Future Crime Problems and Security Solutions – How to Anticipate them and What to Do about them

University of Sydney/Australian Institute of Criminology
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Dawes Centre for Future Crime

UCL DEPARTMENT OF SECURITY AND CRIME SCIENCE

An Inauspicious Start for the Dawes Centre for Future Crime

New Scientist

Time cop

IF YOU have a pessimistic view of the future and a track record of publishing in high-impact journals, you'll be perfect for University College London's new position, Professor of Future Crimes. The winning applicant will head a centre dedicated to "identifying emergent crime and security threats and developing and recommending pre-emptive measures". Civic-minded clairvoyants, fortune tellers and associated fruitloops: this is your time to shine.

Dawes Centre for Future Crime

- Despite New Scientist scorn, Dawes Centre began operations in 2017 under Prof Shane Johnson
- Aims
  - To anticipate how tech or social change can create new opportunities for offending
  - To propose methods to address these problems before they become established
- Research focuses on
  - Crimes likely to emerge over short, medium and long-term time horizons
- Multi-phase approach
  - Broad scan of science/technology literature and leading-edge work across UCL
  - Specific scoping studies – including AI, Cryptocurrency, Advanced Materials, Counterfeiting, Domestic Abuse
  - Projects emerging from these
- Module on Horizon Scanning in Masters in Crime Science
- PhDs

Dawes Centre for Future Crime – PhDs Underway

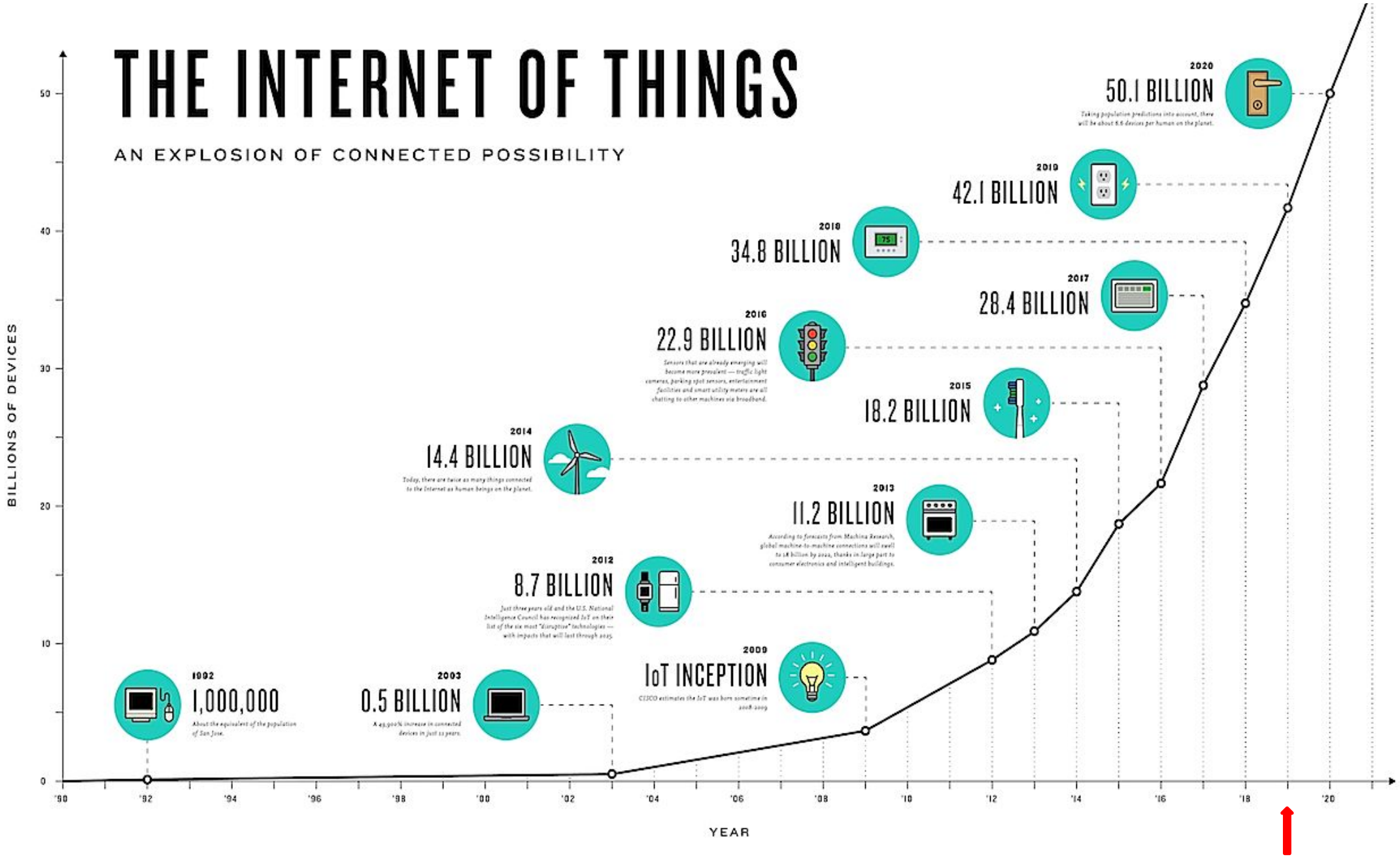
- Crime, place and the Internet
- Biocrime
- Cybercrime risks to London's future street infrastructure
- The effects of cyberweapons
- Detecting emerging crimes using data science techniques
- Addressing Probable Child Sexual Abusers and Victim Profile Characteristics on Instagram
- Identifying opportunities for crime prevention in smart cities and evaluating their social acceptability
- Low energy X-ray backscatter imaging for non-destructive evidence harvesting
- Guarding against Adversarial Perturbation in Automated Security Algorithms
- Horizon scanning through computer-automated information prioritisation
- Refugee flows and instability

The Future…Every Which Way

A Changing World

UCL Jill Dando Institute of Crime Science

The Future… Accelerating



The Future has Arrived at Terminal South – Bringing Crime with it

Drone Disruption

Gatwick Airport

110,000

passengers due to arrive or depart Thursday

760

flights due to arrive or depart Thursday

10,000 passengers affected Wednesday

2.9 million total passengers due to pass through over Christmas/New Year

Source: Gatwick Airport

The Future has Arrived Globally – with Huge Scope for Crime & Challenges for Security

How does Security Face the Future?

- Security seeks to
  - **Reduce risk** of crime
  - **Reduce rate of growth** of crime
  - **Out-innovate** adaptive offenders against a background of tech and social change that may favour first one side, then the other
- By
  - **Spotting** emerging **crimes** and addressing causes that underlie them
  - **Anticipating** criminal **opportunities** directly over a range of timescales and **blocking** them by making changes in everyday world including **designs** of **products, places and systems**
  - **Crimeproofing** products/places/services at design stage to avoid **crime harvests**

  Also by
  - **Spotting** emerging **technologies for crime prevention** and applying them
  - **Anticipating** broader **preventive opportunities** and helping make them happen
- Key things to focus on, then, are
  - **Anticipation** and
  - **Innovations** – which can serve **crime**, or serve **security**

Anticipation: the Challenge

- Anticipation is tricky and potentially overwhelming
  - Many **crime types**, each using diverse **perpetrator techniques**
  - Many crime **targets** and crime **environments**
  - Huge range of possible **resources** can be misused for crime
  - Huge range of **preventive methods** which could exploit new tech – or be defeated by it
  - Huge range of **scientific/tech innovations** coming, individually & in combinations
  - Many complex **contextual changes** in other social/technological domains
- But it's a great challenge for crime science that will run and run!

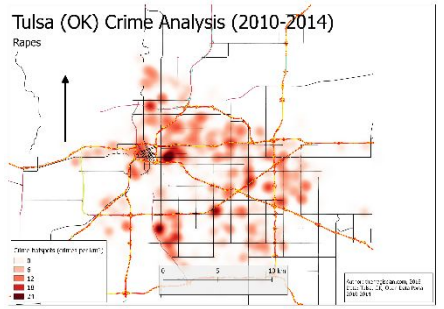
How to Anticipate

- Need
  - Mindset
  - Data from past/present
  - Crime Science frameworks – structure and theory – to take us into future by systematic and rigorous thinking plus some educated speculation

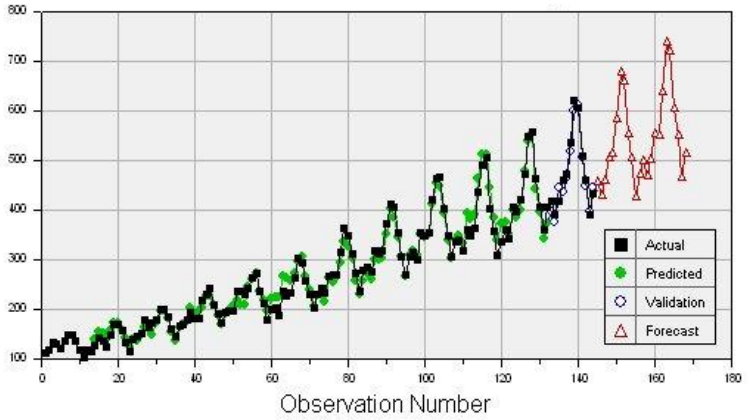
Futures Mindset: Failure to ‘Think Drug User or Urinator’

Data-Driven Forecasting of Future Crime?

