
Modifying Criminogenic Products: What Role for Government?

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Abstract: *Many ordinary manufactured products provide the means or the temptation to commit crime, and the introduction of new products, such as the cellphone or bank machines can create a crime "harvest." Manufacturers have modified dozens, perhaps hundreds of these criminogenic products to make them less attractive to criminals, mostly for commercial reasons, but in some cases under government pressure. This chapter reviews the international experience of modifying products, whether these are the targets or the tools of crime. It describes the range of products modified, the successes that have been achieved and the scope for further changes provided by new technology. It explains why governments have become increasingly drawn into product change, it examines the different roles they have taken, and it identifies the role of other agents of change such as the media or pressure groups. It concludes by discussing the difficulties for governments of taking a more proactive role in product change, including the reluctance of business and industry to accept*

their roles in causing (and preventing) crime, pressures to avoid business regulation, and difficulties of obtaining international cooperation in changing products. Greater than any of these difficulties, however, is the size and complexity of the undertaking, resulting from the variety of industries and businesses involved, the sheer number of criminogenic products, the bewildering speed of their development, their technical nature and the complexity of the information and service-delivery systems of which many are a part. Governments should establish dedicated units to promote product change. These units should: (1) seek to avert crime harvests by identifying potentially troublesome new products and, (2) develop a problem-solving capacity to deal quickly with unforeseen crime threats caused by the criminal exploitation of new and existing products.

INTRODUCTION

Many everyday objects are the targets or the tools of crime, and modifying their criminogenic properties is not a new idea. To prevent people from clipping silver from the edges of coins, the coins were given milled edges from the end of the 17th century. In 1841, the Penny Red replaced the Penny Black, the world's first pre-paid postage stamp. This allowed the postal authorities to use indelible black ink to cancel stamps instead of soluble red ink, which stopped people from washing off stamps and using them again.¹ More recently, the history of the motorcar can be traced in terms of gradually improved built-in security to protect cars from theft (Ekblom, 1979; Svensson, 1982; Southall & Ekblom, 1985; Houghton, 1992; Clarke & Harris, 1992; Hazelbaker, 1997; Brown & Thomas, 2003). At first, full-time chauffeurs provided the only protection these novel machines needed. Later, as they became more widely owned and widely desired, many improvements were made in response to the growing risks of theft, beginning with door and ignition locks, and progressing to the electronic immobilisers and tracking systems built into the latest cars.

Manufacturers have made most of these crime preventive changes for commercial reasons, but they are now coming under increasing government pressure to alter their products in the public interest. This reflects the fact that in most developed countries governments are now relying less on the criminal justice system to deter crime and are placing more emphasis on the role of other public and private agencies in prevention (Garland, 1996). Wider understanding of the costs of the criminal justice

system and its limits in preventing crime have prompted this shift, which has been reinforced by theories that emphasise the causal role of crime opportunities—including those provided by the multitude of manufactured products in everyday use.

This chapter reviews changes that have been made to criminogenic products at manufacture, with or without government prompting. The objective is to explore the future policy scope for this approach and to identify effective means of government intervention. The review was undertaken to complement other work commissioned by the U.K. Home Office to stimulate interest in "designing against crime" among design professionals,² and by the Foresight Crime Prevention Panel (see Introduction chapter) to explore new opportunities for crime and for its prevention created by technology.

The scope of the review is international and examples of product change are reviewed not just from the U.K., but also from other parts of Europe, the United States and Australia. Even if specific constitutional and legal arrangements might underlie differences among countries in their practices regarding product change, it seemed important when reviewing this new field to cull experience as widely as possible.

The review is confined to two kinds of modifications made at manufacture: (1) changes to the product itself and, (2) changes to its labelling and packaging. Labels and packages are included because these can be inseparable from the product (e.g., liquids must be in containers) or they may be intrinsic to its identity and value (brand labels).

The products covered in the review include any mass-produced items that have been altered to prevent crime. These include:

1. Products that *facilitate* crime as well products that are *targets* of crime.
2. Products owned by businesses and governments, as well as those owned by private individuals (though these uses may overlap, as in hotel room furnishings).
3. Products as small as pharmaceutical pills and as large as railway carriages; products as simple as park benches and as complex as automatic teller machines (ATMs).
4. Financial instruments, such as cheques and banknotes, and a variety of other proofs and forms of authentication.
5. Computer software and other forms of electronic information.

Not included in the review are:

1. Changes made after manufacture by product users, such as the fitting of alarms by car owners, or the retrofitting of shields to protect taxi and bus drivers from robbery and assault (though when incorporated by manufacturers in future designs these changes are included).
2. Changes made to the design and layout of buildings and facilities such as housing estates, schools and malls. These come under the well-established field of crime prevention through environmental design, or CPTED (Crowe, 1991).
3. Security improvements made to the interior or exterior of individual premises such as banks, gas stations, shops and convenience stores (though changes made by manufacturers to reduce crime associated with gas pumps, cash registers and ATMs would be included).
4. Changes made to improve the effectiveness of security products, such as safes⁵ and surveillance cameras. It is assumed that manufacturers would make these changes without prompting from government in order to protect their markets. However, any changes made to prevent the misuse of security products, or reduce their collateral costs to the public (e.g., false burglar alarms), would be included.
5. Revenue changes that alter the value of products such as whiskey or cigarettes (and which consequently affect their risks of theft), or legislative changes designed to reduce access to products such as alcohol, drugs or guns.

The review begins with a summary of theory supporting product change as an instrument of crime prevention (Section 1). Section 2 describes the changes that have been made to date, covering the products involved, the crimes addressed, the nature of the changes and the preventive gains achieved. Section 3 analyses the process of change and lays the ground for a closer look taken, in Section 4, at the role that has been played to date by governments. Section 5 considers the future of government policy in regard to product change.

Some case studies of product change are collected together in the Appendix in order to assist the discussion in Section 4 of the roles taken by government, but also to provide more detail for points made elsewhere in the review. The case studies are as follows:

1. Toughened Glasses for British Pubs
2. Caller-ID for Telephones in the United States
3. Tamper-proof Packaging in the United States
4. Cheque Security in the United Kingdom
5. Smart Guns in the United States
6. The V-Chip for Televisions in the United States
7. Redesign of Banknotes Worldwide

1. THEORETICAL BACKGROUND

Until recently, most criminologists would have dismissed out of hand the idea that changing products can prevent crime. The overwhelming consensus, based on decades of research showing that a small minority of individuals is responsible for most of the crimes committed, was that only by changing the criminal dispositions of offenders could crime be effectively prevented. However, a growing body of theory and research undertaken in the past 25 years has established that offenders are as much drawn into crime by easy opportunities as they are pushed into crime by criminal propensities. Consequently, reducing opportunities will also result in preventing crime. This position has been extensively covered in other publications (for example, Felson & Clarke, 1998; Clarke, 2005), and only the main points as they relate to product change are summarised below.

1. *Crime levels in society are as much affected by the opportunities afforded by the physical and social arrangements of society (including the nature and supply of products) as by the attitudes and dispositions of the population. Since the physical and social arrangements of society are in constant flux, so are opportunities for crime.* This is the central contention of routine activity theory, first put forward to explain the rise in burglary in the United States in the 1960s and 1970s (Cohen & Felson, 1979). Two factors acting together were shown to explain this rise. The first was a substantial movement of women into the labour force, which meant that homes were left without "capable guardians" for much of the day. The second was the large increase in the ownership of TVs, audio

systems and VCRs, which provided many "suitable targets" for burglary. These two factors satisfactorily explained the rise in burglary, without the need to postulate any change in the number of "likely offenders" in society. Since this pioneering study, many other studies have shown that crime waves, large and small, can be created by the arrival of new products, including credit cards, cell phones and ATMs (Felson, 2002).

2. *Crime is heavily concentrated at particular places ("hot spots ") and on particular individuals ("repeat victims"). Theft is also concentrated on particular "hot products."* These concentrations of crime are of the same order, if not greater, than the concentration of offending among a small group of the population, and their implications for crime policy are equally important. In particular, they suggest that to preserve resources preventive action should be concentrated where risks are greatest. As for hot products, the example of the motorcar has already been mentioned. Certain models are at much greater risk of theft than others, and which models are taken depends on the nature of the offence. Those taken for joyriding are quite different from those taken for resale, and both are different from models that are targeted for accessories or parts (Clarke & Harris, 1992a). The British Crime Survey provides other examples of hot products. It shows that the objects most consistently stolen from private individuals include cash, vehicle parts and accessories, clothes and purses or wallets. Annual surveys in the United States show that, while shoplifted items vary from store to store depending on stock, certain items are also consistently stolen more often. These include cigarettes and alcohol, designer apparel and training shoes, audio and video CDs and cassettes, trinkets and jewellery, and medicines and beauty products (Clarke, 1999). The acronym CRAVED summarises the attributes of hot products, which are: concealable, removable, available, valuable, enjoyable and disposable (Clarke, 1999).
3. *Crimes always serve specific purposes for the offender and, in choosing to commit a crime the offender makes a crude calculation of the costs and benefits of doing so.* This is the basic position of rational choice theory (Cornish & Clarke, 1986). It implies that the key to effective prevention is an understanding of the situational calculus made by offenders in committing specific kinds of crime. Understanding *why* joyriders take different kinds of cars from those targeted by organised criminals

stealing cars for export, and understanding *how* they set about their respective tasks, yield a host of suggestions for reducing opportunities for each of these forms of car theft. Most of the suggestions for preventing joyriding will concern the security of the vehicle itself, and perhaps the setting in which it is parked. Those for preventing theft of cars for export will also include the security of the vehicle's documentation and of the security ports and border crossings.

