is complex and practice and policy constraints may be “wicked” (Rittel and Webber 1973), and demanding for designers. But there are two complementary ways to help ease the burden: supply of better conceptual frameworks for crime prevention; and use of explicit aids to creativity in this area.

The majority of the crimes are committed for personal profit by criminals. Meanwhile the insurance or security companies make their profits according to the level of the crime committed in their society. The possibility of criminal activities can increase the size of the market for security related companies. In the context of design against crime government emphasise crime mitigation by encouraging changes in the design of infrastructure. They need to analyse and regulate other parties (security and insurance companies) as well as mitigating criminal at the same time.

It seems that our target is not only mitigation of crime but also regulation of companies who deal with criminals. Reducing a crime in some area will reduce the market opportunities for some security or insurance companies. For this reason supervision and mitigation of both parties is necessary. By implementing strict monitoring regulations on security and insurance companies within the areas of obtaining licences, qualifications of individual employees and
equipment, government will be able to control and monitor this enterprises as well as criminal activities.

5.4.1 Bringing together Crime Science frameworks and Creativity Tools

We have seen there is some in-principle fit between the requirements of creativity tools and the structured domain knowledge represented by CCO and the other crime frameworks. How might we further bring them together? Creativity tools can be categorised as several types such as Randomization, Focusing technique, Systems, Pointed techniques, indicated, Evolutionary directed techniques and Evolutionary directed techniques. Experience in applying creativity tools across diverse applications has been considered in the selection and allocation of particular ones to the CCO framework. This will be illustrated in the next Chapter 6.

The use of decision rationale in mixture with appropriate creativity tools within the advanced crime science frameworks described promises a powerful methodology. Mapping provides the threefold benefits of a permanent record, the facility to consider pros and cons and data, and implied or actual rationale for decisions. By using diverse creativity tools to assist in the generation of ideas, whether domain changing or just potentially valuable iterative improvements, the quantity of ideas and quality will, on past experience, be improved. By making use of previous experience in the filtering of creativity tools the user is guided towards a subset within the large number available. The crime science theory encapsulated within CCO and the other frameworks, and the ‘what works, where’ knowledge which can be organised and retrieved with CCO, should further help generate ideas with initial plausibility. The theory and knowledge applied during the process of articulation and reflection of rationale should help appraise and filter candidate solutions as these emerge and are subjected to iterative trialling, feedback and improvement or rejection. The advanced crime science frameworks provide effective means for mapping the crime and disorder event landscape, and thereby should aid the team or individual to ‘free’ their minds from an otherwise overwhelming set of information. In this way working or short term memory may be more effectively applied to the consideration and development of ideas and solutions. A section of an IBIS map illustrating crime and disorder issues, ideas, and relevant
creativity tools is presented in Map 18. This focuses on drawing out the possibilities of intervention to tackle crime promoters contributing to a generic crime problem. While the example is necessarily limited, real-world IBIS maps can be large especially for live projects involving a few or more people within a team working on a project for several days. The blue network symbol in Map 18 indicates a link to another map plane containing further information. A variety of software packages are readily available with open source examples including design VUE and Compendium.

Here in Map 18 author
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Rationale notations have also emerged specifically within crime prevention. They can perhaps meet the design and engineering-sourced ones half-way. The experience of collaboration between crime scientists and designers on several design projects inspired the Security Function Framework (Ekblom 2012b). This describes the design of a product in four discourses:

- Purpose (what is the product for, and what/whose other requirements must it meet?)
- Niche (how does the product relate to other products/procedures in the ecology of security?)
- Mechanism (how does it work, i.e. exert its preventive effect?)
- Technicality (how is it constructed, of what materials, and how does it operate?)

The Mechanism level of SFF draws on CCO, scripts and script clashes. SFF has so far been used for example to characterise already-created clips for securing customers’ bags to tables in bars (Ekblom et al. 2012) and the litter bins already described (Lulham et al. 2012); and an advance specification for explosion-resistant railway carriages (Meyer and Ekblom 2011). Figure 20 illustrate clips for securing customers bags to tables in bars and explosion-resistant railway carriages.

Figure 20: illustrates a secure design for securing customers bags to tables in bars and explosion-resistant railway carriages
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Finding appropriate solution for security issues are difficult process which is in need of several stages. Table 5 demonstrates final stage of recognising issues and finding some security solution in real case studies.

<table>
<thead>
<tr>
<th>Security issues</th>
<th>Contradictions</th>
<th>TRIZ recommended principals numbers</th>
<th>TRIZ solution proposals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bank security and use of bullet resistant Baffle system</td>
<td>Banks need secure glass wall between cashier and customer and customer don’t like it</td>
<td>15,8,29,34</td>
<td>Use of mechanical displacement method, Remove source of issue</td>
</tr>
<tr>
<td>Airport security and monitoring passengers belonging and on time security alert</td>
<td>Human monitoring is not sufficient for monitoring lots of passenger at the same time and threat is non-stop</td>
<td>30,16</td>
<td>Use of electronic alert -- increasing of the trained security officers – decreasing of the passengers numbers</td>
</tr>
<tr>
<td>Border security and monitoring of intruders at short period of time</td>
<td>Human monitoring is not sufficient for monitoring large area and people in short time</td>
<td>15,17,4</td>
<td>Use of electronic alert -- increasing of the trained security officers—use of deterrent methods</td>
</tr>
<tr>
<td>Home office need to identify citizens</td>
<td>Home office want to identify citizens But citizens don’t want this</td>
<td>10,34</td>
<td>Use of electronic methods – make people to ask voluntarily for identification</td>
</tr>
</tbody>
</table>

*Table 5: TRIZ creativity tool with solutions in crime prevention domain*
5.5 Crime Prevention Through Environmental Design (CPTED) projects.