- Simple **induction** – all our yesterdays – underlies hotspot policing

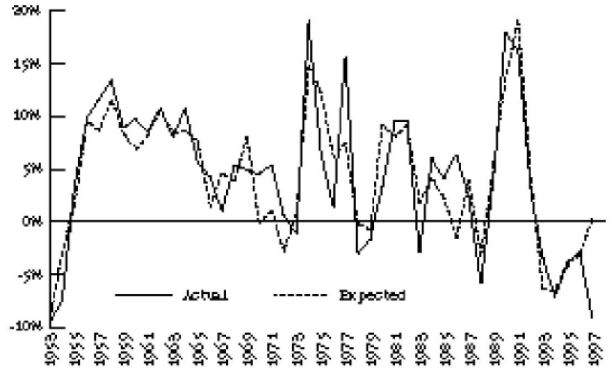


- **Time series** analysis (e.g. ARIMA) – trends, cycles and lags – tomorrow and tomorrow and tomorrow?



- Time series analysis – **statistical modelling** based on a range of explanatory variables

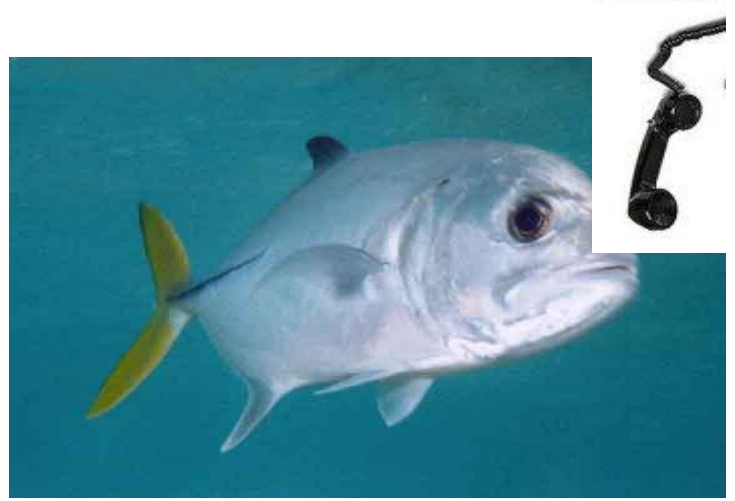
Figure 2. Explaining theft trends. Actual annual change in theft and change 'expected' on the basis of the model.



Dependent variable	Model T4 ΔLog (Theft)		Model B4 ΔLog(burglary)	
Independent variables	Estimatedcoef ficients			
Intercept	-0.03	(0.02)	0.05	(0.02)
Error correction mechanism (lagged residuals from cointegrating regressions)	-0.52	(0.12)	-0.24	(0.11)
ΔLog(consumption over 4 years)	-0.61	(0.93)	1.88	(1.04)
ΔLog(males aged 15 plus males aged 20)	0.43	(0.14)	0.37	(0.24)
ΔLog(consumption)	-1.25	(0.38)	-2.67	(0.62)
ΔLog(consumption) lagged one year	1.10	(0.51)	not included	
Dependent variable lagged one year	0.58	(0.12)	0.36	(0.11)

Issues with Data-Driven Forecasting of Crime Trends

- Simple induction and complex time series
  - No **logical** guarantee that tomorrow will be like yesterday
- Statistical modelling – may, or may not, have captured all the **background variables** that are associated with change
- **Data** may not be available at suitable temporal/ geographical scales

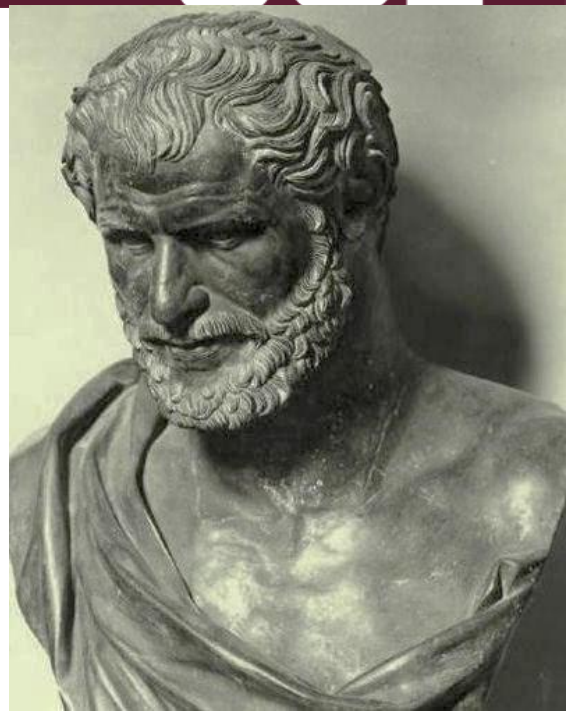


- More generally, the factors underlying crime patterns may not be **strong and stable** – but have complex interactions with context, emergent properties and **nonlinearities** ~
- All in all, quantitative, data-driven forecasting appears **limited in scope and reach**; and the underlying **causal mechanisms** may be tricky to discern and forecast

Using Crime Science Frameworks to Anticipate Crime

- A wider-ranging approach is perhaps achievable by taking the theories, perspectives and frameworks of **Crime Science** and applying the **futures mindset** to it
- Crime Science being
  - ***The application of concepts, methods and knowledge from a wide range of scientific disciplines to the processes of reducing and investigating crime***
  - I.e. the security equivalent of medical science
- Will first cover the Big Picture of causation, then the Small Picture of specific innovations

Change and Constancy



- But before that, we can take a step back by trying, more fundamentally, to distinguish things that **change**, from things that remain **constant**
- To **Heraclitus**, everything is in **flux** – nothing stands still or remains unchanged
- How far does that view hold for crime?
- Specifics of what **criminals/terrorists** want to achieve – strategic **purposes**, tactical **goals**, **tools and techniques** – will **change** as will any **conflicts** that underlie them
- Likewise **security and law enforcement** will have to keep up
- Both will exploit, or suffer from, **new technology** and **social change**

What Changes? What Remains Constant?

- But Heraclitus doesn't have it all his own way
- We can assume that there are some things which will remain broadly **constant** in nature, and possibly level in intensity into the future
  - **Panhuman motives to offend** – subsistence, greed, vengeance, hatred, sexual conquest, defence, domination
  - The inevitability of **inequality and conflict** at individual and group levels
    - Worth looking at Turchin's data-driven analysis of history http://peterturchin.com/
  - The **tactical and logistical requirements of committing crime** against material or human targets, and in face of security and law enforcement
  - The requirements of doing **security** on the basis of limited resources and respecting considerations of procedural and criminal **justice**, not unduly restricting **civil life**
  - Unless **climate change** brings it all crashing down!

- We can take each of the frameworks at the heart of Crime Science and give them a **futures twist**, covering the anticipation of changes
  - To the **causation of crime**
  - To the scope and feasibility of **security interventions**
- And we can combine these frameworks with systematic attempts to identify upcoming changes of a more general nature

Crime Science Approaches to Causation/Intervention

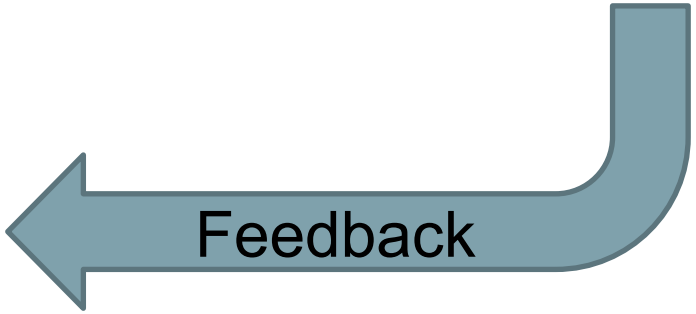
Wider societal changes
- Political
- Economic
- Social
- Technological
- Environmental
- Legal
- Organisational
- Media
- Infrastructural

Crime Science theoretical frameworks

Causes of crime

Perception of crime

Society's capacity for prevention, response, mitigation, resilience, adaptation



Routine Activities

- Everyday routine activities bring together a likely (capable, motivated) offender, with a suitable target, and absence of capable guardians
- Changes to the activity of any one of these elements can influence the likelihood of crime occurrence

In Future:

- *How might **this** innovation, trend or event affect the presence and actions of likely offenders, suitable targets and capable guardians?*
- *How might **these changes** influence the factors that bring the RA triad together or keep them apart?*
- *E.g. new technology changing targets, women's employment emptying homes during daytime, inauguration of new metro line*