4. *Situational changes that increase the risk and efforts of crime and reduce the rewards, temptations and excuses will materially influence offenders' decisions about committing crime.* This is the core of situational crime prevention. More than 100 case studies have been published showing that significant declines in specific kinds of crimes have been achieved by the introduction of situational changes (Clarke, 1997; Sherman et al., 1997; Smith et al., 2002). Those involving changes to products, such as ticket machines, public phones and cell phones, will be reviewed in more detail below.
5. *Most offenders are not particularly determined and can quite easily be put off. This means that, while displacement is always possible, it is far from inevitable.* In accordance with crime pattern theory, many studies have shown that crime closely follows the routines of everyday life (Brantingham & Brantingham, 1993). For example, burglaries and car thefts tend to be concentrated along major traffic arteries, which offenders use as much as everyone else. Vandalism and a range of other petty crimes often track the routes used by children on their ways to and from school. Other studies have shown that offenders do not stray far from home to commit crimes (Wiles & Costello, 2000) and that, very often, little planning or premeditation is involved, but easy opportunities are exploited (Brantingham & Brantingham, 1993). Consequently, when these opportunities are removed offenders show limited motivation to seek new ones. This helps to explain why so little displacement has been found in most of the studies evaluating the results of situational change (Hesseling, 1994). An example from the London Underground will illustrate this point. Soon after new ticket machines were introduced in 1987, people discovered that the 50p slot could be fooled by 10p coins wrapped in silver foil. They also discovered that pressing the coin reject button returned not the 10p that had been inserted, but a 50p coin from the store in the machine. Gangs of offenders began moving from station to station to milk the machines of cash.

After fruitless attempts to arrest them, the fraud was eliminated by mechanical changes to the machines, without any substantial displacement to another form of fraud involving slugs for the £ slot. These slugs were difficult to make and required metal working facilities. Clearly, most of those previously involved in the 5 Op fraud were not sufficiently motivated to start making the £ slugs (Clarke et al., 1994).

6. *Product crime risks vary predictably over time with important implications for prevention.* Because of declining value, the risks of theft decline for most products as they age (unless they become antiques). Cars are an exception as their theft rates increase over their life span. Their security begins to wear out or offenders learn how to defeat it; their spare parts are in greater demand; and, as they are resold, they are kept in increasingly poor neighbourhoods, with more offenders and less secure parking. Most products, especially those defined by CRAVED, run their greatest risks of theft at retail when they are new and when they can be found in large numbers at predictable places. Not just theft, but also counterfeiting and tampering must be guarded against at retail. Most of the changes made by manufacturers to labelling and packaging are made to protect products at this stage in their lives. On a longer time scale, certain new products, such as cell phones and personal computers, are said to go through a "product life cycle," which also determines their theft risks. At first these products attract little theft because they are unfamiliar and relatively unavailable. As their popularity among consumers grows, thieves become attracted to them for personal use or for resale. Subsequently, they become widely available and relatively inexpensive, and their attractiveness for theft declines (Gould, 1969; Mansfield et al., 1974; Felson, 1997).

7. *Because of the complexity of situations giving rise to specific kinds of crime, there are usually many alternative ways to reduce opportunities for these crimes.* These alternatives have a variety of costs and benefits (Clarke, 1997). For example improved packaging and labelling can reduce the risks of tampering or theft at retail, but so can improvements made to shop security. While the ultimate costs of these improvements fall upon consumers, the immediate costs fall differently upon retailers and manufacturers. They might not be able to agree who should make the changes and might tacitly agree to absorb the cost of theft. Again, this means that consumers suffer in terms of higher prices. It also

means that taxpayers bear the costs of an increased burden on law enforcement and the criminal justice system.

8. *Because offenders are adaptable, criminals and those seeking to prevent crime are engaged in a perpetual arms race* (Ekblom, 1999; Pease, 2001). One variant of the life cycle hypothesis emphasises the role played by prevention in reducing product vulnerability in the later stages of the cycle. Thus, Home Office researchers have argued that "crime harvests" resulting from the sometimes hasty introduction of criminogenic products are diminished by retrofitting crime prevention measures (Ekblom, 1997; Pease, 1998). One example is the cell phone, which criminals in the United States quickly learned how to "clone" so that they could use copies of legitimate phones free of charge. In 1995, these frauds were costing U.S. cell phone companies about \$800 million. Within four years they were virtually eliminated through a series of technological counter-measures taken by the cell phone companies, and there has been no sign of a resurgence of cloning and no new widespread forms of wireless fraud have appeared in the United States (Clarke et al., 2001).⁴ Other cases where prevention seems to be winning the arms race—forging of banknotes, for example—are mentioned below, but there are also cases where the struggle between criminals and crime prevention has been more equal. For example, car theft rates are dropping in many parts of the world, but they still remain unacceptably high. Vehicle manufacturers would no doubt have made more determined efforts to improve car security if they were as much harmed by thefts as the phone companies were by cloning.

9. *Casual offenders often discover product vulnerabilities, which are then transmitted by word-of-mouth, the media and the Internet. Much larger numbers of casual offenders then exploit these vulnerabilities, as well as organised criminals who exploit them on a larger scale.* The use of slugs in the London Underground ticket machines described above seems to have followed this pattern. First, some isolated instances were discovered at a few scattered stations, and then slugs quickly began to appear at many other stations in the system. Subsequently, organised groups of offenders began systematically to milk the machines at groups of nearby stations. The same kind of a pattern held for cell phone cloning in the United States. Soon after the occasional cloned phone began to appear (presumably as the result of individual know-how), organised

criminals began to produce them on a large scale. Not only did these phones provide free phone service, but they also protected the identity of the illegitimate users. Consequently, they became attractive to drug traffickers and other criminal groups.

The theoretical propositions summarised above should make clear how certain products can produce crime waves, small or large, and how they can be modified to reduce crime. More than that, however, the propositions also provide policy makers with sound reasons for becoming involved in product change. If products can be modified to reduce the crime burdens they impose on society, governments have the right, if not the duty, to seek changes in these products. In seeking these changes, governments are helped by the facts that products wear out and must be replaced, and that manufacturers are constantly updating them for their own reasons. The question then becomes, not *whether* government should be involved in product change, but *how* limited government resources can best be used in achieving product change. To answer this question, the product changes that have been made to date need to be examined, the government role in these changes needs to be identified and the scope for future change needs to be assessed. Section 2 below begins with an examination of the changes made to date.

2. PRODUCT CHANGES MADE TO DATE

As mentioned, there is a long history of redesigning products to reduce the risks of crime. Manufacturers have made these changes to improve profits, safeguard their market positions or to exploit new sales opportunities. In making these changes, they have not been guided by crime prevention theory, but have tried merely to make things more difficult for the offender. In most cases, they have acted without government prompting and have probably given little thought to the public benefits of their actions, or to the possible costs in terms of displacement and escalation.

The review below covers the products involved, the associated crimes and the nature of the changes made. No attempt was made to provide a complete list of products changed because of the sheer scale of the undertaking. When changes to labelling and packing are included such a list would run to hundreds of items. Even then it would almost certainly be incomplete since product changes are frequently not documented and are difficult to find through literature reviews. In any case, without first

classifying products in some meaningful way, the list would be difficult to interpret. However, existing product classifications based on retail or industrial sectors proved too general to be useful in the present context. Dividing products into *targets* of crime (i.e., hot products) and *facilitators* of crime was unsatisfactory because some products are both (for example, credit cards are stolen for later fraudulent use). More problematic was that most products fell into the category of facilitator, and subdividing this according to the crimes involved ran into the difficulty that some products, such as cars (see Table 1), have been altered to prevent a variety of crimes.

Another attempt to classify products, this time by the *nature of the changes* made, also proved unsuccessful. In this case, changes were classified using the then 16 opportunity-reducing techniques of situational crime prevention (subsequently expanded to 25; Cornish & Clarke, 2003), which were grouped under four main categories of increasing the *effort* or the *risks* of crime and reducing the *rewards* and the *excuses* (Clarke, 1997). Using all 16 techniques resulted in too many empty cells, while use of only the four main categories resulted in most changes falling under increasing the effort and reducing the rewards.

A third attempt, to classify products according to the *victim* (e.g., businesses, private individuals, or the public at large), was abandoned

Table 1 Changes Made at Manufacture to Cars and Crimes Prevented

Crime	Device or Redesign
Unauthorised use and joy-riding	Ignition locks; improved door locks; steering column locks; alarms; immobilisers
Theft of cars or major body parts	As above but also: parts marking; GPS (global positioning system) locators; tamper-proof licence plates; microdots ⁵
Theft from car	Stronger door locks; alarms; lockable gas caps; redesigned emblems; security coded radios; removable radios; dispersed audio system
Vandalism	Retractable aerials
Assassination	Armour plating; ram bars
Illegal use of rental car	GPS locators to detect speeding (Greenman, 2001)

because so often there are multiple victims. For example, car theft harms (1) individual owners, who are caused much inconvenience even if they recover their cars; (2) insurance companies, who must make compensatory payments; (3) the public at large, who must pay larger insurance premiums; and (4) the police and the courts, whose resources are burdened (Field, 1993).

In the end, the most useful classification proved to be a simple division between *consumer products*, owned by private individuals, and *business products*, owned by financial institutions, transportation and telecommunication companies, public institutions and government bodies (when acting as service providers). Useful as it proved, this distinction is blurred by the facts that:

- Changes made to labels and packages are intended to protect consumer products at retail before they have reached the hands of consumers.
- Private individuals regard many products that have been altered (for example credit cards or banknotes) as their personal possessions when in fact they are essential tools of business.
- Some consumer products only become targets or facilitators when owned by business (for example, bathrobes are only likely to be stolen when they belong to hotels and glasses become potential weapons in pubs).

Consumer Products

The main categories of consumer products that have been changed are *cars and car parts*, *food and drugs (packages and labels)* and *electronic equipment* (e.g., TVs, computers and software, photocopiers, and "safer" handguns). A listing of consumer products that have been changed to prevent specific crimes is presented in Table 2.