One of the most important aspects of CCO framework is the environmental aspect. Blocking of criminal activities is one of the main methods that environmentally affect rate of the crime. There is a huge potential for use of explicit aids to creativity in this area. Generating new creative ideas against accessibility of criminals to important public areas such as banks, transport hubs and others are extremely important for the general public.

Financial institutions particularly banks are one of the most vulnerable areas among public facilities. The importance of design against criminal activities drives security engineers to come up with new ideas which will help to protect security of public and banks. Design for physical blockage of thieves is most effective design in this area. Figure 21 illustrates physical blockage of thieves with a bullet resistant baffle system which has been an established technique since 1990.

To create a secure, functional interface between staff and customers at the counter level, engineers must develop an actual barrier which has capability of protecting the bank staff.

The advantage of bulletproof glass protection, as a creative idea, in the banking security sector is a system producing easy communication between customers and staff and at the same time establishing a subtle deterrent to thieves. Therefore, with this system, there is no direct contact between customer and staff.

![Vertical bullet resistant Baffle System](image)

*Figure 21: Bank’s vertical bullet resistant Baffle system (secure industries 2013)*
One disadvantage of the current is system is the lack of clear communication and trust between clients and the bank’s employee. Customers are looking for better service and more close communication with bank staff without any interference; bulletproof glass protection can prevent free communication. Figure 22 demonstrates people’s frustration as an amusing cartoon, when it comes to communication issues with bank cashier (The Telegraph April, 2013). Every year bank’s expenditures become higher even without the true knowledge of actual security needs or implications.

*Figure 22: People’s frustration in communication with bank cashier (The Telegraph April 2013)*

The banking sector needs to change their protection methods with new ideas, to better their service and public relations. Physical blockage of criminals can be interpreted in different ways. A good design should represent various possibilities how to remove the source of a problem. Generally the highest issue for a bank is the storage facility of money, near the counter or next to a staff member. By implementing a creativity tool application we can generate several ideas for this sector which will possibly eliminate the problem of theft and fraud without interference to bank’s services. Map 19 illustrates IBIS map for bank security issues.
The research on bank robberies in United Kingdom reveals that most offenders aim for cash placed next to bank cashier because it is a quick and easy assault. The usage of the IBIS map and TRIZ contradiction matrix tell us a best mitigation method for this problem is removal of the existing cash storage facilities at the counter. Automated pneumatic tube cash distribution system could be an alternative to currently used arrangement. In this system the cylindrical containers are propelled through a network of tubes by compressed air or by partial vacuum. They could be used for transporting currency from a bank’s teller to a safe vault under the bank’s construction or the other way around. A cashier operating a computerised system at counter will deduct or add cash to the vault placed underground via pneumatic tubes. Therefore thieves or bank robbers will not have access to the cashier’s money at the counter and consequently the attempt for bank robbery will be prevented. Figure 23 illustrates a design for automated pneumatic tube cash distribution system.
Another problematic area in banking sector is cash recycling ATM systems and ID fraud. According to the Financial Fraud action losses to United Kingdom card holders totalled £388 million in 2012 which showed 14% increase from total fraud losses of £341 million in 2011. Conducted research reveals that crime rise in 2012 was mostly driven by rough scams designed to bypass security systems which resulted in duping consumers into handing over their own cards and PIN numbers. Sharp increase of card forgery in telephone banking and lack of card holder proper identification is one of the main reasons behind increase of loss in banking sector. Figure 24 demonstrates the loss to banks and merchants during years 2004 to 2012.
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Figure 24: illustrate losses of the bank and merchants in UK 2012 (Steven J. Murdoch)

The overall fraud losses in 2012 are £475.3 million; up 11% since 2011 but for the purpose of comparison it is helpful to exclude losses from phone banking since these figures were only available after 2009 (and are only 2.7% of the total). One of the most common aspects of all digital fraud, such as phone banking fraud, internet shopping and Personal ID fraud, is to recognise the true owner of the presented ID.

To partially address this issue the banking sector or government can use a new generation of palm vein scanners for ATM machine connected to central data identification centre governed by legal institution.

5.6 Palm vein authentication, a creative solution for ID authentication

Palm vein authentication uses the vascular patterns of an individual’s palm as personal identification data. Compared with another biometric scan, a palm has a broader and more complicated vascular pattern and thus contains a wealth of differentiating features for personal identification. The palm is an ideal part of the body for this technology; it normally does not have hair which can be an obstacle for photographing the blood vessel pattern, and it is less susceptible to a change in skin colour, unlike a finger or the back of a hand.
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When the infrared image is captured, only the blood vessel pattern is visible as a series of dark lines Figure 25. Based on this feature, the vein authentication device translates the black lines of the infrared ray image as the blood vessel pattern of the palm Figure 26, and then matches it with the previously registered blood vessel pattern of the individual (Watanabe, M., Endoh, 2005).