Rational Choice

- Offenders make 'rational' decisions to commit particular criminal acts at particular times and places as a function of their perception of risk, effort and reward, i.e. **opportunity factors**

In Future:

*How might **this** change affect the **objective** or **perceived** levels of risk, effort and reward encountered or engendered by offenders as they decide whether or not to commit a crime?*

*How might it affect broader **opportunity structures** and **criminal involvement** choices?*

E.g. scalable offending on the internet, more valuable targets, police cuts

Crime Pattern Approach

- Understanding offender **activity spaces** and **movement patterns** and how this shapes their perception & awareness of local environments and the crime opportunities they offer

In Future:

- *How might **this** change affect offenders' ability to move within, spot opportunities and get to know risks in their activity space?*
- *How might that **activity space** itself change?*
- *E.g. introduction of new **transit** systems, use of mobile **navigation** applications that direct people through areas they would otherwise not visit, or availability of **data** on the activity and content of places*
- *How might offenders **develop activity spaces** in virtual environments, or in physical ones made accessible by new technology? E.g. unmanned aerial vehicles open up the 3rd dimension*

Crime precipitators

- A psychological approach that considers the role of factors in or near the immediate crime situation which influence the motivation/emotion of offenders, making their search for, or exploitation of, criminal opportunities more likely. Environmental cues, events or influences can **prompt, pressure, permit or provoke** criminal behaviour

In Future:

*How might **this** change influence the nature, strength and patterns in situational **precipitators**, or the **susceptibility** of offenders to them?*

E.g. children becoming visible on social media, train travel becoming more stressful, expression of racist views online

25 Techniques of Situational Crime Prevention

- Extensive catalogue of **practical techniques** (www.popcenter.org/25techniques/) organised around situational prevention principles (risk, effort, reward to offender; excuses and provocations).

In Future:

*How might **this** change enable, or constrain, the successful realisation, operation or implementation of each of these categories of preventive technique?*

E.g. new cutting disk material and cordless drill defeat current target hardening technique

Risk and protective factors

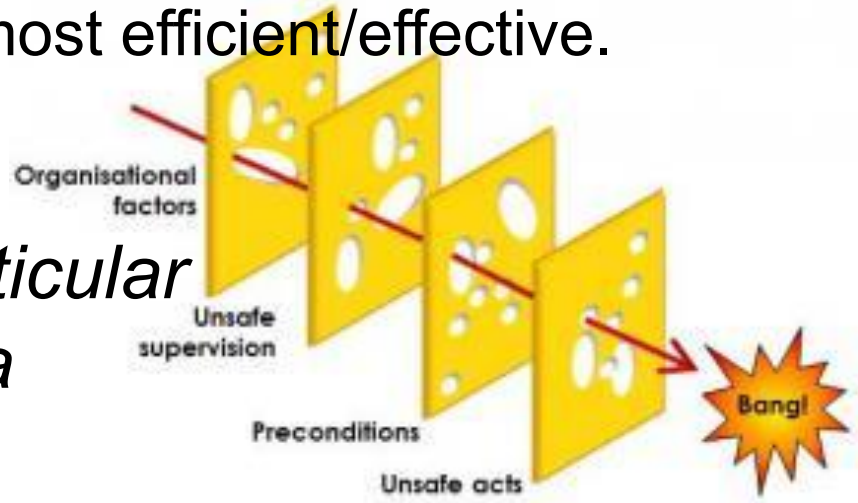
- RF suites such as CRAVED (Clarke 1999) have been developed to inform understanding of what makes a product "hot" (i.e. targets at high risk of theft/misappropriation), or makes a place more risky. Hot products are considered to be those that are Concealable, Removable, Available, Valuable, Enjoyable, and Disposable
- Other suites cover **protective** factors e.g. IN SAFE HANDS (Whitehead et al) for mobile phone design

In Future:

- *How might **this** change influence individual risk/protective factors, or sets thereof? E.g. how might **firearms** become more/less Concealable, **copper metal** more/less Valuable?*
- *How might **this** change shift balance between risk v protective factors?*

Crime scripts

- These describe **sequences** of action and decision-making, usually by offenders, in what might be a complex Modus Operandi
- E.g. Approach ATM, check if anyone looking, fit scanner device, return later to collect data, sell/misuse data…
- Can identify '**opportunity paths**' (cf Reason's Swiss Cheese model of accident causation) and '**pinch points**' where intervention is most efficient/effective.

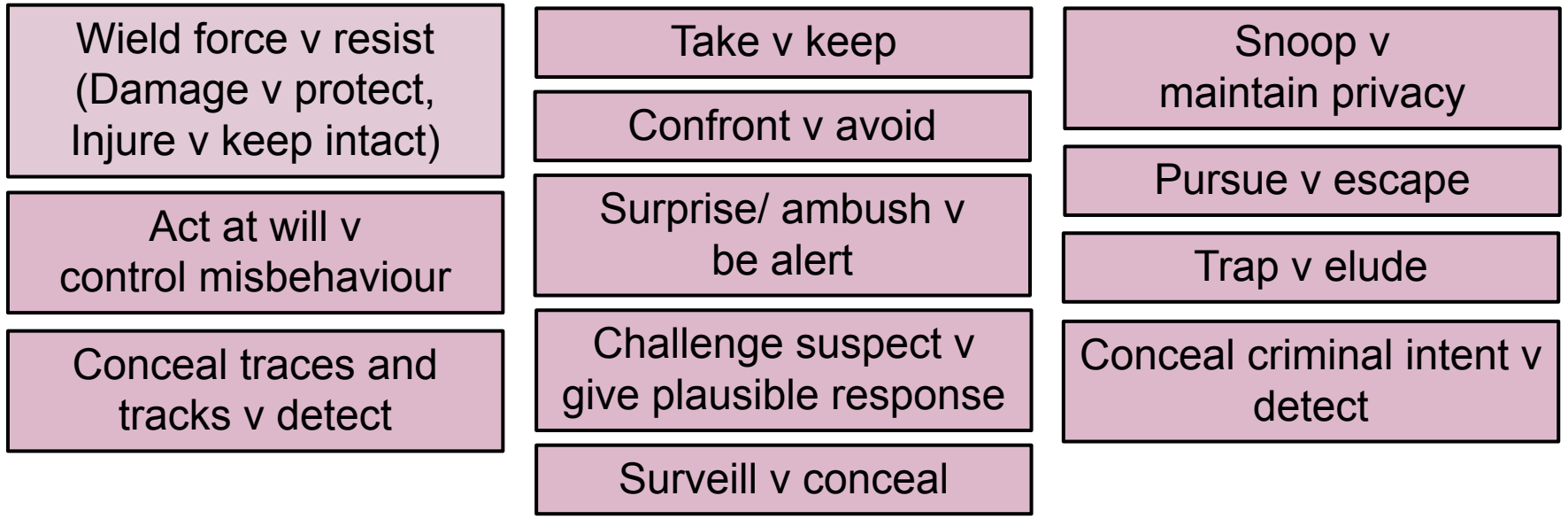


In Future:

- *How might **this** change facilitate or inhibit particular script elements, and how they fit together as a workable sequence for committing crime?*
- *How might **this** change enable entirely new crime scripts?*

Putting Frameworks Together – Script Clashes

- We can identify **tactical clashes** between offenders and security at key stages of their scripts