Business Products

Many more business products than consumer products have been changed, and the main categories are:

- *Vehicles* (buses, train carriages, taxis and trucks);
- *Service-delivery devices* (public phones, parking meters, cell phones, coin fuel meters, cable-TV boxes, automated teller machines or ATMs);

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Table 2 Crimes Prevented by Changes to Consumer Products

Crimes Prevented	Products Changed	Devices or Redesign
VEHICLE THEFT	Cars; motorcycles	See Table 1 for list of anti-theft devices
THEFT OF CAR PARTS	Car audio systems	Removable radios and face plates; security-coding; dispersed audio system
	Car parts	Parts marking; windscreen VIN etching; microdots
	Car emblems	Redesign of VW (Mueller, 1971) and Cadillac emblems to prevent removal by juveniles
SHOPLIFTING	CRAVED products	Large packaging for small items; source tagging
OTHER PRODUCT THEFTS	Cell phones	Account verification technology
	Computers	Automatic tracking when logged onto Internet (Evans, 2000)
	Paint tins	Dulux tamperproof tins (Design Council, 2002)
	Gas caps	Lockable caps to prevent gas siphoning
	Handbags	Alarms and strengthened material to prevent thieves cutting the bag to steal wallet in crowds (Design Council, 2002)
BURGLARY	Luggage labels	Flap to conceal address
FRAUD	Mileometers in cars	Tamper-proof design
COUNTERFEITING	Photocopy machines	In-built bank note recognition software
	Product labels	Holograms on liquor labels
	Expensive watches	Customer registration and authentication certificates

(continued)

Table 2 (continued)

Crimes Prevented	Products Changed	Devices or Redesign
COPYRIGHT INFRINGEMENT MENT	Software; music; videos; movies	Programmed to prevent illegal copy- ing (Lake, 2001)
TAMPERING	Food and drug products	Tamper-proof packaging and seals
HACKING	Personal computers	Anti-virus software; firewalls
ILLEGAL DRUG AND ALCOHOL USE	Syringes Painkillers Mixer drinks and “alcopops”	One-time use syringes Narcotic neutralised by chemical if time release capsules broken open ⁶ Clear labelling of alcohol content and avoidance of packaging to ap- peal to under-18s
HARASSMENT	Phones	Caller identification devices
VIOLENCE	Cars TVs Handguns	Bullet-proof models V-chips to prevent viewing of vio- lent programs Biometric recognition/electronic bracelets to identify authorised user
TERRORISM/ REGIONAL CONFLICT	Diamonds	“Fingerprinting” and authentication schemes to inhibit sales of “blood” or “conflict” diamonds, mined ille- gally to fund terrorism and regional wars (Rawls, 2001).

Note: Sources are cited within this table only when they are not cited elsewhere in this chapter.

- *Cash containers* (including those in many service delivery devices but also cash registers, vending machines, ticket machines, gambling machines, coin meters);
- *Furnishings and fixtures* (park furniture, pub glasses, hotel room equip-ment); and,

- *Financial instruments and other authorisations* (banknotes, credit cards, cheques, postage stamps, passports, vehicle registration documents and license plates).

A listing of business products that have been changed to prevent specific crimes is presented in Table 3. No doubt many products have been overlooked, including specialised metering and recording devices used throughout business and industry (scales, time clocks, taxi meters,⁷ tachographs, etc). Manufacturers probably have to improve these regularly to prevent tampering,⁸ but these changes rarely come to the attention of criminologists.

Effectiveness of Product Changes

Relatively few of the product changes listed in Tables 2 and 3 have been formally evaluated (defined as a quantitative assessment published in an academic journal or government research report). However, some act so directly to reduce crime opportunities that their impact is essentially self-evident. For example, few thieves seeking cash would break into public phones that could only be operated by pre-payment cards. In some other cases, it would be obvious if changes had not worked.¹⁴ Thus, there would have been a media outcry if drop safes had failed to stem bus robberies in the United States, or tamperproof seals had not stemmed further poisonings of the Tylenol variety (*Case Study 3*). In yet other cases, such as the fitting of bulletproof shields in taxis, some basic statistical data suggest that the changes were effective.¹⁵ Lastly, if changes made to protect businesses profits had failed to work, or worked only for while, this would not have escaped the notice of the businesses concerned, which would have taken fresh action to stem losses.

In fact, most of the evaluations that have been published (see Table 4) show positive results, sometimes spectacularly so (with pride of place being taken by the virtual elimination of cloning, which cost U.S. cell phone companies more than \$800 million in 1995). However, no systematic evaluation plan guided the studies undertaken, many of which were conducted by advocates of situational prevention. The changes were often "known" to have worked and the purpose of the study was to document the evidence. All the studies were retrospective and they were often forced to use weak research designs and small numbers of cases.

Table 3 Crimes Prevented by Changes to Business Products

Crimes Prevented	Products Changed	Devices or Redesign
VEHICLE THEFT	Trucks; construction plant	Variety of built-in anti-theft devices
OTHER PRODUCT THEFTS	Shop coat hangers	Designed to reduce "rail grabbing" of multiple items
	Hotel room hangers	Clothes hangers integrated with the hanger rail
	Hotel towels, ash-trays	Monogrammed towels, ashtray, etc.
	Shopping carts	Prepayment/refund systems; redesign to reduce usefulness of trolley outside shop; electronic locking/disabling systems (Design Council, 2002; Neeley, 1998)
BURGLARY	Gas pumps	Self-service pumps modified to prevent pumping before payment
	Coin-fed fuel meters	Replaced by card-operated prepayment meters ⁹
THEFT OF CASH	Public phones	Prepaid phone card (see also changes to reduce vandalism)
	Cash registers	Automatic transaction recording
	Vending machines	Strengthened cash containers. Alarms activated when tilted or switched off. Last-in-first-out system for the coin return mechanism
ROBBERY	Buses	Drop safes incorporated in buses
	Taxis	Bullet-proof shields in American taxis
THEFT OF SERVICE	Cell phones	Anti-cloning and account verification technology
	Public phones	Blocked access to long distance service and PBX systems
	Business phones	Blocked access to long distance service
	Parking meters and ticket machines	Slug detection devices

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Table 3 *(continued)*

Crimes Prevented	Products Changed	Devices or Redesign
	Cable TV boxes and satellite systems	Scrambling of signals; encryption of digital signals; matching programming with consumer address (Paradise, 1995)
	Postage meters for businesses	U.S. Mechanical meters replaced by electronic digital meters difficult to corrupt (Plastiras, 1998)
	Automatic ticket gates	London Underground ticket gates are designed to prevent "turnstile" vaulting and fare evasion by checking tickets at entry and exit
FRAUD	Credit/bank cards ATMs	Account verification technology In-built video-recording of customers
	Vending machines	Slug recognition devices
COUNTERFEITING	Banknotes/credit cards/cheques Passports/green cards Identity cards Driving licenses Vehicle registration documents ¹⁰ Postage stamps Academic transcripts	See Appendix for case studies of changes to prevent counterfeiting of banknotes and cheques. Many of the same changes have been made to passports, driving licenses, ID cards, stamps, etc. Similar changes have been incorporated in academic transcripts by college and university printers ¹¹
	Tickets	Barcoding to prevent counterfeiting and fraud "Contactless" smart cards for London Underground (Benham, 2002)
	Licence plates	See Table 4 for details of changes made to Swedish number plates. The Association of Chief Police Officers has called for similar changes to be introduced in Britain (Williams, 1998)

(continued)

Table 3 *(continued)*

Crimes Prevented	Products Changed	Devices or Redesign
HACKING	Computers	Anti-virus software; firewalls
MOTORING OFFENCES	Rental cars	Track rental cars for illegal use
	Tachographs	Automatic logs of long distance truck trips; digitisation of tachographs (Anderson, 1998)
VANDALISM	Public phones	British Telecom redesigned phone kiosks and introduced the "Oakham" booth to reduce vandalism; similar changes in Australia (see Table 4)
	Street lights	Bullet-proof shields incorporated for lights in drug-dealing areas in the United States
	Park furniture	Designed to be fixed to ground and to be resistant to deliberate damage
	Bus shelters	Open design to reduce vandalism and graffiti (Design Council, 2002)
	Glass	Toughened
	Road signs	Made from plywood in rural areas to prevent satisfying "clang" when shot at (Wise, 1982)
LOITERING	Public seating	"Bum proof" designs to discourage sleeping on benches and seats
ILLEGAL SUBSTANCE USE	Public phones	Modifications to reduce their value to drug dealers ¹²
	Airliners	Smoke detectors in lavatories
	TVS and head-phones for prison inmates	See-through casing to prevent concealment of drugs (LiCalzi O'Connell, 2001)
ASSAULTS	Buses	Plastic shields for bus drivers
	Railway carriages	Open designs to facilitate natural surveillance
	Pub bottles/glasses	Bottles/glasses that cannot be used as weapons
	Jail phones	Time rationing and account verification technologies

Table 3 *(continued)*

Crimes Prevented	Products Changed	Devices or Redesign
TERRORISM/ REGIONAL CONFLICT	Airport seating	Designs that make it easy to see suspect packages left beneath the seats (Design Council, 2002)
	Car Licence plates	Modified numbering systems to prevent identification of ethnicity of car owners. ¹³

Note: Sources are cited within this table only when they are not cited elsewhere in this chapter.

Even without these limitations, the studies leave some important questions unanswered. While they may show that product changes can sometime be highly effective, they do not indicate which kinds of changes work well and which do not. They also tell us little about the durability of benefits achieved through product change. How often does technological development make changes redundant (the removable car radio) and how long do modifications resist renewed criminal attack? Finally, they tell us little about the cost-effectiveness of measures and about the extent to which their crime prevention benefits are eroded by displacement.

These questions are not merely of academic interest, but are of vital concern to governments when considering their future roles in product change. To answer them, governments will have to invest much more heavily in research. They will also need to develop a new research relationship with business, because it is businesses that have made most of the product changes. Until now, governments have generally taken the position that businesses should evaluate their own crime prevention measure since they are the main beneficiaries. Unfortunately, businesses have been resistant to evaluation for a variety of reasons: the results of the measures may be obvious to them; they avoid expenditure that does not lead to increased profits; and they fear giving advantage to competitors by the release of information about effective (or ineffective) practices.¹⁶

However, it is clear from examples listed above that product change can bring considerable public benefits, and that failure to change products can result in significant public costs. The full extent of these costs is not always readily apparent. For example, shoplifting, assisted by easy opportunities, often supports a drug habit, while cloned phones were a boon to organised crime and drug traffickers in the United States. Likewise,

Table 4 Evaluated Product Changes

Product	Device or Redesign	Study	Findings
Cars	Steering column locks introduced in Germany (1962), the USA (1970) and England and Wales (1971)	Webb (1997)	Car theft rates decreased/stabilised after steering column locks introduced. Best results in Germany, where locks were compulsory for all cars (new and old) from 1962
Car radios	Security coding	Braga & Clarke (1994)	Theft from German-made cars began to decline in U.S. and Germany in the late 1980s following introduction of security coding
Major body parts of cars	Parts marking	Harris & Clarke (1991); Rhodes et al. (1997)	Parts marking of "high risk" cars produced, at best, modest reductions in professional auto thefts
Vehicle number plates	Laminated and tamper-proof plates with VIN mandated for Sweden in 1971	Jill Dando Institute of Crime Science (2002)	Production and distribution of plates is highly secure. Sweden has similar joyriding rate to E&W, but much less professional theft
Private phones	Caller identification made available in New Jersey in 1988	Clarke (1992)	Introduction of Caller-ID resulted in immediate 25% drop in harassing/obscene phone calls in areas with service
Cell phones	User and account verification technologies enhanced in the United States in 1990s	Clarke et al. (2001)	Losses from "cloning" were reduced from \$800 million in 1995 to \$50 million in 1999. Minimal displacement; highly cost-effective