![Palm vein scan base technology and scan probe sensor](image)

*Figure 25: Palm vein scan base technology and scan probe sensor (Watanabe, M., Endoh, 2005).*

5.6.1 Implementation of contactless palm vein authentication

Implementation of a contactless identification system enables applications in public places or in environments where hygiene standards are required, such as medical applications. In addition a sufficient consideration was given to individuals who are reluctant to come into direct contact with publicly used devices.

Legal institutions are being urged to take a greater role in preventing fraud. To improve security measures a demand for accurate biometric authentication methods was created; to mitigate forgery cases in United Kingdom by involving dozens of financial or legal institutions which has cost hundreds of millions of pounds. To protect the user’s privacy and personal information the registered biometric information should be stored in a central data identification centre. Users could access their accounts by comparing a scan of their palm to a pre-registered scan stored in a central data identification centre governed by legal institution. This system can reduce growing cases of bank card thefts and fraudulent financial transactions. The data generated by this technology can be used in several applications such as monitoring identification of citizens claiming on benefits or for various identification applications governed by legal institutions such as the Home Office. Figure 36 illustrate the palm vein scanner used in ATM systems and office access controls.
Fraud in telephone banking is another massive challenge many organizations face. To eliminate phone banking fraud we can use IBIS map breakdown analysis and the TRIZ contradiction matrix. Our existing ATM facilities can address this issue without introducing new ideas. Map 20 illustrates the IBIS breakdown analysis for guaranty ID data collection method and data’s theft possibility risks.

In this method financial institutions will implement new arrangements that every account holder should have a biometric palm vein scan before opening an account. New generation of ATM machines will also match or get the new biometric scan of customers as well as banks. All collected data will be immediately sent and saved in the national database governed by legal institution. The rest of data collected by governmental organisation will be sent to the same database governed by legal institution directly connected with the government.
Any formal governmental organisation will be able to identify individuals with a verification process true a data centre. Individuals, who will need to be verified by any official organisation could use palm vein scanner located in governmental offices or any ATM machine connected to central data verification.

Verification of personal ID true ATM machine will be required if any suspicious transaction has been made. The person who needs to be verified will type the given code by verification authority in any close ATM machine connected to central data and then will scan his/her palm immediately. This will verify either the user or targeted person as the account owner or as a fraudulent individual.
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Monitoring of people in public is another important area of interest in urban infrastructure security. In recent years the UK government has reduced police funding greatly. People remain convinced that there were fewer visible police officers on the streets deterring criminals. Police Authorities frequently voiced their concerns about the Total Standard Spending (TSS) figures produced by Home Office claiming that it does not cover increasing costs but UK Government insisted that police funds are rising (Treasury, CSR - October 2010). Cuts to police funding announced in the October 2010 Spending Review as part of the Government's programme to tackle the huge deficit also attracted considerable controversy. Funding is set to reduce by 20 per cent in real terms by 2014/15. Using TRIZ contradiction matrix and IBIS map analysis reveals that we can overcome lack of police officers by introducing electronic representation of police. Digital representation of the police force in districts with high crime rate will both prevent and reduce future assaults and risk of loss among civil and police forces.

Currently most large cities in United Kingdom have districts with high crime rates where assault and knife attack take place. With creative environmental design engineers are physically able to remove problematic areas with in urban environment, such as dark corners in train and underground stations which are not sufficiently protected. This implementation can be established by placing sensor lighting, audio and visual monitoring devices such as IP intercom. Installation and maintenance of IP CCTV cameras along city thorough fares can be costly. Depending upon the needs of police force, IP microphones can be useful replacements for IP cameras. Audio recording can make a tremendous difference for legal departments when evidence is needed in court. Quick responses of police department will save costs that might occur during any incident.

A network of sensitive IP microphones connected with existing Wi-Fi facilities in a city and automated voice recognition central spread through districts with a high crime rate can be an effective way to despatch a police patrol even without a call to emergency response. The system will automatically indicate the precise address (location) of an incident for the police officers to deal with (microphone was triggered due an alarming noise or several key words such as help). The main control centre will send the GPS co-ordination data of the threat area to the police patrol from closest station. Figure 27 illustrate schematic picture of future London security system design run by an IP network.
Chapter 6. Application of mapping and decision rationale with CCO

Mapping of the decision rationale provides enriched information which is beneficial in two ways. It enhances system development by improved decision making through provocation of alternatives and defined consideration of issues; and it can radically enhance the effectiveness of co-creativity among collaborators/partners, which is especially useful in crime prevention. It can also facilitate knowledge transfer to new problems and contexts.

In practice, the mapping of decision making involves the recording of influences and factors relating to an evolving decision, usually in the form of visual maps. The Issue Based Information Systems (IBIS) concept was originally developed by Rittel (Kunz and Rittel 1970) to address wicked problems and is now embodied in software developed for aerospace, civil and healthcare (Aurisicchio et al. (2009, 2010)). It is a graphical method using a network of nodes and connecting arcs to capture not just decision rationale but also the rationale involved in problem diagnosis and requirement capture and deliberation (in this it has obvious links with process models of prevention).
In the IBIS logic mapping an issue is generally captured in the form of a question. Each description can be enriched using the File node to capture graphical data such as sketches, graphs, photographs and written notes. Depending on the design expertise available an extra level of sophistication can be applied in the description of the design solution.