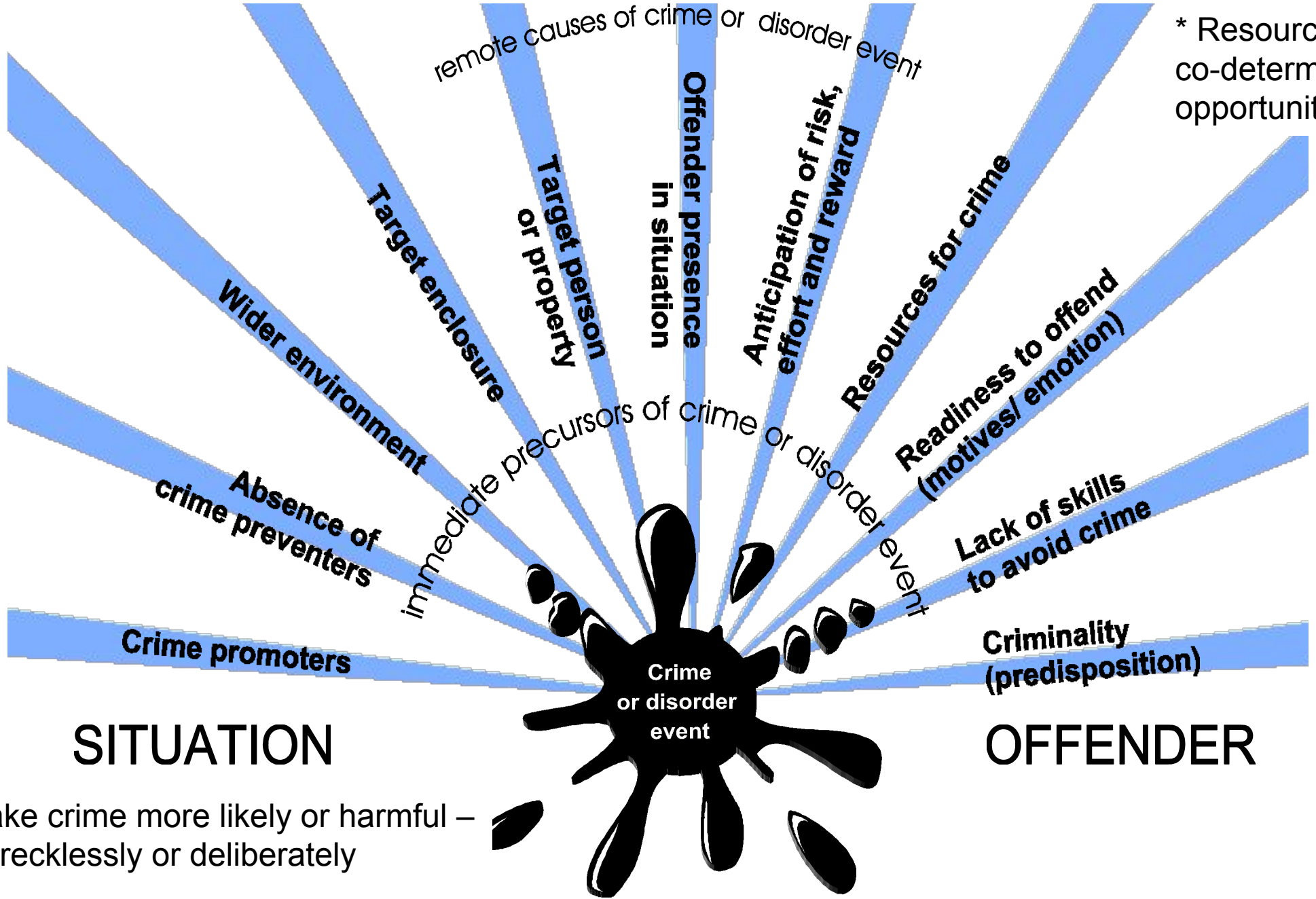
- These clashes
  - Influence **criminal plans and outcomes**
  - are **generic and perennial** – will always need to be faced
- **Innovations** can **disrupt the balance** of these clashes, & favour one side over other
- ***In future**, which side will gain from a sudden breakthrough?*
- *How can we design things to **advantage the good side**?*

Putting Frameworks Together, and more – CCO

- The traditional Crime Science frameworks don't join up well – there are overlaps, differences in terminology and gaps, and they focus on different levels (psychological, ecological, geographical…)
- In thinking about future crimes and preventive interventions, better to bring them all into single framework where easier to envisage interactions
- The **Conjunction of Criminal Opportunity** tries to do this
  - Ecological and psychological
  - Identifies 11 kinds of cause of criminal events – agents and entities – and 11 counterpart preventive interventions intended to block those causes
  - Focuses on immediate or proximal causes – what the offender brings to the crime situation – rather than remote, upstream or distal ones
  - But we can work back upstream to the more remote ones (causes of causes; causes of combinations of causes), including future changes we're interested in

The Conjunction of Criminal Opportunity – Causes

Preventers include guardians, place managers, handlers… plus designers, manufacturers …



* Resources co-determine opportunities

Promoters make crime more likely or harmful – inadvertently, recklessly or deliberately

Mapping Future Crime Risks with CCO

We can start with **causes**, and we can ask:

For each of these 11 causes of criminal events

– *What future **changes** can we anticipate, which might affect **this** cause, or combination of causes?*

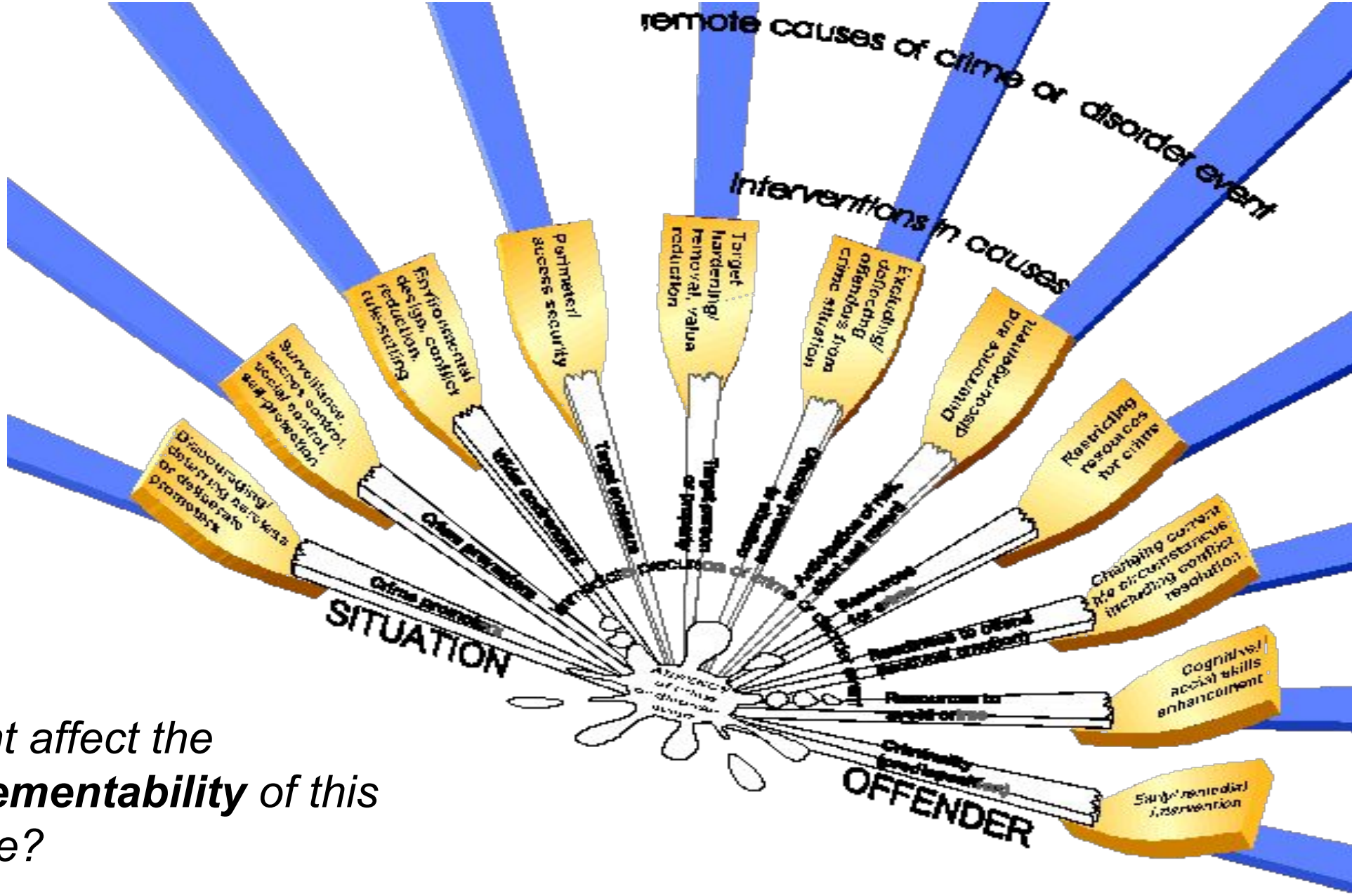
Or we can start with a **change** and ask

– *Which of the 11 **causes** of criminal events might **this** change influence?*

https://5isframework.wordpress.com/conjunction-of-criminal-opportunity/

Conjunction of Criminal Opportunity: Intervention

- Each of the causal elements has a counterpart set of **intervention principles**
- These are realised through practical **intervention methods** as described in the 25 Techniques