Modifying Criminogenic Products

Table 4 *(continued)*

Product	Device or Redesign	Study	Findings
Public phones	Blocked access to long distance lines and PBX exchanges	Bichler & Clarke (1996)	Phone frauds of more than \$1 million per month at the Manhattan bus terminal were virtually eliminated. No apparent displacement
Public phone kiosks	Coin boxes and other equipment strengthened; reinforced glass used; kiosks replaced by booths	Markus (1984); Challenger (1991); Bridgeman (1997)	Target hardening substantially reduced vandalism and theft from public phones in Australia and U.K. in 1970s and 1980s. In South Australia and the Northern Territory incidents of deliberate damage declined from nearly 6,000 in 1988 to about 1,100 in 1989
Jail phones	Time rationing and account verification technologies	La Vigne (1994)	Inmate violence connected with abuse of phone privileges reduced by 50% at Rikers Island
Credit cards	Anti-counterfeiting features in card; account verification technology	Webb (1994); Levi & Handley (1998)	These improvements together with more secure delivery of new cards led to a 40% decline in frauds losses, which fell from about £165 million in 1991 to about £97 million in 1994
Buses	Drop safes/exact fare systems in late 1960s	Stanford Res. Inst. (1970)	Robbery of bus drivers in New York and 15 other U.S. cities reduced by more than 90%

(continued)

Table 4 *(continued)*

Product	Device or Redesign	Study	Findings
Buses	Polycarbonate protective screens for Cleveland Transit driver-operated buses	Poyner & Warne (1988)	Installation of screens on 180 buses "almost entirely eliminated" assaults on divers, previously occurring at a rate of one per month
London Underground ticket machines	Blocks on slug use	Clarke et al. (1994)	Blocks on use of 50p coins (costing £135,000) eliminated cash thefts to value of more than £250,000 per year
Parking meters	"Duncan" meter with slug-rejecter device and coin window	Decker (1972)	Introduction of "Duncan" meter led to an immediate 30-80% drop in slug use in New York City neighbourhoods

Notes:

- (1) Evaluations of retrofitted drop safes in buses and bus-driver shields were included because these were subsequently adopted at manufacture.
- (2) Only the most recent and/or comprehensive studies are listed in cases where more than one evaluation was undertaken.

easy theft of tempting targets like cars and their contents can be the first step for some young people on a criminal career. This gives government a strong incentive to see that evaluations are made of changes to business products. It also reinforces the general point that investment by government in private prevention could be more cost effective than increased investment in the criminal justice system (van Dijk, 1994).

Summary

This review of product changes made to date has shown that very many different products have been modified to prevent crime. Indeed, the variety suggests that almost any product could be misused for crime. While also quite various, the crimes prevented fall into several main categories, which are as follows: theft of products (including vehicle and vehicle parts); theft of services; theft of cash; product tampering; robbery and burglary; fraud; counterfeiting and illegal copying; violence; and vandalism.¹⁷

Most of the changes have been made to *business* products, which are essential tools for conducting business or delivering service. Of changes made to *consumer* products (i.e., ones intended for private ownership and use), most involve labelling and packing. Since many of these changes are designed to prevent crimes occurring at retail, such as shoplifting and product tampering, the principal beneficiaries once again are businesses. Apart from packages and labels, the most often-changed consumer product is the motorcar. The security of new cars is almost continuously being improved to cope with new crime threats or changes in criminal methods, and to take advantage of new technologies. These technologies are almost daily expanding the scope for product changes, which already show great variety and, sometimes, considerable ingenuity.

Relatively few evaluations have been published of product changes. These often show substantial crime reduction benefits, but they leave many questions unanswered about the generality of these benefits, about their longevity and about their cost effectiveness. A much greater investment is needed in evaluation in order to help governments think about their role in product change. This investment will also require governments to develop a new research relationship with business, which plays the dominant part in product change.

In order to prepare the ground for a closer look at the roles played by governments in product change, Section 3 of this paper will examine the processes involved in product change, the parties involved, and the ways in which they have brought pressure to bear.

3. THE PROCESS OF PRODUCT CHANGE

Most product changes are made by businesses for straightforward commercial reasons: to protect the integrity of services provided to the public; to stem cash losses; to prevent a decline in sales; to avoid product liability suits (resulting from tampering, for example); or to provide competitive advantage. To repeat some of the examples mentioned above, vending machine operators and public phone service providers have strengthened cash containers to prevent theft; bus and train companies have required vandal-resistant materials to be used for seats and other fixtures; manufacturers of expensive wrist watches have issued certificates of authenticity; distillers of high-priced alcoholic beverages have included holograms in labels; financial institutions have established automatic account verification procedures for credit cards; retailers have required small, easily shoplifted

products to be packaged at manufacture in bulky containers; and self-service gas stations have installed gas pumps requiring prepayment. Governments have initiated similar changes when acting as essential service providers. For example, they have continuously sought to upgrade the security of banknotes, passports and vehicle registration documents.

Most of the changes to protect government and commercial interests have been relatively uncontroversial and have attracted little public comment. They quietly appear and become part of everyday life. Manufacturers make them on their own initiative or in agreement with business customers, including governments, retailers (and retailers' associations), financial institutions and service providers such as train and bus companies.

In some cases, business has failed to act even when it is the main victim. For instance, rather than introduce costly prevention, many retailers prefer to tolerate a certain amount of shoplifting so long as this does not significantly impact profits. (In the United States, they can even write off these losses against tax.) Unfortunately, their calculations do not include the public costs of prosecuting and sentencing apprehended shoplifters. Sometimes these failures to act can have serious consequences, as when organised criminals began to make a business of cloning phones and of counterfeiting credit cards.

Businesses have also failed to act in cases where product changes would protect the public, but would bring no special benefits for themselves. For example, vehicle manufacturers have long been criticised for doing too little to improve car security. They have claimed that the public would not pay for the increased security, but others have accused them of profiting from theft through sales of replacement cars or parts (Brill, 1982; Karmen, 1981). Only when public safety is threatened, as in the case of product tampering, do manufacturers act speedily, though, again, this is partly self-interested. Sales of pharmaceutical and food products would have been severely hit had action not been taken to prevent tampering (See *Case Study 3*).

It seems particularly difficult to get manufacturers to act in the public interest when:

- They are scrambling to develop new products, such as cell phones, before crime vulnerabilities are manifest.
- Changes are costly, inconvenient and not of proven value. British Telecom was unwilling to speed up the introduction of caller identifica-

tion solely on the basis of early suggestions from the United States that this had prevented obscene phone calls.

- The crimes are considered trivial by dominant interests and public concern is not high (obscene phone calls again provide an example).
- The solutions are controversial owing to cultural factors (U.K. drinkers are said to prefer their beer served in ordinary glasses, not ones made of toughened glass) or concerns about civil liberties (caller identification and, in the United States, the right to bear arms).

In the struggle for change, a wide range of parties can become involved on either side of the debate. Apart from government in its role of public watchdog, these parties include the following:

1. *Pressure groups*—Consumer associations and motoring organisations have brought pressure to bear on manufactures to improve the security of cars. For example, the British consumer magazine *Which?* (1991) has published data showing how easy it is for thieves to break into new cars. In some cases, pressure groups have opposed product changes. For example, an alliance of women's organisations fearing that caller identification would reveal the locations of women's refuges and the American Civil Liberties Union seeking to protect the freedom of callers ensured that this service could only be offered in most U.S. states with a call blocking facility (see *Case Study 2*). Occasionally, pressure groups have taken up positions on either side of a debate, as in the case of Handgun Control and the National Rifle Association in the debate about safer guns (see *Case Study 5*).
2. *The media*—Pressure groups often make use of the media to advance their cause, but the media can also act independently. The *New York Times* has for many years advocated a variety of controls on firearms, including the production of safer handguns, and it also played an important part in publicising the high risks of robbery and homicide of immigrant taxi drivers in New York. This campaign played a part in the measures adopted to deal with the problem, including a requirement for built-in shields between driver and passengers. Quite frequently, the media also fans public concern about particular problems—phone box vandalism, robberies at bank machines and TV violence—that leads to product change. This coverage is particularly intense when a prominent person falls victim (as when Donna Shalala, Health and Human Services Secretary in the Clinton administration,

fended off robbers at an ATM in Washington in March 1999), or following some catastrophic event such as the Tylenol poisonings (*Case Study 3*) or a school shooting in the United States.