Use of associated file information of IBIS provides a defined record for decision making; besides improving and enhancing system development, IBIS provides a rich source of information for data mining. To illustrate the application of decision rationale we can use the issue of tackling threats when hackers or criminals cause radio frequency identification (RFID) tags to behave in unexpected ways. These can be exploited to enable unauthorized people to snoop on others, stealthily collecting data on them without their explicit approval or even knowledge. A duplicated Oyster card (for touch-free and repeated travel on London transport facilities), for example, in the hands of unauthorised persons can reveal and monitor all of the authorised owner's travel history. This could be abused by criminals to identify whether the user is going to be at a particular address or when they are out of contact, therefore offering an opportune time for account access. The IBIS approach can be applied to capture text, graphics and data in three phases: preparation; capture; deliverables, as indicated in Table 6. The application of IBIS mapping to RFID spoofing is illustrated in Map 21.
Map 2.1: Exploration of RFID hacking

1. By chance observation of RFID signals and removing the tag
2. By hacking the mainframe

Hackers are able to:
- Duplicate and manipulate RFID tags

Questions:
- Are we able to monitor the signals?
- Are we able to control the mainframe?

How?

Protection of tags by using different methods, such as physical barriers, and anti-spoofing technology

Digital barriers are able to protect RFID security

Prevention of sending signals to anti-spoofing RFID tag

Hacking software

RFID hacking software

Exploration of RFID hacking

Future hacking without an authorized user?
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<table>
<thead>
<tr>
<th>Phase</th>
<th>Outline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparation</td>
<td>IBIS mapping can be implemented in two steps as follows</td>
</tr>
<tr>
<td></td>
<td>1- Goals: prevent hackers from RFID data hacking.</td>
</tr>
<tr>
<td></td>
<td>2- Segmentation: Breaking down the process of unauthorized person.</td>
</tr>
<tr>
<td>Capture</td>
<td>The capture phase can be implemented in three steps:</td>
</tr>
<tr>
<td></td>
<td>1- Processing: recognize the interconnectivity of RFID hacking process.</td>
</tr>
<tr>
<td></td>
<td>2- Forecast of all kinds of RFID hacking possibility.</td>
</tr>
<tr>
<td></td>
<td>3- Prioritize of capturing data in mapping rationale.</td>
</tr>
<tr>
<td>Deliverables</td>
<td>Implementation of the solution suggested as a result of the rationale process.</td>
</tr>
</tbody>
</table>

*Table 6: Preparation, capture and deliverables phases in the implementation of an IBIS approach*

6.1 CCO, Scripts and 5Is: Frameworks for facilitating creative crime prevention

The main conceptual framework advocated here for facilitating creativity and innovation is the Conjunction of Criminal Opportunity (CCO) (Ekblom 2010, 2011a). This brings together the whole range of immediate causes of criminal events, and likewise the counterpart preventive interventions, intended to block, weaken or divert those causes.

As described by CCO, a criminal event occurs when:

- There is a predisposed and ready offender
- There is a perception of an acceptable risk of harm, effort, reward
- An individual or individuals who is/are predisposed are properly-equipped with tools and perpetrator technique
- A predisposed individual encounters a valuable and insecure target
- There is an absence of people who can act as ready, willing and able preventers (e.g. guardians, place managers or handlers)
- In the presence of people who can act as crime promoters (e.g. careless sales staff, delivery person who leaves back door unlocked)
- In an environment whose properties favour offender over preventer
- That perhaps features an enclosure e.g. a building or compound

CCO causes are shown in Figure 28. The corresponding agents and (inanimate) entities of CCO are defined in Table 7.

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Figure 28: Conjunction of criminal opportunity (CCO) (Ekblom, P.2008)
### Agents

The Offender can be characterised as people with potential criminal activities or people with criminal background. Crime Promoters are people who, Make crime more likely, by unwittingly, carelessly or deliberately happen.

- Shaping the situation or influencing the offender (supplying weapons, tools or information, inducing the offender’s cooperation by illegal threat or reward, promising to buy stolen goods, promising to look away (corruption)
- Intervening during the criminal event (giving encouragement, distracting the victim or preventers)
- Reacting after it (helping dispose of stolen goods and weapons, providing an alibi etc)  

Crime Preventers as positive agent are people who make criminal events less likely happens, by their:

- Early /developmental intervention - tackling risk and protective factors
- Avoid conflicts
- Exercise self-control
- De-escalate fights
- Earn a legitimate living and achieve esteem and social inclusion

( Ekblome.P2008)

### Entities

Entities are the ‘things’ in crime situations.

The Target of crime may be a person or object that is inherently: vulnerable, valuable and accessible

The target can be: safes, locked rooms or gated compounds or vulnerable people’s property.

Enclosures are situated in turn in a Wider Environment. This could be, Housing estates, town centres, transport interchanges. This areas can encourage crime because they are: Logistically/ tactically favourable for the offender and for crime promoters, unfavourable for crime preventers

- Concealment/surveillance (sight / sound)
- Rationale for legitimately being present – ‘cover’
- Escape/pursuit
- Presence of promoters offering support/ turning blind eye

( Ekblome.P2008)

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**Table 7: Agents and entities of the Conjunction of Criminal Opportunity (developed from Ekblom, P.2008)**
CCO is intended to assist users by providing a model for a highly complex and diverse set of potential crime situations through a relatively limited list of attributes which capture all the essential SCP theories and more on the offender side, but which are integrated in a single formulation. With this ‘one-stop-shop’ it thereby frees the working memory of users for consideration of potential solutions. Admittedly, the three causes of the Problem Analysis Triangle are replaced by 11 CCO equivalents. But providing a standard, integrated, terminologically consistent and rigorous format is claimed to help practitioners consider all causal factors and preventive options systematically. CCO moreover offers a universal and moderately detailed ‘mechanism map’ of the immediate causal preconditions that must come together for a criminal event to occur. The mechanism perspective enables CCO to centre on analytic and generative causal and contextual factors rather than simply being a superficial listing of causes and a ‘natural history’ of preventive methods.