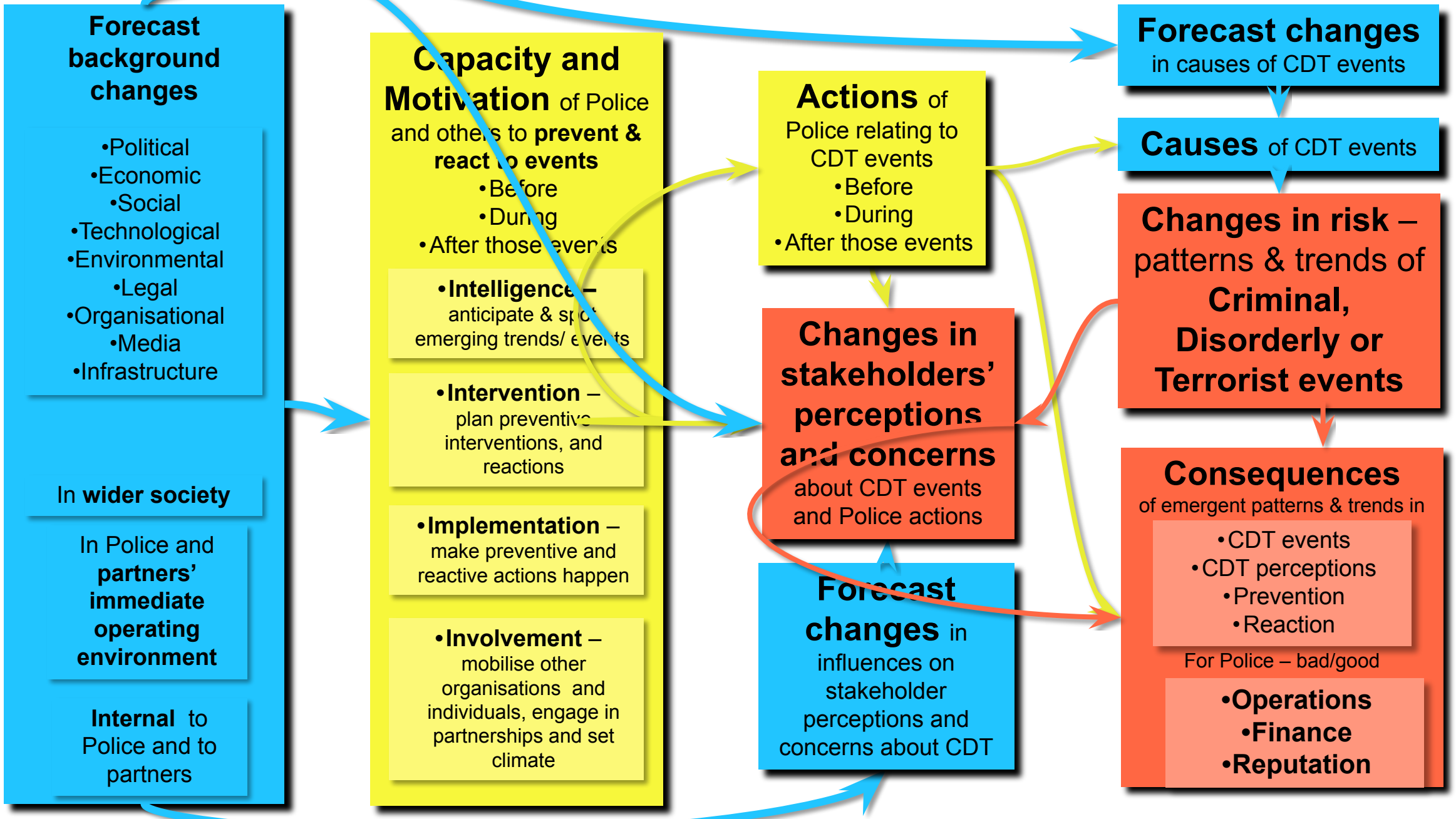


- We can again ask:
- *What changes might affect the **impact** or the **implementability** of this intervention principle?*

Crime Prevention Process

- We can also ask about the **performance** of crime prevention – either looking at the impact of future changes on the **SARA** process (Scanning, Analysis, Response, Assessment), or the **5Is** equivalent
  - *How might **these** changes affect the **capacity** and **motivation** of Police and their partners, and the **context** of undertaking the tasks (and their detailed sub-tasks) of*
    - *Intelligence*
    - *Intervention*
    - *Implementation*
    - *Involvement (partnership, mobilisation, climate-setting, accountability etc)*
    - *Impact and process evaluation?*

Crime Futures – a Systematic and Integrated Approach

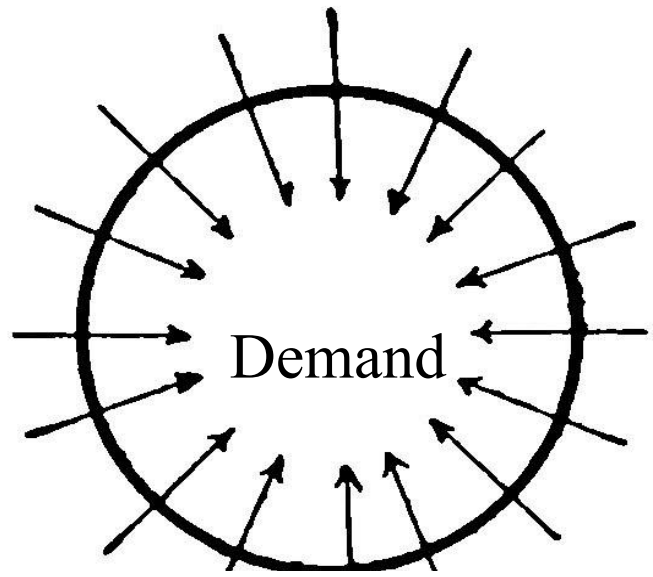


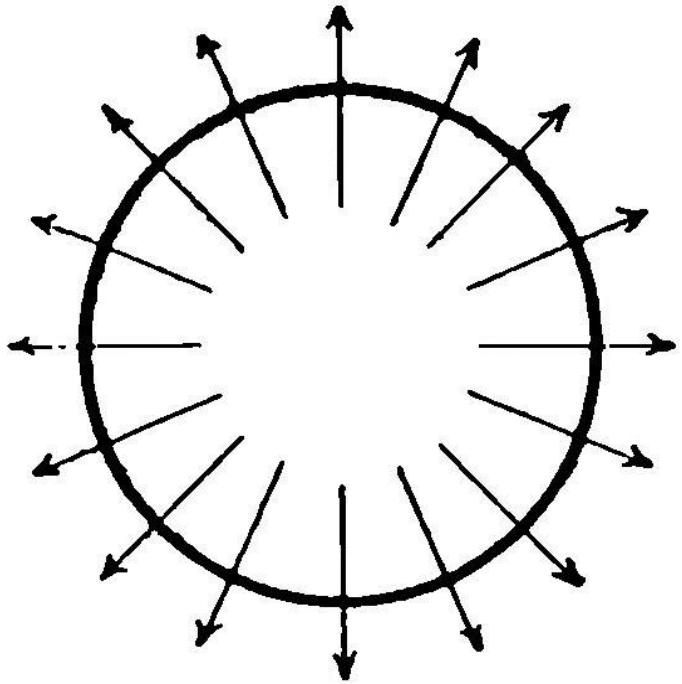
The Small Picture: A Closer Look at Innovations

How to Anticipate the Impact of Innovations on Crime/Security?

We can take different perspectives:

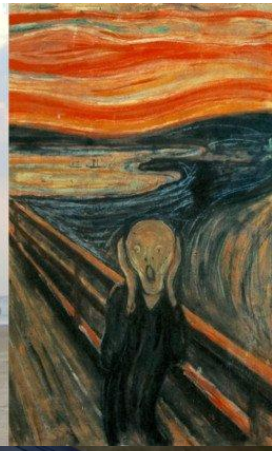
- Causal v functional
  - **Causal** – e.g. *how might this innovation generate stress or conflict, supplying precipitators?*
  - **Functional** – *how might this innovation serve criminal or security purposes?*
- Within functional
  - **Demand-side** focus – *what do criminals or security need to be invented, to solve their problems/ complete an opportunity? Is any specific requirement holding them back?*
  - **Supply-side** focus – *what can this new piece of science or technology do for criminals or for security?*