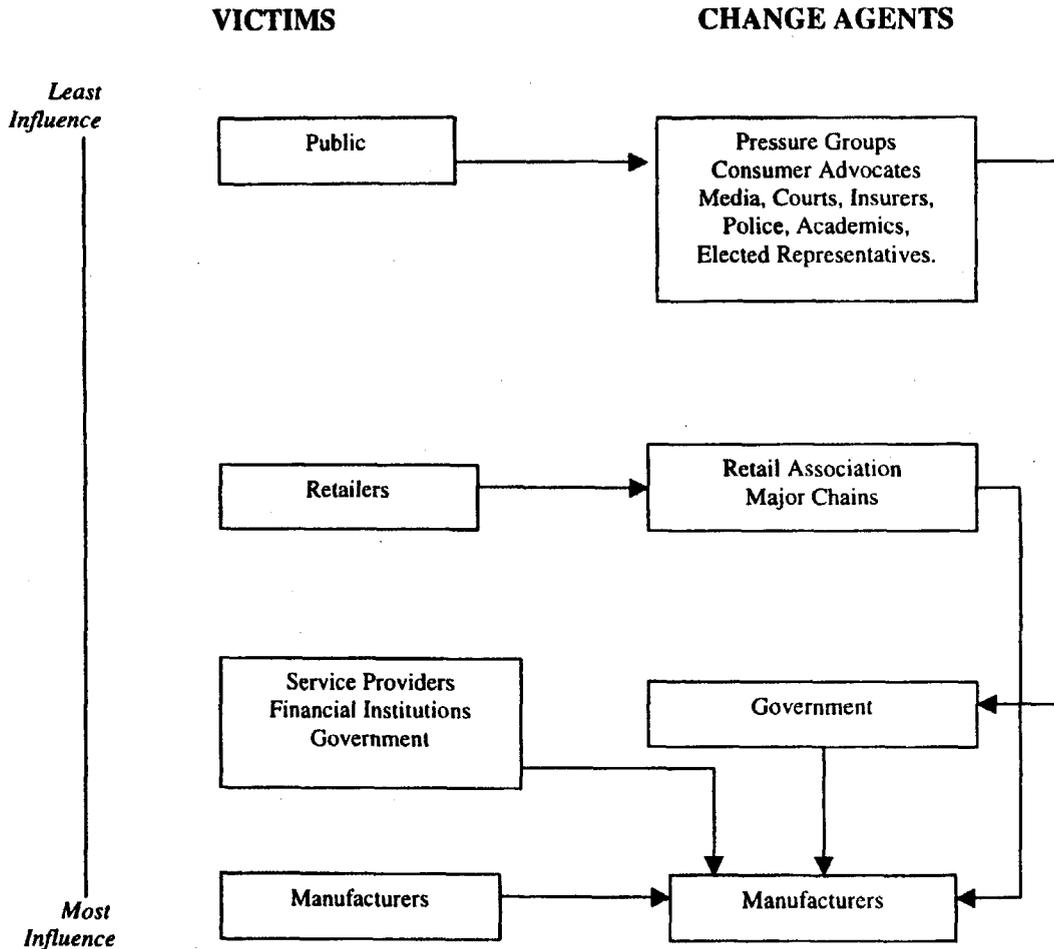
3. *The courts*—In the United States, customers who have been robbed at ATM machines or assaulted in their rooms commonly bring negligence suits against banks and hotels (Kennedy & Hupp, 1998; Guerette & Clarke, 2003). Product liability suits are much less common, though the introduction of tamperproof seals for food and pharmaceutical products was hastened by the fear of such suits (see *Case Study 3*). More than 30 city and county governments in the United States have attempted to sue gun manufacturers for irresponsible manufacturing and sales practices. These suits, which involve novel legal issues, remain unresolved (see *Case Study T*), though *public nuisance* suits focused on irresponsible sales practices are currently making more progress than *product liability* suits focused on gun design (Butterfield, 2002).
4. *Insurance companies*—Insurance companies sometimes provide discounted car insurance policies for models with built-in theft prevention devices. In some U.S. states, they are required to do so by law. The NRMA (National Roads and Motorists Association) in Australia, which is a hybrid insurance and motoring organisation, produces annual theft data for all models of car on the road in an attempt to draw attention to the need to improve vehicle security (Hazelbaker, 1997). The Highway Loss Data Institute in the United States, which is a road safety research organisation funded by the insurance industry, goes somewhat further. It not only publishes similar league tables, but it engages in discussions with manufacturers to get them to remedy specific security weaknesses on particular models (Hazelbaker, 1997). The Association of British Insurers has a testing centre at Thatcham in which vehicles are subjected to simulated criminal attack; their performance influences the "insurance band" a given model will be assigned to, and hence the premium the owners must pay. Needless to say, the manufacturers take this process seriously.
5. *The police*—Although the police may be among the first to become aware of problems caused by particular products, they have played only a small role to date in calling for product changes. Again, the exception is cars, where police often complain publicly about poor security. In 1990, it is reported that the Major Cities Police Chiefs Association, representing 63 cities in the United States and Canada,

successfully petitioned General Motors to improve the design of steering column locks on their vehicles (Staff, 1990).

6. *Elected representatives*—Politicians quite frequently become advocates of product change. For example, Rep. Charles E. Schumer, Democrat of New York, has consistently pressed the gun manufacturers to produce safer guns. And advocates of the V-chip (see *Case Study 6*) included politicians, such as Rep. Ed Markey, Democrat of Massachusetts, who drafted clauses of the bill that was eventually enacted.
7. *Academic researchers and design professionals*—While few academics and design professionals have shown any interest in product change (Erol et al., 2002), some notable exceptions exist. For example, research programs undertaken by Levi and his associates on credit card and cheque fraud (see *Case Study 4*) have helped to reduce this problem, while Shepherd's pioneering work on injuries in pub fights has resulted in some pubs and clubs now serving beer in glasses that do not shatter when broken and that cannot be used as weapons (*Case Study 1*). The inventor of the V-chip, Tim Collings, was a Canadian electrical engineer who said he had been deeply affected by the murder in 1989 of 14 students, all women, by a Montreal gunman, who was a collector of graphically violent videos (Monaghan, 1997). Stimulated by a partnership between the Design Council and the Home Office, designers at Central St Martins College of Art and Design have produced design studies for restaurant chairs that reduce opportunities for bag theft (Ekblom, 2000).¹⁸

Closer study is needed of the roles played in product change by these "change agents," but the routes through which they bring pressure to bear on manufacturers are depicted in Figure 1. On the right of the diagram are the main change agents, whereas on the left are the main victims,¹⁹ both listed in order of the degree of pressure they can bring to bear on the responsible manufacturers. The main point of the diagram is to illustrate the indirect route that pressure for product change must take when the *public* is the victim. Almost all other victims have direct and immediate access to the manufacturer concerned. For example, ATM manufacturers have to be highly responsive to the concerns of the banks, which are the main customers for their products (though many other businesses, such as convenience stores and hotels, are now installing ATMs.) When the public is the principal victim, however, this pressure must be exerted through a variety of other parties and, ultimately, must be translated into

Figure 1: Pressure for product change
 (Arrows show directions of pressure).



action by the government. In Section 4, a closer look is taken at the part that has been played by government in product change, before discussing (in Section 5), whether government has a greater part to play.

4. GOVERNMENT ROLES TO DATE

As explained in the next section, governments are beginning to think more proactively about product change, but until now their response to the need for modifying products has been reactive and *ad hoc*, designed to solve a specific problem connected with a particular class of products rather than to develop a longer-term policy position. Consequently, governments have

adopted a wide variety of roles in product change and this variety seems to be increasing, perhaps in response to the growing possibilities for change opened up by new technology. Keeping abreast of this evolving situation is just one of the difficulties encountered when describing and classifying the role that governments have taken in product change, particularly in a review of this kind that attempts to cover all products in a variety of countries. Other difficulties are as follows:

1. The role taken by government in any specific case depends on the options available, which vary with the product, the state of current technology and with a host of other circumstances. For example, the U.S. federal government could only require V-chips to be installed in all new television receivers because the invention had recently become available and because a government-imposed system had already been developed for rating and displaying the violence content of TV programs. Absent these conditions, the government could not have acted so forcefully. Taking account of the multitude of these circumstances in a review of this kind, without becoming hopelessly enmeshed in detail, presents a difficult challenge.
2. The willingness of governments to intervene in the private sector depends on their political complexion. Thus, Conservative Party governments in the U.K. and Republican Party governments in the United States have generally been reluctant to intervene in business practices or to expand the role of government in regard to business and industry. Which varieties of governments have been in power, and for how long, can therefore have a marked impact on a country's record of product change.
3. Levels of concern about crime, which can vary considerably from one country to another or in the same country over time, can strongly influence a government's willingness to become involved in product change. For example, concern about car theft prompted the Conservative government in 1992 to publish "league tables" of the most stolen cars in an effort to get manufacturers to improve their security (Pease, 2001).
4. Whether the private sector or government offers particular services is also subject to policy. Thus, many services previously offered by government in the U.K. and some other countries—rail services, subsidized housing, water, telecommunications—are now offered through

private enterprise. In days gone by, many of these services were originally provided by business.

5. The government role in product change depends on the system of government in place in the country concerned, its constitutional powers and its relationship with the legal system. These matters are difficult enough to understand about one's own country, but they are multiplied many times over when other countries are included. Thus, most people in Britain probably have little understanding of the scope for government intervention in a federal system such as exists in the United States, which at one and the same time limits the power of central government while expanding that of state and city governments.²⁰
6. The laws and legal traditions in different countries can greatly affect the scope for government intervention. In the United States, for example, there is a strong tradition, almost unknown in the U.K., of entrepreneurial lawyers filing class action liability suits on behalf of groups of citizens harmed by the products or practices of business and industry.

Despite these difficulties, the roles taken to date by government in product change can be classified into one of eight broad kinds. In order of the degree of pressure applied, these are government as bystander, arbitrator, enabler, persuader, financier, litigant, legislator and customer. The discussion of these roles is illustrated by the case studies in the Appendix.

1. *Bystander*. It was argued earlier in this review that most product changes are made quietly by industry with little involvement of other parties. Government may be barely aware of these changes, but in some cases it becomes ensnared in controversy when changes have upset the public. These upsets are often short-lived and the public becomes used to the changes, but in other cases, more might be at stake and the row might escalate. Ministers might then be drawn in willy-nilly, still essentially in the role of bystanders trying to steer a middle course. This seems to have happened in the controversy over safer bottles and glasses in pubs (see *Case Study 1*).
2. *Arbitrator*. Government has sometimes become involved in the role of "arbitrator" between industry, on the one hand, and a variety of consumer groups and pressure groups on the other. One example relates to the legal tussle in the U.S. between the phone companies and the American Civil Liberties Union (ACLU) over the introduction

of Caller-ID (see *Case Study 2*). State regulatory agencies became heavily involved in this dispute, attempting to find solutions that resolved the privacy issues, that served consumer interests and that were consistent with state laws. As the case study shows, however, technology finally came to the rescue by providing a set of choices for consumers that afforded satisfactory protection to both calling and called parties.