In the 5Is approach, CCO is mainly applied under Intelligence (specifically, the Causes subheading) and Intervention (interrupting, weakening or diverting those causes). But beyond describing the principles and methods of the intervention, there is much more practical detail that needs to be addressed in selecting, replicating or designing innovative preventive action. CCO and 5Is together can potentially contribute to a rich decision rationale, as outlined in the next section.

Creativity tools can help develop the number of ideas and if a process of convergence and divergence is followed as in the creative problem-solving process (CPS), they will involve evaluation, embodying and refinement of the ideas considered as a means to improve quality (Isaksen and de Schryver (2000)). Creativity tools may be of significant value in enabling the design space to be explored systematically and for developing the details for each step of the idea in order to overcome challenges and issues inherent in idea realisation. This systematic exploration fits well with the comprehensive mapping out of crime causes and preventive interventions within CCO, the ability to envisage dynamics and contradictions of scripts and script clashes and the attention to practical detail of implementation in 5Is.
6.2 Use of creativity tools against crime example

The implementing of idea generation methods in design against crime is a complicated technique which it is necessary to be developed as a chronological method. The real scope of using creativity tools to find security threat is still widely unknown in the UK, in particular with regard to systematic threat finding and systems dedicated to the control of public spaces. To explain this research, an example is given of a case study which is based on several idea generation methods to find a common security problem in most transport hubs. The target in this case study is addressing the failure of the passenger monitoring system with CCTV at Heathrow airport. With the combination of Risk analysis, IBIS and idea generation methods as a process, solutions for failure of the passenger monitoring system in Heathrow airport demonstrated in figure 29.

![Figure 29: Illustrates stages of idea generation method.](image)

The first step in this process is a risk assessment of CCTV system of our target transport hub, which is located all along this airport and consider as one of most important monitoring system that functioning for security of passengers and staff. There is no single method of risk assessment that covers all types of threats in Heathrow airport. Risk assessment for public monitoring system (integrated with CCTV system) of Heathrow airport combines two main factors for consideration as a follows.

1- Liability threat including fault in CCTV system networks of the airport.
2- The human threat including failure of operational officers in CCTV control room.

It can be assumed that most important threat emanates from human factors comprising from passengers and airport staff.
Risk analysis of public monitoring system (integrated with CCTV system):

The first step in developing risk analysis of the passenger monitoring system in the Heathrow airport was constructing a conceptual model based on standard security risk analysis terminology. The aim was to use the most intuitive and common interpretations. Figure 30 illustrates risk analysis of failure of the passenger monitoring system in CCTV of Heathrow airport.

![Diagram of risk analysis](image)

*Figure 30: Demonstration of public monitoring system risk analysis (Ida Hogganvik and Ketil Stølen)*

Complexity of research related to the use of creativity tools in idea generation against failure of the passenger monitoring system, lead the author to decrease the scope of this example only to digital monitoring and work on a new idea for issues in this area.
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There are several important aspects in digital public monitoring need to be addressed. For instance why public monitoring is necessary, who are our targets and subjects of our investigation, what is our perimeter and area of monitoring and finally what is our limitation in public behaviour monitoring.

Investigation of the above questions demonstrate that for security of customers and staff in any public transport hub, we need to have a record of all events including incidents which will be time encapsulated as a digital video and a sound recording. These records can be used for future investigation and online control of public affairs. The area of CCTV digital recording varies according to policy of transport hub managements. It can be defined according to the threat for public and staff.

To start this process we need to identify most possible security threats which can be defined in two ways. The first way is to research about past criminal activities which was occurring. The second way of finding security threats is to find out unrecognised security threat which can happen in the future and we need to find them with risk analysis boosted with creativity tools for finding new threats.

A risk analysis conducted with a specific model will be a gateway to understanding security vulnerabilities in the existing public monitoring system at the Heathrow airport.

Using creativity tools in boosting risk analysis can facilitate the speed of threat recognition. In this example map 22 illustrates that there are many hidden possible threats which can occur if the CCTV public monitoring system will not operate properly.

For example if a CCTV control room officer cannot recognise an imminent terrorist activity then the consequence of his neglect can have a catastrophic outcome for customers and staff in Heathrow airport.
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Lateral thinking: Solutions are proposed by looking at a problem using random associations, provocation, challenging current solutions and divergence. Requires both curiosity and confidence and encourages a wide range of alternative solutions. Build evaluation of ideas is necessary to identify worthwhile concepts to develop.

TRIZ: Provides a framework and toolset for systematic, inventive problem solving but is sometimes viewed as complicated and difficult to use; this can be overcome by sustained use and practice.

Map 22: Illustration of hidden digital threats come from human factors
In this case study author found three main risks which constantly threaten Heathrow airport and they are noted as follows.

- Unauthorised access to classified areas in the airport
- Unauthorised removal, displacement of properties and tools by staff, thefts and terrorists
- Passengers and staff anti-social behaviour and suspicious passengers

To accurately identify the trouble and the mechanism of generating deterrent solutions for proposed threats, a consistent and comprehensive crime prevention framework is needed.