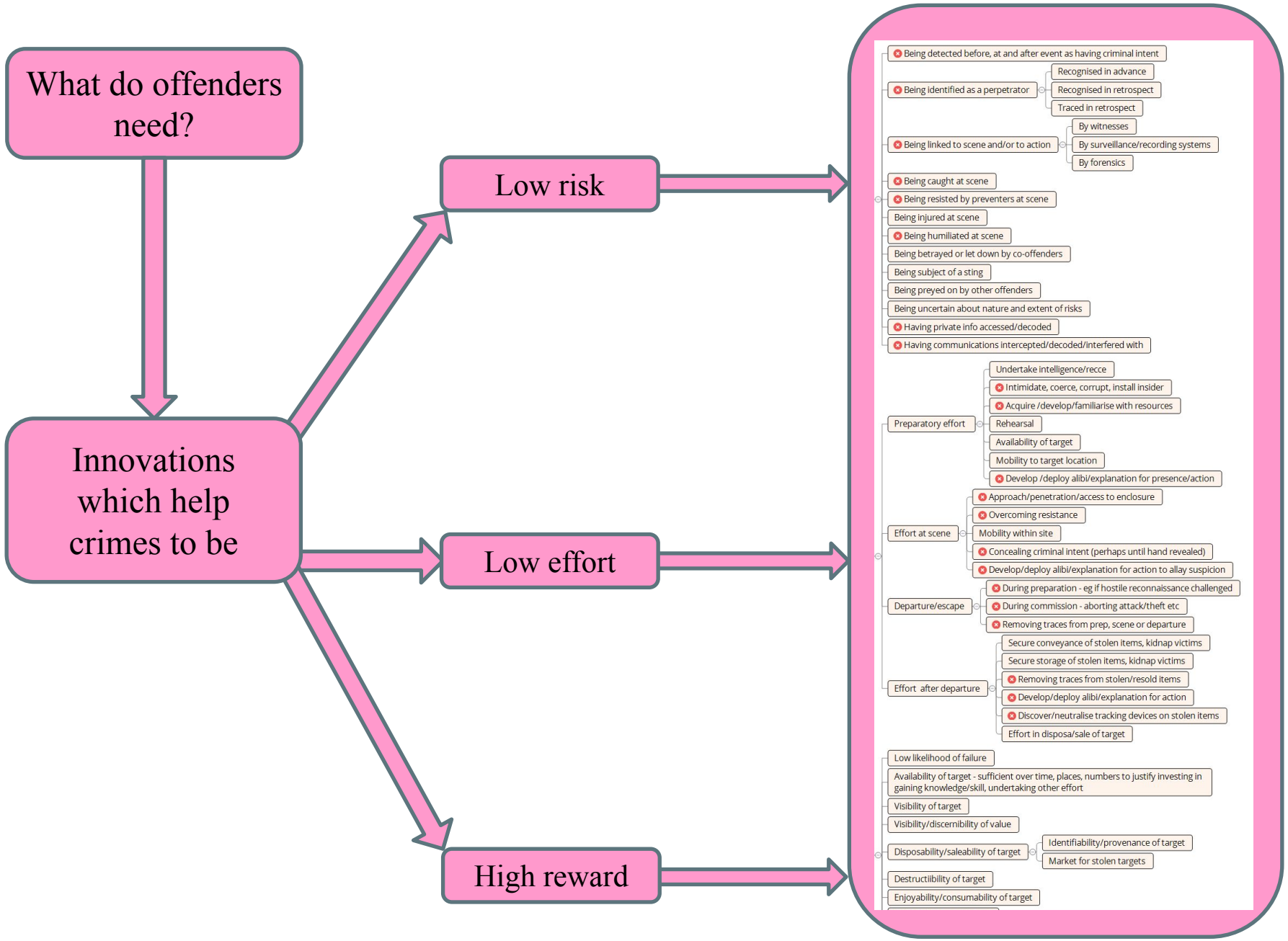


Causal Side – **Drones**

- Drones can **precipitate** crime by
  - Generating **stress** over noise
  - Generating **conflict** over noise, visual intrusion, spying
- Drones can cause **injury** and **damage**
  - By falling out of sky
  - By collision with aircraft



Function – Demand-Side – Offenders' Needs in General



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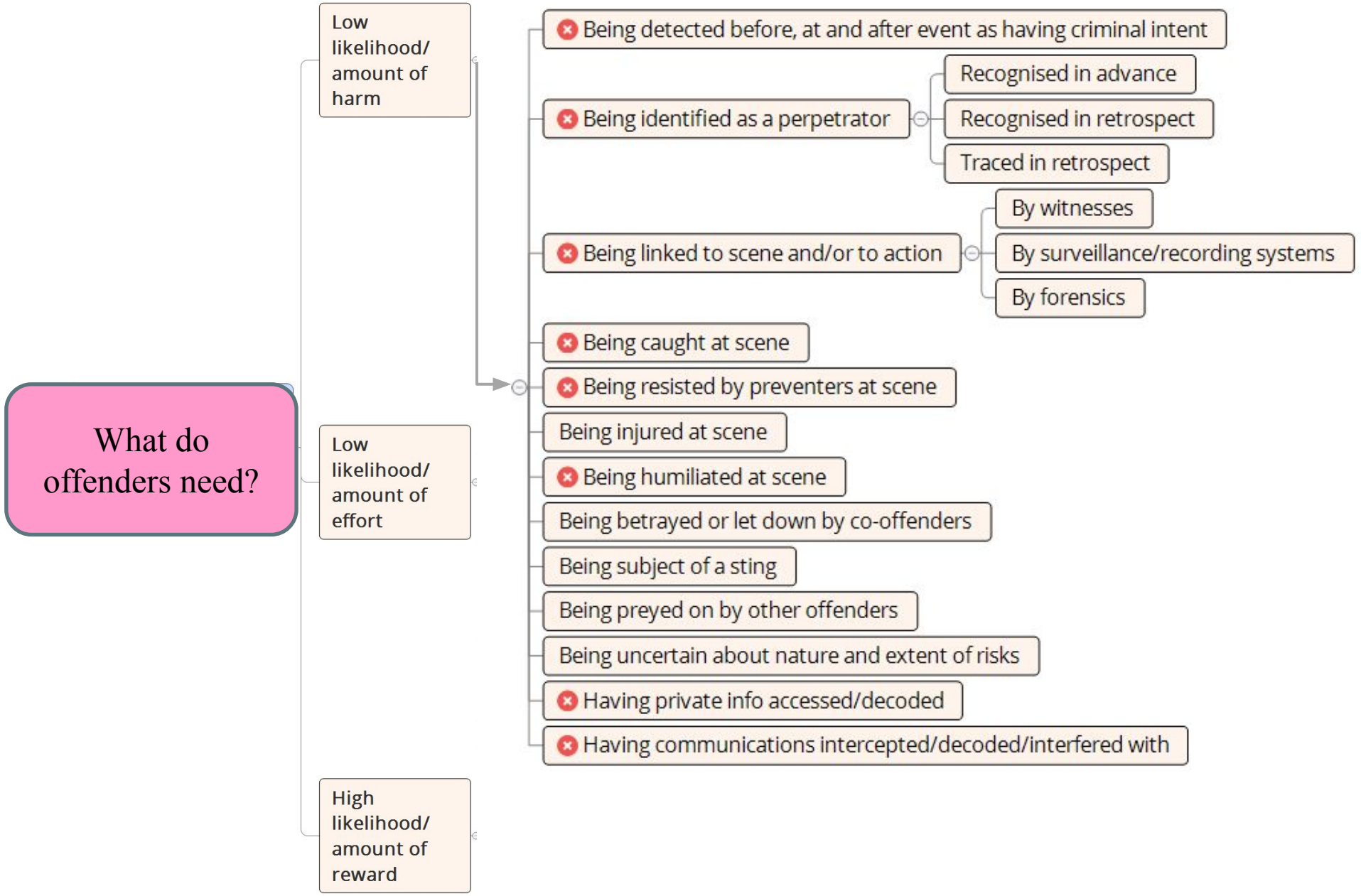

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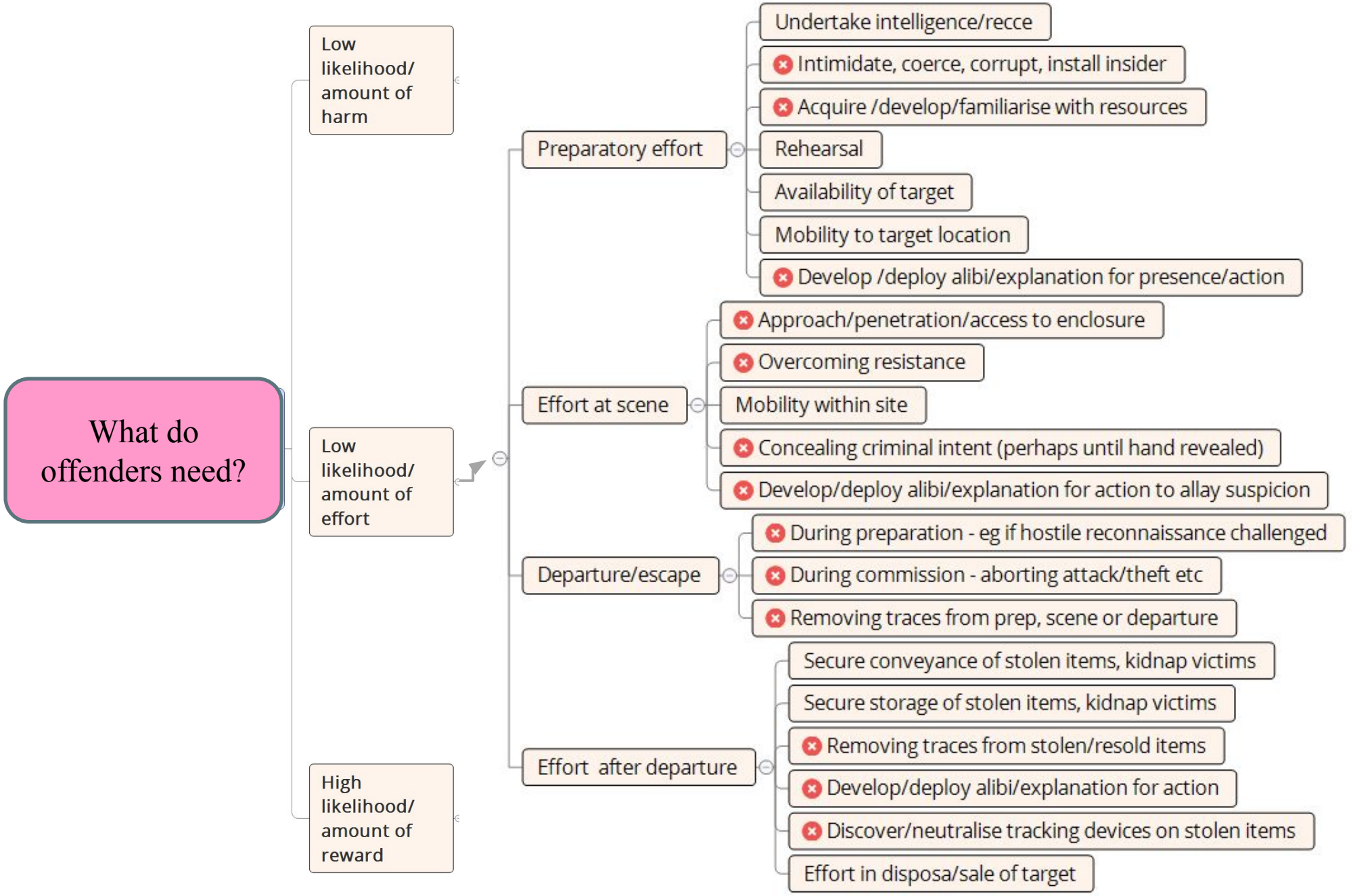