3. *Enabler*. Government acts in the role of enabler when it helps to bring about product changes that manufacturers desire but which require the cooperation of other parties—consumers, retailers, law enforcement and perhaps local or state governments. The best example of government as enabler lies in the regulations enacted by the U.S. Food and Drug Administration to govern tamper-proof sealing (see *Case Study 3*). These regulations were needed by business and industry to provide protection against product liability suits and, indeed, were developed with their active assistance.
4. *Persuader*. Government attempts to persuade manufacturers to change their products are of two kinds. The first, a "soft" approach, consists of behind-the-scenes discussions with manufacturers and industry representatives to persuade them of the need for change. An early example would be the agreement reached in the U.K. early in the 1970s between the Home Office and car manufacturers (represented by the Society of Motor Manufacturers and Traders) to install steering column lock on all new cars (Webb, 1997). The Home Office performed a similar role in orchestrating changes made in the early 1990s to credit cards, debit cards and cheques (see *Case Study 4*). More recently, it has adopted a more confrontational "hard" approach in regard to the security of cars and cell phones, which makes use of the media to blame intransigent manufacturers for failing to act. In both cases, it issued reports showing that the products themselves were contributing to the problem and calling attention to needed security improvements (Crime Prevention Agency, 1997; Harrington & Mayhew, 2002).
5. *Financer*. Governments can wield considerable financial power in persuading manufacturers to act. They can, in theory, let contracts for specific products meeting defined security standards; provide subsidies for product development; permit tax write-offs for expenses incurred in product development and manufacture; and impose fines on recalcitrant manufacturers. To date they have made little use of such powers

in securing modifications to criminogenic products, though a notable exception was the announcement made by Andrew Cuomo, Secretary of Housing and Urban Development in the Clinton administration, and Attorneys General from New York and Connecticut, that they would give preferential treatment in the procurement process to gun makers who adhered to a code of conduct signed by one of their number (see *Case Study 5*). This prompted a lawsuit brought by seven gun manufacturers charging that Cuomo and his co-defendants were illegally trying to influence where law enforcement agencies bought weapons.

6. *Litigant.* Handguns also provide the clearest example of governments making use of the courts to force manufacturers to change their products. As described in *Case Study 5*, in a repeat of action taken against tobacco companies, numerous city and county governments in the United States are in the process of seeking legal settlements against gun manufacturers to compensate for the costs of dealing with injuries and deaths caused by their products. Many of these suits have failed, but the final outcome is far from settled. It is clear, however, that the gun makers have been placed under great pressure by the suits to change harmful marketing practices and the unsafe design of their guns.
7. *Legislator.* Governments have most often resorted to legislation in the case of car security. Steering column locks were made compulsory in Germany for all vehicles in 1961 and in the U.S. for new cars from 1970 (Webb, 1997). Various state governments in the U.S. have required insurance companies to discount premiums for cars with in-built security devices. The U.S. Motor Vehicle Theft Law Enforcement Act 1984 required that the major body parts of new "high risk" cars be marked with the vehicle's identification number (or VTN) (Harris & Clarke, 1991), a provision that may soon be extended to all new cars. In 1998, the EU passed a law requiring all new cars to be fitted with an immobiliser,²¹ and a year later Australia followed suit by issuing an Australian Design Rule with the same requirement.²² (Western Australia went one step further by passing a law that made the installation of an immobiliser a prerequisite also for transferring ownership or re-registering of an existing car [Forbes, 2000].) Perhaps the most controversial legislation to date was that passed by the U.S. Congress in 1996, requiring all new television sets to be fitted with a V-chip to

allow parents to prevent their children from viewing violent programs (see *Case Study 6*).

8. *Customer*. For many products—passports, vehicle license plates and registration documents, banknotes (see *Case Study 7*)—government is the main customer and can require that suppliers meet certain security specifications. These specifications are constantly updated to take advantage of new technology, to accommodate new procedures (such as computerized scanning of passports), or to resist new criminal attacks. Despite its strong and direct role as customer, these changes often involve ministers and officials in much additional effort in explaining and justifying the changes to the public, and sometimes to a wider set of constituencies at home and abroad. For instance, as explained in the case study, when the U.S. government changed its banknotes, it had to take steps to reassure those hoarding its currency overseas that the old notes would still be valid.

Comment

Despite the short history of their involvement, governments have already taken a wide variety of roles in regard to product change. These have been discussed above in terms of government as bystander, arbitrator, enabler, persuader, financier, litigant, legislator and customer.

With so few examples to draw upon, it is hazardous to draw conclusions about the relative merits of these roles, though some, such as arbitrator or enabler, seem generally unproblematic. Few would also question the government's right, or indeed responsibility, to require changes to products for which it is the customer. Lastly, because most product changes are introduced by business and industry for their own reasons, it seems entirely appropriate that government's most usual role everywhere has been that of bystander—though in some cases, such as toughened glasses and bottles, one might have wished them to act more aggressively to assist change.

The more problematic roles are those assumed by governments in trying to get businesses to act when they are reluctant to do so. Some noteworthy differences have emerged between countries in their willingness to exert authority. In the United States, for example, governments have more often resorted to legislation, but sometimes with little to show as a result. As described in the *Case Study 6*, the V-chip has been a failure because parents see little need for it and rarely use it. Parts marking, which

was strongly resisted by industry because of its supposed costs, seems also to have failed in its objectives because the original legislation enacted a faulty compromise: To save expense, the government agreed that only "high risk" vehicles should be marked. This was a reasonable decision in itself, but the methodology for determining "high risk" was flawed because it rested on theft statistics that failed to discriminate between joyriding and professional vehicle theft. As a result, many cars taken by joyriders were included in a program that was designed to prevent professional thefts, and some models stolen by professionals were not marked (Harris & Clarke, 1991). At best, therefore, only modest reductions in car theft could be expected from this program, which is the result found in recent evaluations (Rhodes et al., 1997). For some time, the government has been locked in disagreement with manufacturers about whether to extend the parts-marking program to cover all vehicles (the manufacturers continue to complain about the costs [Stoffer, 1997]), though the Attorney General, Janet Reno, announced on July 31, 2000, that she had determined that parts marking ought to be extended to the entire range of models sold in the United States (Padula, 2000).

The most successful legislation to date is probably that enacted in Germany requiring steering column locks to be fitted on all cars, which resulted in an immediate and sustained drop in car thefts. This was a far better result than achieved by similar legislation in the United States (which in fact made standard a feature already provided by most manufacturers) and also by the voluntary agreement reached in Britain (Clarke & Harris, 1992; Webb, 1997). However, the critical element in the success of the German legislation was not requiring manufacturers to build-in these locks, but requiring the owners of existing cars to retrofit the locks.

It is impossible to say whether government can be more successful as litigant than legislator. The only cases to review, those brought by county and city governments in the United States against the gun manufacturers, have yet to be resolved, though they have put the industry under pressure to make its guns safer. However, it is uncertain what lessons can be drawn from this legal tussle for other industries and products let alone other countries. There are so many factors that make it an unusual case, including a U.S. Constitution that permits ownership of firearms, the formidable lobbying power of the National Rifle Association, and the existence of a multitude of state, county and city jurisdictions that make such suits possible.

Guns excepted for the present, it could be argued that where persuasion has failed the case for change (or at least the particular changes sought by government) may be weak, and resorting to legal powers in the circumstances is likely to produce disappointing results. This may be why governments in the United Kingdom, aided by a less legalistic tradition and the closer contacts possible with industry in a smaller country, have tended to avoid legislation and have generally relied on persuasion to secure desired changes. In the past, they have made successful use of behind-the-scenes discussions with industry, but recently they have adopted a more public, confrontational stance, perhaps as they have come under increasing pressure to bring down crime. In the recent cases relating to vehicles and cell phones, British governments have published detailed information about security failings in order bring pressure to bear on manufacturers (Crime Prevention Agency, 1997; Harrington & Mayhew, 2002). The Home Office report documenting the considerable variation in theft risks for cars was successfully used by Home Secretary Kenneth Baker in bringing pressure to bear on manufacturers to make security improvements to their vehicles (Pease, 2001). Similarly, the Home Office report on cell phone theft caught the attention of the media" and, soon after its publication the five major wireless phone companies announced they would phase in a series of measures to make cell phones inoperable after theft.²⁴

Whatever these differences between countries, governments everywhere have been reluctant to use their considerable financial powers (such as tax write-offs, subsidies and fines) in pursuit of change. This is surprising given that costs are the main reason that industry gives for resisting change. Considerations of the public interest, uppermost in the minds of government officials, rank much lower among the concerns of businessmen and industrialists. This reality cannot be ignored and more study should be made of the scope for government to exercise financial power. Pease has suggested that that S17 of the Crime and Disorder Act, which requires local authorities to anticipate crime consequences, could be extended to cover manufacturers. He points out that Alfred Pigou (1877-1959) was the first to advocate a tax upon industry that produces negative crime externalities and that this could include crime externalities of the kind discussed in this review (Pease, 2001). While a detailed discussion of this point falls outside the scope of the present review, we cannot forbear repeating a suggestion that one of us has previously made (Clarke, 2000), which builds upon the study undertaken by the Home Office to document

the disproportionate involvement of certain cars in theft. Along the lines of the "polluter pays" principle in some environmental legislation, perhaps the manufacturers of these cars could be sent a notional bill each year (copies to the media) for the costs falling on the criminal justice system as a result of the deficiencies of their products. This would ratchet up "hard" persuasion one further notch.

5. FUTURE POLICY OPTIONS

As explained above, whenever governments have acted to bring about product change, irrespective of the particular role taken, their action has been *ad hoc* to solve a particular problem. Only recently have governments begun to think about formulating policy to guide their actions in this arena. The Australian Institute of Criminology (a government research institution) has published a brief review of the scope for "crime prevention through product design" (Lester, 2001), and the Dutch government has established a small unit, *Senter*, to study the implications of new technology for crime and crime prevention (Lester, 2001). In the United Kingdom; the crime prevention panel established by the Department of Trade and Industry under the Foresight initiative worked to this same brief and, for the past few years, the Home Office has been commissioning research (such as this review) on criminogenic products. Together with the Design Council and the Royal Society of Arts, it launched the *Design against Crime* initiative to stimulate interest in "designing out crime" among professional designers.²⁵

The Foresight Crime Prevention Panel has recommended: (1) that a dedicated funding stream be established by government to focus science and technology attention on crime reduction; (2) that a national strategy be established to deal with all forms of e-crime; and (3) that ongoing programmes should be established to address crime at all stages of a product's life and to permit "horizon scanning" for future crime threats and prevention opportunities presented by new technology (Department of Trade and Industry, 2000b).