For this reason the various interventions that have been measured in the CCO framework crime prevention has been picked out. Matching up of the threats within a model of 11 CCO framework counterparts can categorize the broadest scope of criminal action that comes inside the definition of crime prevention.

With the categorization of defined threats in the CCO framework, the author can effectively transfer knowledge and the principles which can support the broad reach of prevention strategies. These strategies will be brought forth and re-evaluated by process of specific creativity tools application.

Map 23 illustrates matching up of threats with one of 11 branches of CCO framework, and the process of generating prevention strategies.
Map 23: Illustration of matching up defined threats with one of 11 CCO framework’s counterpart

The operation of finding suitable prevention strategies to use of creativity tools begin with recognition of the type of threat and understanding of the role of the correct type of creative instruments for generating novel ideas to determining threat.

In this example author intend to use TRIZ contradiction matrix for generating new ideas against (monitoring passenger and staff anti-social behaviour and suspicious items) as the nature of this threat related to a technical and mechanical resolution.

Map 24 illustrates the use of the IBIS mapping technique to choose the right type of creative solution and counterpart.
Map 24: illustrate the use of IBIS mind mapping technique to choose the right type of creativity tools.

Role of the IBIS mapping technique for finding appropriate creativity tools will be beneficial here.

To solve the issue of tracking individual along the airport, the author introduces the TRIZ contradiction matrix theory for categorizing solutions based on this methodology.

Use of the TRIZ contradiction matrix here provides a variety of solutions to tackle the problem of monitoring and tracking of individuals along the airport. Monitoring passenger flow can deliver the data needed for understanding passenger behaviour and their flow through the airport.
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The TRIZ contradiction matrix provides an engineering solution for this case study, which involves techniques for solving mechanical issue that existing CCTV systems can not able to endure.

In this case the author is breaking down the problem of CCTV scheme to track individuals along airport into functions and identifies worsening and improving parameters based on 39 TRIZ Parameters.

And so, using the contradiction matrix, identify among the 40 Inventive principles demonstrate how to solve this trouble. Here base on this principle author found principles [3] [19] [35] [5] which have to be considered and developed for generating novel thoughts in automated video passengers tracking systems.

**Principles**

35. Change of physical and chemical parameters 11.61%

28. Mechanical principle replacement 8.57%

10. Prior action 7.32%

3. Local quality 6.79%

13. Other way round 6.66%

19. Periodic action 5.71%

15. Dynamicity 4.46%

6. Universality 4.11%

2. Taking away
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29. Pneumatic and hydraulic structures 4.11%

27. Cheap short-life instead of costly long-life 3.75%

34. Rejecting and regeneration of parts 3.57%

4. Asymmetry 3.39%

8. Anti-weight 3.21%

26. Use of copies (copying) 3.04%

18. Mechanical vibration 1.96%

22. Turn the harm to one’s good 1.79%

32. Changing color 1.62%

33. Homogeneity 1.43%

9. Prior counteraction 1.43%

21. Skip 1.43%

1. Segmentation 1.25%

5. Combining 1.25%

14. Spheroidality 1.25%

38. Strong oxiders (strong oxidents) 1.25%
Application of creativity tools to enhance the design of inherently safer urban infrastructure

11. Beforehand cushioning
   1.07%

16. Partial or excessive action
   1.07%

20. Useful action continuity
   0.71%

25. Self-service
   0.71%

30. Flexible shells and thin films
   0.71%

39. Inert atmosphere
   0.71%

36. Phase transitions
   0.71%

31. Le materiau poreux
   0.54%

40. Composites
   0.54%

23. Feedback
   0.18%

12. Equipotentiality
   0.18%

24. Intermediary
   0.18%

*Figure 31: Illustration of 39 TRIZ Parameters (Time to innovate)*

Rendering of proposed parameters demonstrates as the observing table.
| Parameter [3] | Change an object's structure from uniform to non-uniform, change an external environment (or external influence) from uniform to non-uniform.  
- Use a temperature, density, or pressure gradient instead of constant temperature, density or pressure.  

Make each part of an object function in conditions most suitable for its operation.  
- Lunch box with special compartments for hot and cold solid foods and for liquids.  

Make each part of an object fulfil a different and useful function.  
- Pencil with eraser  
- Hammer with nail puller  
- Multi-function tool that scales fish, acts as a pliers, a wire stripper, a flat-blade screwdriver, a Phillips screwdriver, manicure set, etc. |
|---|---|
| Principle [19] | Instead of continuous action, use periodic or pulsating actions.  
- Hitting something repeatedly with a hammer  
- Replace a continuous siren with a pulsed sound.  

If an action is already periodic, change the periodic magnitude or frequency.  
- Use Frequency Modulation to convey information, instead of |
Morse code.

- Replace a continuous siren with sound that changes amplitude and frequency.

**Use pauses between impulses to perform a different action.**

- In cardio-pulmonary respiration (CPR) breathe after every 5 chest compressions.

<table>
<thead>
<tr>
<th>Principle [35]</th>
<th>Change an object's physical state (e.g. to a gas, liquid, or solid.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter changes:</td>
<td>- Freeze the liquid centers of filled candies, then dip in melted chocolate, instead of handling the messy, gooey, hot liquid.</td>
</tr>
<tr>
<td></td>
<td>- Transport oxygen or nitrogen or petroleum gas as a liquid, instead of a gas, to reduce volume.</td>
</tr>
</tbody>
</table>

**Change the concentration or consistency.**

- Liquid hand soap is concentrated and more viscous than bar soap at the point of use, making it easier to dispense in the correct amount and more sanitary when shared by several people.