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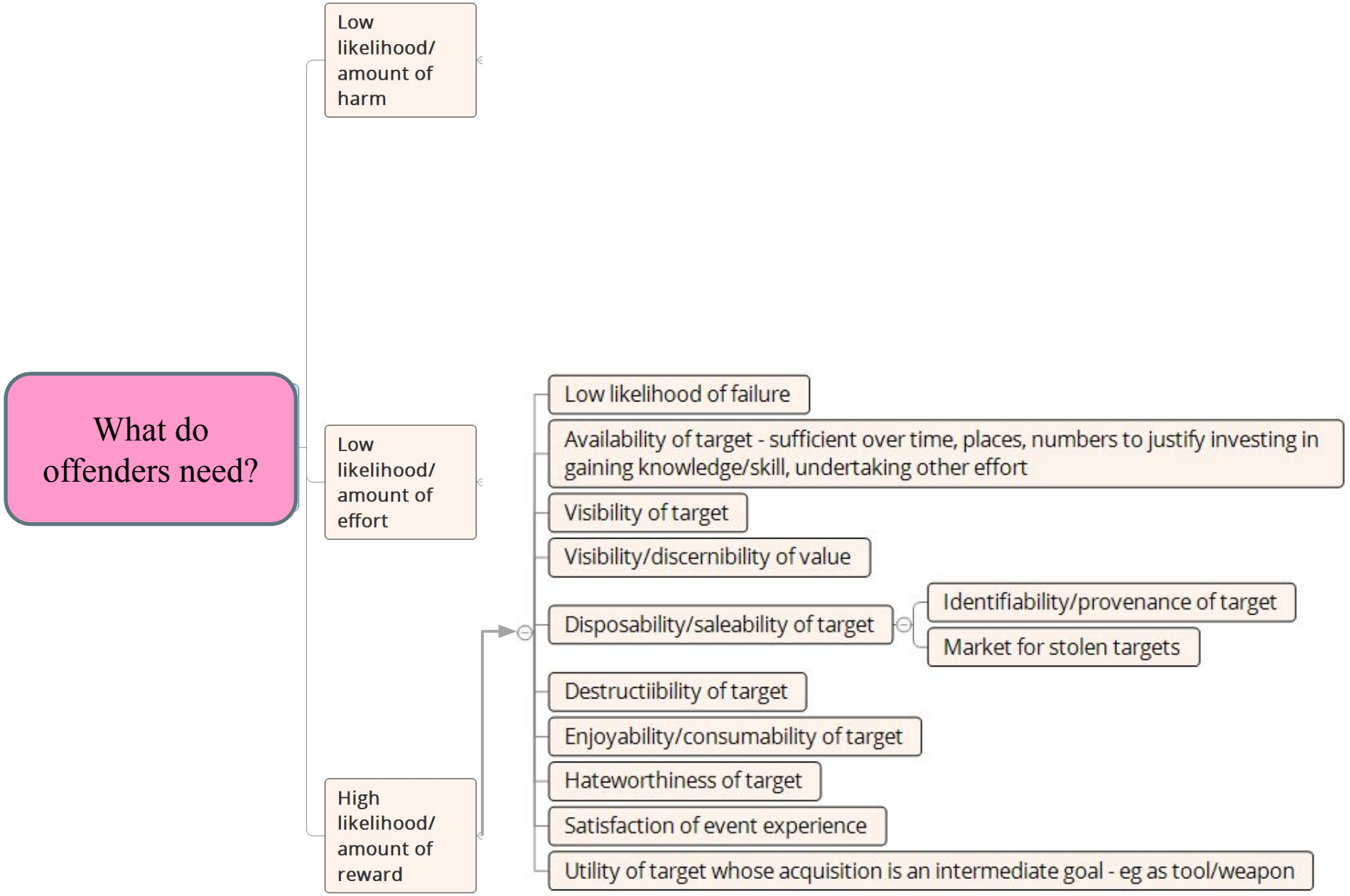
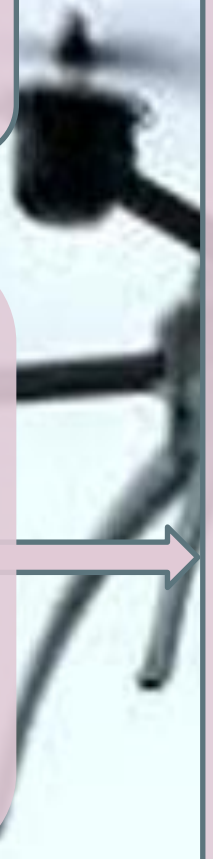


Function – Supply Side – What can Drones Offer Crime/Security?

Functional **essence of drone?**

Active, mobile, effective, 3D telepresence of human agency



- Remote operation - can go to and do in different places from humans in general, individual agents in particular... remoteness can range from metres to many km... Allows distancing of agent from hazards, tracing by traditional means eg facial recognition
- Mobility and agility in different modes - air, land surface, walls, water
- Different size/shape/body configurability from agent - entry/exit, detectability eg through size/shape/disguise
- Communication with agent - coded/encrypted
- Sensors - human + more - inc Radar
- Image capture, transmission, recording
- Image interpretation
- Autonomy at various levels from tactical to more operational... navigation, risk and objective identification, decision, response
- Ease of operation/ limited training by user
- Conveyance of goods to/from destination
- Actuation
- Self-defence v threats/protection v natura/ accidental human hazards
- Generic regulatory requirements - eg licensing, identification, constraints on flight eg line-of-sight operation, no-fly zones
- Cheap

Function – Supply-Side – Drone can be:

Tool for criminals

- **Misused** – hostile recce, IED delivery, drug delivery
- **Misbehaved with** – noise, intimidation, voyeurism
- **Misled with** – causing panic, riot