These moves are the clearest sign yet that governments are becoming more proactive in regard to product change. In this section, we consider the implications of such a policy shift and we discuss the merits of two different approaches: (1) the anticipatory design approach foreshadowed by Foresight and, (2) a problem-solving approach drawn from situational

crime prevention and problem-oriented policing. But first we should mention some of the obstacles that governments will encounter in pursuing more proactive policies. These can be summarized as follows:

1. Despite the major policy shifts brought about by changed academic and official understanding of crime and its control, the public and business remain largely out of this loop. For them, the solution of crime is still to catch and punish those responsible.²⁶ As Garland (1996) has pointed out, this view has been consistently reinforced by the draconian rhetoric of governments seeking to win popular approval even when, at the same time, they have been pursuing more enlightened prevention policies. The prevailing public view of crime makes it easy for businesses to argue (even when not cynically pursuing their own interests) that it is not their products and practices that need to be changed, but the police and the criminal justice system.
2. Whatever their political complexion, governments are reluctant to extend their functions and are especially reluctant to intervene in business. While the threat of terrorism has supposedly made the public more accepting of government intervention, it seems likely that business will continue to be protected from intervention unless terrorism is directly involved.
3. It can be difficult for governments to obtain the proprietary information from industry that may be needed to design and implement product changes. This information might have commercial value and, in some cases, publishing it could hurt the sales of manufacturers whose products are shown to be more at risk of theft than those of their competitors. Lastly, where contemplated changes afford individual manufacturers no commercial advantage (as in the case of the V-Chip) they have little incentive to provide data.
4. Products originating in Japan and other countries with low crime rates often have less in-built protection. This is one reason why the Honda Accord and Toyota Camry (Japanese-designed cars) topped the list of most stolen cars for many years in the United States. Governments face a particular problem of negotiating with these overseas manufacturers.
5. EU regulations prevent any single member country from mandating security standards for all products of a particular class, whether domes-

tic or imported. Obtaining EU-level agreement on such regulations, particularly when crime risks vary considerably among countries, can also be difficult.

6. Legislation designed to promote free markets make it difficult to prevent sales of legitimate products that criminals use as tools. These include magnetic strip decoders/encoders (used by criminals to produce fake credit and debit cards), wireless scanners (for capturing telephone numbers needed for cloning cell phones²⁷) and devices to reprogram PINs for car radios (needed if stolen radios are to be used or sold).
7. Freedom of information laws and the Internet make it easy for anti-business interests and other groups to spread information about methods of committing product-related crimes such as credit card fraud, telephone fraud and counterfeiting.

Problem Solving Versus Anticipation

Greater than any of the above obstacles faced by government in pursuing a more proactive policy of product change is that presented by the size and complexity of the undertaking. This is due to: the variety of industries and businesses involved; the sheer number of criminogenic products; the bewildering speed of their development; their technical nature; and the complexity of the information and service-delivery systems of which many are a part. Together this suggests that uniform solutions will be of limited application and, if so, preemptive action to nip crime harvests in the bud, though prudent and necessary, may not be enough on its own. It could even lead to much wasted effort through focusing on products that have become outdated and are no longer of interest to criminals, or repeating solutions that criminals have already learned how to defeat.

This is not an argument for neglecting past experience. Effective crime prevention, like any other body of expertise, relies on the systematic accumulation of knowledge and practice. Translating this knowledge into practical guidelines and incentives to prevent the emergence of future problems is both important and necessary. It is also important to invest in the building of designers' capacity to develop new crime-resistant products.²⁸ But in a world that is changing at ever-increasing rate, there is also a need to respond quickly to new and unforeseen crime threats by developing tailor-made solutions. Here, the difficulty lies not in identifying troublesome products early enough, since the police and media seem well attuned

to these crime waves. Rather, it will be in discovering quickly enough just how the product is exploited, by whom and under what conditions, and with what resources (Ekblom & Tilley, 2000). Only with detailed knowledge of these matters is it possible to design and implement effective solutions.

A well-tried methodology for this kind of problem solving work is provided by the action-research model employed in situational crime prevention and problem-oriented policing. This model consists of several sequential stages: identifying specific problems; analysing the conditions giving rise to these problems; identifying a range of possible solutions; assisting the implementation of the most acceptable and promising of these; evaluating the results; and starting all over again if these results are disappointing (Ekblom, 1986).

Dealing with actual current problems rather than hypothetical future ones would lend greater urgency to government efforts, while the evaluation stage built into the action research model would help to focus these efforts on the most realistic solutions. A problem-solving approach would therefore help the government to use its limited resources to greatest effect—or to "get the grease to the squeak"—which for many years has been a watchword of crime prevention practice (Hough & Tilley, 1998).

A Balanced Approach

We have suggested above that governments are poised to adopt a more proactive policy of product change, and we have argued that this policy should be composed of two complementary components: (1) an anticipatory component designed to forestall crime harvests; and (2) a problem-solving, retrofit component to deal quickly with new, unanticipated problems. The correct balance to be struck between these two components will only emerge through experience. Even if more hope for the future is placed on anticipatory action, problem solving should be given equal weight to begin with since solutions are urgently needed for problems caused by some existing products (see Table 5).

Research and Information Needs

If governments are to become more proactive in seeking product change, they will also need to make a greater investment in publicly promoting the concept, in developing a body of relevant expertise and in commissioning research. We endorse previous suggestions that this investment should be

Table 5 Criminogenic Products for Which Redesign Is Needed

Product	Redesign Needed
Cars	Ignition interlock and keypad ignition systems to prevent drunk driving ²⁹ Continuous electronic ID monitoring to prevent theft Electronic control of speed on highways
Trains, buses, trucks	Ignition interlock and keypad ignition systems to prevent drunk driving
Airliners	Breathalyser with video-recording built into start up procedures CCTV surveillance of cabin Strengthened/sealed cockpit door to prevent terrorism Computer-mediated facial recognition of legitimate crew
Automatic teller machines	Biometric recognition techniques
Fertilisers and chemicals	Remove ingredients that facilitate bomb construction
Cordless drills and other hand tools	Reduce their value for breaking into premises, vehicles and vending machines
Lock tools and designs	Breaking and entering, safe cracking, password and encryption breaking for data theft and extortion
Information: Maps, building plans, bomb recipes	Restricted access to prevent terrorism, breaking and entering
Digital cameras	These assist child pornography because pictures do not need professional processing
Phones	Ways needed to prevent illegal phone tapping and other invasions of privacy
Cell phones	Disable after theft
Phone kiosks, bus shelters and railway carriages	Scratch-resistant and shatter-proof glass

Modifying Criminogenic Products

Table 5 *(continued)*

Product	Redesign Needed
Magnetic stripe gift cards	Prevent theft of stolen numbers by hackers and counterfeiters (Sullivan, 2001)
Spray paint cans	Reduce their usefulness for graffiti ³⁰
Pharmaceuticals with alcohol or narcotics	Replacement of addictive/intoxicating ingredients in mouth-wash, decongestants and pain relievers

in the form of a research and development unit wholly dedicated to these tasks (Pease, 1997; Clarke, 1999).

Promoting the concept of product change would require the unit to be fully conversant with the results of "horizon scanning"; to keep abreast of overseas developments and those occurring in product safety, road accident prevention and other related areas of work (Christie, 2000); to make presentations to professional audiences (including industrialists, business leaders, government officials, academics and design professionals); and to use the media to inform the public of the benefits to be achieved. In order to develop bodies of expertise, the unit would need to develop consultancy relationships with a wide range of individuals in industry, business, the police and the universities, and would need to establish consultative committees composed of representatives from these fields. The research it would need to commission would span a wide range of scientific, technological and criminological topics. This review alone has identified several topics deserving of more research, including: the extent to which criminogenic products are exploited by organised crime and by criminals who are supporting drug and alcohol habits; the roles of pressure groups and other key actors in securing or inhibiting product change; the scope for governments to exercise financial powers and incentives in respect to product change; the research relationship between business and government; and the cost-effectiveness of product changes, including studies of displacement.

The Foresight Crime Prevention Panel (Davis & Pease, 2001) and the Home Office have undertaken some of these promotional, development and research tasks, but have not done so recently. In any case, assigning

these tasks to a designated unit would raise their priority and their visibility to business and industry. If the unit were permanent, this would also greatly assist the development of relevant body of expertise. *Senter*, the unit established by the Dutch government was placed within the Ministry of Justice,³¹ but whether this is the best arrangement, and what is the best balance between commissioned and in-house work, are technical questions lying beyond the scope of this review.

CONCLUSIONS

There can be no end to the criminal misuse of legal products. Even if dozens, perhaps hundreds of products have been successfully altered to prevent crime, criminals will continue to seek new ways of exploiting products so long as the rewards are great enough. In some cases, they will be helped by changes made by manufacturers to expand the uses of their products or improve their convenience. In addition, completely new products and associated services are being continually introduced for business and consumer use, all of which provide new opportunities for criminals. There is no end in sight to this technological development, and there seems no possibility of our economy ever being able to deliver (or indeed wanting to deliver) these products and services at a price everyone could afford. Even in such a Utopia, normal human greed and vice would continue to result in their criminal exploitation.

This is not meant as a counsel of despair because, at the same time, technology is continually delivering new ways to prevent crime. Those on the immediate horizon include: biometric recognition technology and "smart" cards to reduce the opportunities for fraud; "chipping" of goods³² or source tagging at manufacture to reduce the scope for shoplifting and other theft (DiLonardo, 1997); and use of the Internet, GPS and wireless technology to provide instant checks on ownership for a wide variety of goods such as cars, computers and television sets (Clark, 2001).^B

As repeatedly mentioned in this review, businesses are the main victims of crime caused by products, and businesses usually provide the solutions. It is when the public is the victim, or when heavy costs fall on the public sector, that governments have been forced to intervene. It might be tempting for them to continue in this primarily reactive mode, but we believe this would be a mistake. There is ample evidence from the evaluations reviewed above that crime harvests caused by particular products are stoppable, even if they are not always predictable. The reductions achieved

can be quite considerable, with many resulting benefits: police resources are conserved; the profits of organised crime are reduced; habitual offenders find it harder to support drug and alcohol habits through theft; and the public is saved much inconvenience and misery. Government could help to deliver these benefits with a relatively small commitment of its resources.

APPENDIX

Case Study 1: Toughened Glasses for British Pubs

We all know that broken glass can be dangerous, but it is difficult to use as a weapon unless there is a way to hold it without being cut. The design of beer glasses and bottles therefore, is of considerable importance in making them useful as weapons. For example, the traditional beer glass of heavy base and slender trunk, rising to a wider mouth at the top, is ideal for use as a weapon. The hand can grasp the base easily, and if need be, it is easy to smash the glass first on the bar.³⁴ The same applies to the older quart size bottles of beer (still available in some areas), whose top rises into a slender tapered end, which may be easily grasped and smashed against a hard surface to make a jagged-edged weapon, or may be smashed directly against the victim's face.