**Change the degree of flexibility.**

- Use adjustable dampers to reduce the noise of parts falling into a container by restricting the motion of the walls of the container.
- Vulcanize rubber to change its flexibility and durability.

**Change the temperature.**

- Raise the temperature above the Curie point to change a ferromagnetic substance to a paramagnetic substance.
- Raise the temperature of food to cook it. (Changes taste, aroma, texture, chemical properties, etc.)
- Lower the temperature of medical specimens to preserve them for
**Application of creativity tools to enhance the design of inherently safer urban infrastructure**

| Principle [5] | Bring closer together (or merge) identical or similar objects, assemble identical or similar parts to perform parallel operations.  
- Personal computers in a network  
- Thousands of microprocessors in a parallel processor computer  
- Vanes in a ventilation system  
- Electronic chips mounted on both sides of a circuit board or subassembly  
  
  Make operations contiguous or parallel; bring them together in time.  
- Link slats together in Venetian or vertical blinds.  
- Medical diagnostic instruments that analyse multiple blood parameters simultaneously  
- Mulching lawnmower |

| Table 8: outcome of TRIZ contradiction matrix principles (Solid creativity) |

The effect of TRIZ contradiction matrix principles lets the author to propose a novel idea for CCTV engaged with the passenger monitoring system.

Analysis of threats with TRIZ contradiction matrix, provide some principles which can serve to identify new idea for mitigating this threat.

Use of IP rail base CCTV camera along airport can potentially mitigate crowd flow control monitoring problem. An internet protocol (IP) camera is mounted upon a rail to allow movement thereupon under receipt of control signals conveyed over the internet. A remote user is able to cause the camera to move along the rail to a desired position and may view the images captured by the camera. The camera is intended for security and tracking applications in various assumptions such as airports, offices, corridors, etc. This estimate can help security officers to monitor passengers and staff all along Heathrow airport.

Proposed idea can be the perfect solution for larger space such as airport and parking lots.
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Since it enables dynamic tracking of every security situation, particularly in spaces where people and objects move constantly and fix camera solution cannot provide efficient results.

This type of IP rail based system can offer a larger range of functionality in public monitoring.

Figure 32 illustrate the use of rail based IP camera and functionality of this system.

Figure 32: Illustrate use of rail based IP camera and coverage directions (Wikimedia T5).
Chapter 7. Conclusion

7.1 Summary of objectives and achievements

This research was focused on developing an enhanced method of using creativity tools within the CCO framework for crime prevention. The need for robust new ideas that are sufficiently developed and implemented in security of citizens is critical in the future. With the help of specific creativity tools for design and delivery of a comprehensive response to a crime problem, we can address and mitigate many types of crime and disorder.

New ideas and methods of mitigation against crime will change some infrastructure to a safer and securer condition. This need is also vital for our future growth. Application of creativity tools to enhance the design of inherently safer urban infrastructure can be an alternative approach to solve security design issues. In this research some new methods of thinking, modelling and finding tactical solutions to tackle crime and social disorder have been implemented.

7.2 Use of creativity tools in crime prevention and suggestions

This thesis has described a framework for the application of creativity tools for design against crime.

- Crime prevention needs a significant creative and innovative capacity to keep up with diversity of contexts, changing conditions and adaptive offenders.
- A wide range of creativity tools have been developed to generate variety of solutions, with the effectiveness of some of them indicated by a considerable evidence base.
- In order to develop a solution, evaluation and articulation of ideas generated is critical. Decision rationale processes using visual mapping as an aid are available and have been validated in diverse practical contexts.
- These tools must be combined with crime prevention domain knowledge to generate and test solutions that are theoretically and empirically plausible.
- While there are limits to the effectiveness of traditional crime science frameworks in stimulating and channelling innovation, the more advanced counterparts such as CCO offer a greater prospect.
The use of decision rationale in combination with creativity tools within the CCO and other advanced frameworks represents a powerful and sophisticated methodology that appears to have the potential to develop new insights and solutions.

Our experience with designers is that many of them are romantics in the sense of favouring the intuitive over the rational, analytical, calculating approach. We suspect some crime prevention practitioners are similarly-aligned.

In fact, many designers make a virtue of this. Lulham et al. (2012) argue that crime science frameworks serve only to describe existing designs and cannot be used prospectively to facilitate creative generation of ideas, or more radically to reframe problems rather than uncritically and unimaginatively follow the letter of the original brief. More general concerns exist about stifling creativity, not stimulating it. This is open to challenge. Coping with constraints of one or other kind is at the heart of creativity and innovation, be it the constraints the laws of physics, the situational causes of human interaction or generic intervention principles known to work or not to work.

Whether the tools will provoke ‘big C’ game-changing creative concepts rather than tweaked ‘little c’ improvements is an open question. Game-changers will more likely arise from sustained effort, an environment that encourages and permits risk taking and a deep, perhaps intuitive appreciation of theoretical processes of causation of crime and preventive intervention. What is uncertain at this stage is whether CCO and related crime science frameworks can supply that intuitive appreciation, embedding in the practitioner’s mind as a fundamental mental schema which implicitly comes to shape how they think, or whether the frameworks must remain ‘on the surface’ to be used with explicit effort alongside equally explicit creativity tools.