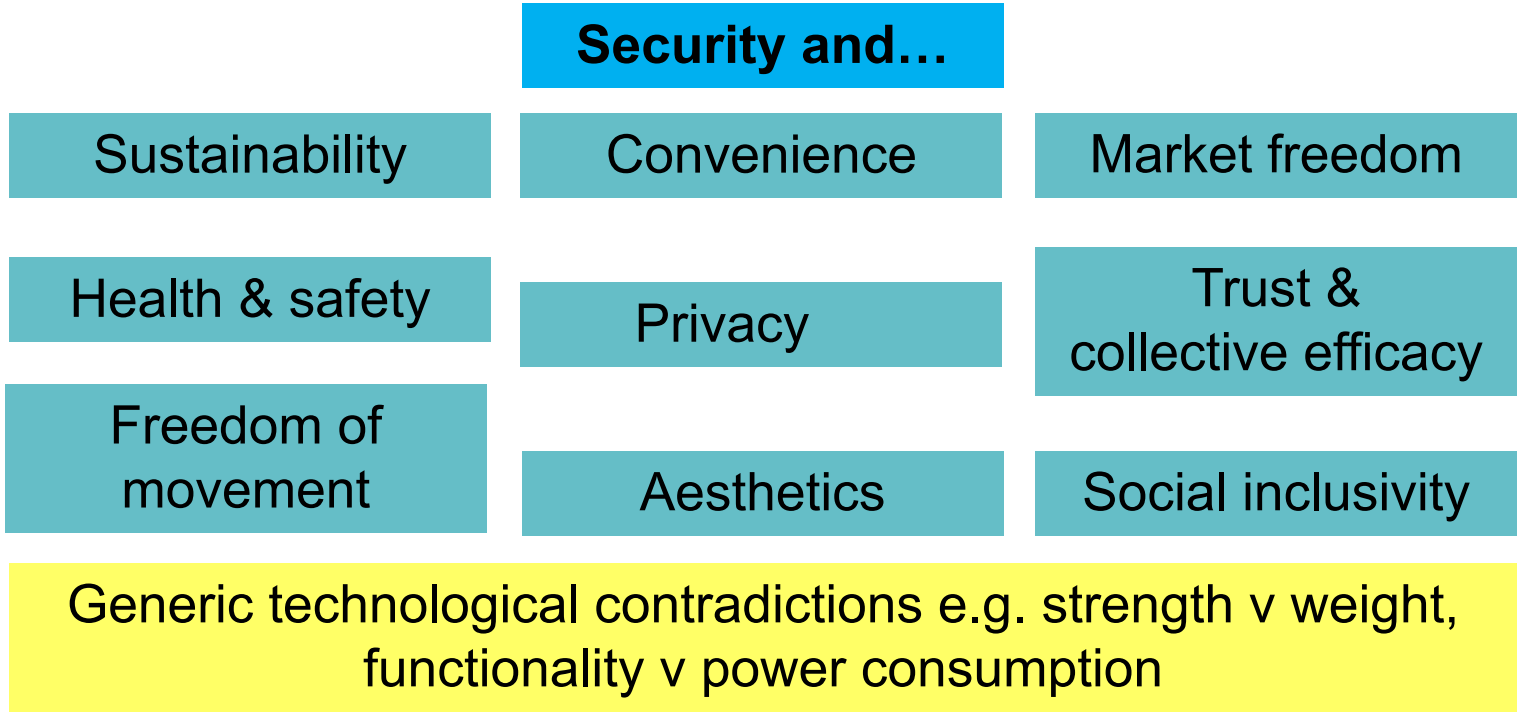
Target of crime

- **Misappropriated** – stolen, or stolen from (deliveries)
- **Mistreated** – shot down by angry neighbour
- **Mishandled** – false licence, smuggled in
- **Misbegotten** – counterfeit model, spares

Aligned with security

- **Secured against above risks** – e.g. identification, limiters
- **Exploited to control crime** – surveillance, detection, pursuit
- **Proofed against Mistakes & Mishaps** – e.g. log/ check

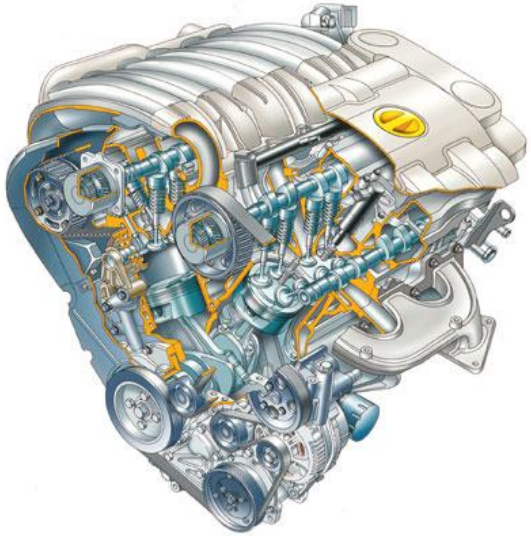
- **What's stopping us** from making the future favour security?
- Various broader **design contradictions** can hold back exploitation of current/future technologies by the security side (offenders are less constrained):



- *Will innovations relax, bypass, or tighten these contradictions?*
- *Can we steer innovations in beneficial directions, or at least be ready with mitigations?*

- **Tunability** of materials, applications, for optimisation to diverse contexts
  - 'What works' in crime prevention is very context-dependent
- **Smart discriminator** functions
  - What's good for legitimate users (e.g. **Smaller, lighter, more portable, more durable, cheaper, easier to operate**) is good for thieves
  - How to serve one while thwarting the other?
- **Adaptable, reconfigurable** form
  - Modelled on swing down fire escapes – both configurable and discriminating
- **Creative leap** rather than compromise

Mobility *or* Armour > Mobility *and* Armour



- **TRIZ** – a theory of inventive principles **triz-journal.com**
- Based on analysis of **oodles** of patents
- 40 generic **Inventive Principles**
- 39 **Contradiction Principles** – the sharper-expressed the contradiction, the easier the problem to solve…link to troublesome tradeoffs and the fundamental contradiction at the heart of crime prevention (**user-friendly, abuser-unfriendly**)
- **Lookup tables** – what inventive principles solved what contradictions in past?
- Analysis of **evolutionary trends** of invention (solid > segmented > flexible > field) – look for what's likely to be next on the market, to limit search for next solution or response

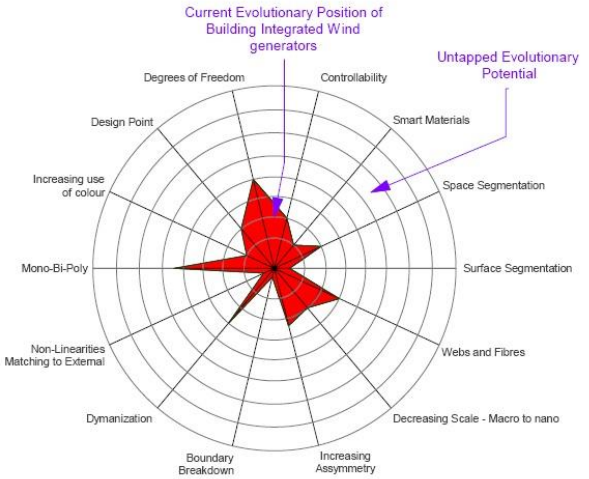


Fig. 4. Untapped Evolution Potential in integration of Wind Energy into Buildings (reproduced from McGee 2005 with permission).

Example trends of interest to crime/security

Applications

- Drones
- Autonomous vehicles
- Smart rail signalling systems
- Non-GPS navigation
- Blockchain
- Brainwave reading/ control
- Smart lighting
- Performance-enhancing prosthetics
- Instructional technology
- Script kiddies

Generic technologies

- Hyperconnectivity
- AI
- Robotics/ Nanobots
- Quantum computing
- SCADA
- 3D printing
- Mass customisation
- Portable, renewable power
- Wearable ICT
- Smart materials
- Stealth technologies
- Sensors, sensor fusion
- IoT
- Pharma
- Chemical synthesis
- GM/ CRISPR
- Advanced optics
- Hacking (both senses)

Background changes

- Climate change
  - Temperature
  - Sea level/ acidification
  - Water, food shortage
- Mass migration
- Antimicrobial resistance
- Commodity scarcities
- Commodity substitution e.g. Mo for Pt catalysts
- Circular economy
- Universal wage
- New finance/ banking models
- New working patterns
- New transport/ movement patterns
- Any concentration or dispersal of value, anywhere in the value chain

Identifying the Forecast Changes of Interest

- Set a timescale
- Identify likely
  - **Internal** Police changes
  - Changes in **immediate operating environment of police** – regulations, traffic etc
  - Wider **background changes – Political Economic Social Technological Environmental Organisational Media Infrastructure**
- For each change (or maybe changes in combination), ask
  - *Might it increase or decrease the risk of **crime** and influence **feelings of safety**?*
  - *What might the harmful or beneficial **consequences** be for society (or some specific sector/organisation), of that change in risk?*
  - *How might the change affect the capacity of Police to continue **implementing** current preventive interventions, or to introduce new ones?*
  - *How might it affect Police **partners**' ability and motivation to **support or collaborate** on prevention?*
  - *How might it affect **other stakeholders** in **supporting or undertaking** preventive action?*

How to select issues for appraising future crime/security impact?

- Scope of candidate cause/trend
  - **Timescale** – immediate future…to 2050? Cycles of research, innovation, policy?
  - **Perspective** – Supply-side, demand side, both?
- Attributes of cause/trend
  - **Certainty/clarity** – is trend reliable? What's the evidence? Is there controversy?
  - **Interactions** – multiple trends raise complexity but may be more realistic?
  - **Influence on crime/security** – given the trend, how strongly/ plausibly/ and reliably will it affect crime or security? E.g. feasible for offenders to get/ apply?
- Crime problems and solutions
  - **Importance** – severity of harm, volume of harm from crime? Rate of growth?
  - **Discernibility** – broad possibilities or specific crimes in specific contexts?
  - **Tractability** – will we ever be able to do something about crime problem?
  - **Urgency** – how soon do we need to take action to intercept the problem?
  - **Countermoves** – is a crime/security arms race likely?
  - **Ethics, proportionality, public confidence** – human rights, non-discrimination?
- Research considerations
  - **Interest** – to home disciplines, connection with theory, research and methods
  - **Researchability** – sharp research questions

Happy Horizon-Scanning!