Ultimately, it is an empirical matter whether the frameworks and tools can generate more, and more plausible, preventive ideas in principle; and how to make this process work in practice. We now anticipate a phase of practical trialling and development of the creativity tools and crime frameworks in combination and would welcome the involvement of other colleagues.

Design against crime, as practice based design, is a research agenda linked to an understanding that design should address security issues without compromising functionality, aesthetics or other forms of performance. Creativity can be as unexpected as crime; design for secure environments that address both users and abusers without making them look ‘criminal’ is the ultimate target of our research.
The interdisciplinary area of enquiry in design against crime is:

1. To reduce the incidence, impact and fear of crime through the design of products, services and environments.
2. To equip necessary tools and resources to mitigate crime.
3. To promote logical benefits of designing out crime to industries and national governments.

Using this methodologies here will enable the development of products and environments which inherently reduce the incidence, impact and fear of crime.

The hidden realities of our society indicate that crime and social disorder will more likely increase in the future. We believe that there is an underside to the rise of crime in this country which should be addressed by security design engineers. The vast majority of criminally active individuals in United Kingdom have not had stable employment. The persistent increase of jobseekers will eventually have a negative impact on the economy and safety of our society.

The security of our citizens will remain unstable if we do not start to use a different approach in reducing crime by changing a design of urban infrastructure. The usages of excessive force against criminals will unlikely reduce the crime rate. The excessive police force against citizens instead could promote or even trigger anti-government protests, and will lead eventually to anarchy and social unrest within society. This thesis discusses a need for a knowledge-based design approach to use creativity tools in design for crime prevention. We will also explain how we can stimulate performance of security engineers in inherently safer urban infrastructure. Design for creative confrontation against crime will reduce costs for the public sector including expenses associated with running of secure prisons.

In this thesis we will explain how selected creativity tools can effectively improve the capability of security designers to tackle crime issues in urban infrastructure. We will also explain how engineers can trace and find the main cause of crime with an issue-based information system.
7.3 Future work and recommendations for Further Scientific Research

Much of the response to criminal activities so far has been based on the assumption that conventional crime will remain the norm. Reducing criminal activities in the United Kingdom is still a feasible goal. The latest Queen’s speech (Her Majesty Queen Elisabeth II (2013)) outlined necessary reforms for the confrontation of crime and disorder, both physical and in cyberspace.

This research was dedicated to address the causes of criminality and creative confrontation within criminal activities through effective design. In an ideal world designers would be more creative than criminals but in reality some criminals can be far more creative than security system designers. Understanding the reasons behind any criminal activities and effective mitigation is an area for future research. The large number of senior police officers and security designer close to retirement will push the designer to urgent capture and storage of their valuable knowledge about past design and mitigation. Using IBIS mapping and strategic capture of retired expertise knowledge will help the security designer to understand criminal mentality and mitigate the crime according to their techniques.

The necessity for prediction and having new ideas against creative criminals are clear when it concerns cyber space crime. In cybercrime there is no physical contact between criminals and victims, thus physical mitigation of criminals is impossible; consequently criminals have less fear from the law. Most of our house appliance and security products are going to be developed with IP control and connectivity; new software’s will bring all IP systems into a single integrated system. Imagine that control of all aspect of your life will be in hands of fearless cyber criminals is enough to push designers and security engineers to use creative ideas against them. This represents a significant challenge for the future, but also one which can be tackled using the creative framework and rationale developed and described in this thesis.
Nomenclature

(CPNI): The Centre for the Protection of National Infrastructure
(RASC): Risk Analysis and Security Countermeasure Selection
(CCTV): closed circuit television
(AMS) : Aerial Mapping system Motion Picture
AR-73 : Radar Image Correlation Still Picture Viewer
AR-13 : Motion Picture Film Viewer
AS-27 : Image Interpretation System
BM-30 : Image Matching Planimetric Compiler
EH-3 : Motion Picture Film Processor
ES-20 : Motion Picture Film Editor
NSC : National Security Council
NSC : National Safety Council

DOE : U.S. Department of Energy
DOI : domain of interpretation
DOJ : U.S. Department of Justice
ADoS: Active denial of service
DRA : data recovery agent
DRP : disaster recovery plan
DSA : Digital Signature Algorithm
DHCP: unique identifier
DVD : Digital video disc
DVDR: digital video disc recordable
DoD: U.S. Department of Defense
DISA: U.S. Defense Information Systems Agency

Www : World Wide Web
WAN : wide area network
WAP : wireless access point
WAP : Wireless Application Protocol
IP : Internet Protocol
IPA : initial privacy assessment
IPs: Internet Protocol security
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References


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Appendix:

Table 1: Design discourses; provide information on methods of crime prevention in detail

Table 2: Classification of creativity tools; provide information and define a five-dimensional category of creativity tools approach

Table 3: Some example creativity tools; provide information and a list of selected specific creativity tools useful in crime prevention domain

Table 4: Proportions of alcohol-related violent incidents; provide information about level of alcohol related crime and public concerns

Table 5: TRIZ creativity tool with solutions in crime prevention domain; provide information about some creative solution for common security problem.

Table 6: Preparation, capture and deliverables phases in the implementation of an IBIS; provide information on approach

Table 7: Agents and entities of the Conjunction of Criminal Opportunity; provide information on systematic intervention