Some changes have occurred in the design of bottles, including the introduction of "glass cans" that do not have a slender top to grip and metal cans to replace the larger bottles in Australia. However, change in the design of glasses has been slower in coming because publicans and drinkers alike hold various beliefs about the shape of a beer glass (and its other attributes, such as its surface, temperature, how it has been cleaned, etc.) and its effects on the taste of the beer itself. The alternative possibility therefore, is to change the properties of the material used to make glasses.

Working with colleagues, J. P. Shepherd has shown that the type of glass used in traditional beer glasses can cause serious injuries (Shepherd et al., 1990a; Shepherd et al., 1990b). The glasses are made of annealed glass which, when broken, produces many sharp edges that are can be lethal, or cause disfiguring injuries. Shepherd has also shown that most glasses are smashed into the victim's face, where the glass breaks on impact (Shepherd et al., 1990a), and he has argued that a simple step to reduce the severity of injuries would be to manufacture pub glasses out of tempered

rather than annealed glass. Tempered glass is the same as that used in car windscreens. It is much stronger than annealed glass in impact resistance and when broken shatters into small "sugar lump" fragments that are far less injurious. While no studies have investigated the effectiveness of toughened beer glasses in reducing injury, there is a long and proven safety record of the use of tempered glass in automobiles. Tempered glassware is no more expensive to produce than annealed glassware and it lasts some 20 times longer than annealed glasses.

In 1997, the then shadow U.K. Home Secretary Jack Straw drew attention in the course of pre-election campaigning to the problem of pub violence. He said that over half a million individuals were assaulted by others who were intoxicated and that more than 5,000 people in Britain were maimed every year as a result of attacks involving broken glasses. Straw pointed out that figures from 22 police force areas showed that the number of disorder incidents due to alcohol had risen by more than 20% over two years. The 1996 British Crime Survey had also suggested that nearly 20% of violent incidents occur in and around pubs, amounting to some 13,000 incidents a week. He called for a "three-pronged" approach to the problem, including the wider use of toughened glasses (Mason & Little, 1997).

During the course of 1997 and 1998, there were a number of meetings on drinking and violence in which various interest groups participated. These included the Addiction Forum, Alcohol and Health Research Group (Scotland), the Portman Group (an industry association), and the Addiction Research Group in Canada. These meetings generally endorsed the need for toughened beer glasses (Notarangelo, 1997; Staff, 1997). In February 1998, Mr. Straw, who was then Home Secretary, attended a Crime Concern conference and noted, "Partnership is the key to reclaiming the social and commercial hearts of our communities from the drunken yobs" (Staff, 1998a). The Crime and Disorder Bill (subsequently the Crime and Disorder Act), which he announced, would in fact require such partnerships. While it also revived some draconian police powers, this legislation recognized the need for police to work hand in hand with business and bar owners, and especially local governments, which are intimately involved with the local bars through licensing, zoning and other matters.

Mr. Straw noted in his remarks that industry had agreed to make wider use of toughened glass in pubs and clubs. In fact, it seems that the big brewers controlling most pubs have been much slower to adopt toughened glasses than independent pubs and bars (Design Council, 2002).

There are also regional variations in the use of toughened glasses. For example, they are more widely used in the North West than in London or the South East, perhaps due to the *Safe Glass-Safe City* campaign mounted by the Greater Manchester Police and the Manchester Evening News (Design Council, 2002). These facts suggest that a stronger push is needed from government to promote the use of toughened glasses.

Case Study 2: Caller-ID for Telephones in the United States

Caller-ID is a service provided to telephone subscribers in the United States (and under other names in many other countries) that allows the receiver of a phone call to see the number of the caller, along with other personal information such as name and address from which the call is made. It is a relatively simple technology (Slawson, 1997) that, when first introduced required the subscriber to install a special device that displayed the information. The service was first offered in 1988 to residents of New Jersey. At that time, the display device cost around \$70, and New Jersey Bell charged the subscriber \$6.50 per month for the service. Today, most telephones of average price have the Caller-ID feature built in, and the cost to subscribers is minimal, due to the widespread competition among the different providers.

The new service was made possible by investment in new high-speed network signalling systems (Slawson, 1997) that became the standard switching technology used for the provision of Caller-ID and other services. Late in 1987, New Jersey Bell conducted a small trial offering and concluded that Caller-ID was a service that customers really wanted (Clarke, 1992). The service was quickly introduced, touting many benefits for businesses and individuals, which may be summarised thus:

- *For businesses*, Caller-ID makes it possible to: recognise incoming calls and route them to the appropriate operator; ascertain customer addresses (useful for services such as food delivery or vehicle breakdown service); and match calls to databases of credit records, spending patterns, etc. (Australian Communications Authority, 1998).
- *For individuals*, Caller-ID provides enhanced control over incoming calls: people like to know who is calling, to screen calls and return them at their leisure, to record missed calls and to enjoy a range of additional services that are often packaged with Caller-ID, such as call waiting and call trace.

An additional benefit, the focus of the present discussion, is that of reducing the level of obscene and harassing calls. These are not only upsetting to the victims, but they entail considerable costs for the phone companies and police who must deal with complaints. An early evaluation of Caller-ID concluded that the number of complaints about annoyance calls (15% of which were obscene calls) declined by 25% after Caller-ID was introduced. The study further reported that there was little evidence that annoyance calls were displaced to other parts of New Jersey that did not have Caller-ID (Clarke, 1992).

Despite its various benefits, opposition to Caller-ID quickly emerged (Hall, 1990). New Jersey Bell and other companies that followed its lead were criticized for introducing the service too rapidly without consideration for consumer concerns for privacy (Australian Communications Authority, 1998), though it must be said that subsequent surveys of consumers have revealed that consumers want it both ways: they want to control what information about themselves goes out, but they also want to obtain maximum information about calls and callers that come in. The debate concerning privacy therefore is essentially one of trying to balance these two competing demands of individual subscribers.

Some of the privacy concerns were of a specific nature. Subscribers with unlisted numbers feared that this benefit would be undermined by Caller-ID. Women's groups argued that it would enable abusers to track down partners who had taken refuge in shelters. Some law enforcement officials said it would compromise the safety of covert operators. Social workers feared it would inhibit the flow of information to crisis hotlines (Hall, 1990). Consumer groups were concerned that the associated databases of information about subscribers would be sold to telemarketers. Finally, some state officials complained that the service violated the terms of their wiretapping legislation. (For example, Pennsylvania found that Caller-ID violated its Wiretapping and Electronic Surveillance Control Act.³⁵)

The American Civil Liberties Union (ACLU) quickly marshalled these various concerns in a series of state court actions taken against individual telephone companies when they sought to introduce Caller-ID.³⁶ Many of these early cases focussed on the right of customers to block display of their numbers when making calls. This facility could be provided under the existing technology, but the phone companies argued that the

costs of doing so were too great. They also argued that this facility would destroy the ability of Caller-ID to prevent annoying calls. However, the pattern was soon set by a ruling made by the Pennsylvania Public Utility Commission in November 1989, upheld in the courts, that Caller-ID must be made available in Pennsylvania with a call-blocking facility for "at risk" customers, such as those in battered women's refuges or in some law enforcement positions. A series of similar judgments were made in other states and the phone companies soon abandoned their opposition to the call-blocking facility.

A second focus of debate concerned the ability of consumers to opt out altogether of the Caller-ID service. Some telephone companies had simply introduced Caller-ID without taking steps to inform subscribers or customers what the service involved. Because the service works much better with as many customers participating as possible, the strong tendency was to automatically include an individual's number in the sending part of Caller-ID, and *charge* only those who wanted the receiving service—that is to see the number of the person who had called. This was called the "opt-out" model. Consumers had to take steps to opt-out of any part of Caller-ID or they stayed in. The alternative was to invite customers to "opt-in" to Caller-ID, which was the option favoured by the critics of Caller-ID.

While regulatory agencies and courts argued over privacy and other issues, consumers and business moved ahead and solved most of the problems raised by Caller-ID, driven by the sheer force of technological development. Although solutions vary considerably in detail from state to state, the following is probably a reasonable rule of thumb in terms of the provision of services:

1. Most plans are offered on an opt-out basis.
2. Per call blocking is offered free, and some areas also offer line blocking free, especially for unlisted subscribers.
3. The ability to block reception of calls with the caller's number blocked is widely offered.
4. 911 and other important community services can override blocking.
5. Many states have legislated the set up of "no telephone solicitation" lists, and require the bonding and registration of telephone solicitors

(Cerasale, 1999). The European Union has also introduced similar regulations and mandated customer education upon introduction of the new service.³⁷

There are also at least six other ways in addition to Caller-ID to deal with annoying telephone calls. These include call trace, call trap, call screen, selective call acceptance, call return, and various special devices. Some of these services are usually offered free, such as call trace or call trap, while others are offered on a per fee basis (Privacy Rights Clearinghouse, 2000). The convergence between computers, the Internet and telecommunications has also made possible a variety of new ways to enhance and capture the telephone numbers and personal information of telephone users (Carroll, 1999).

Case Study 3: Tamper-Proof Packaging in the United States

In 1982, seven people died in Chicago as a result of swallowing cyanide-tainted Tylenol. That event caused widespread fear about the safety of personal products that were displayed on open shelves in stores. Since that time, there have been periodic outbreaks of product tampering. In 1988, the U.S. Food and Drug Administration (FDA) received 488 tampering complaints, most of which concerned food and beverage products. Nor were these incidents confined to the United States. In 1989 in the United Kingdom, Heinz suffered an incident of tampering with its baby food products, which cost at least £2 million in advertising to relaunch the product after it was protected with tamper-resistant packaging. And in 1994, Safeway's labelled tonic water was contaminated with deadly nightshade. Although no one was hurt, the cost for recall was at least £44,000.

The Tylenol event was catastrophic not only for those poisoned, but also for the businesses that suffered enormous losses through public avoidance of their products. It took Tylenol several years to regain the 35% of market share it had in 1982, and cost the company \$100 million dollars just to send out consumer warnings (Teresko, 1983). This event, together with the widespread public concern, spurred both government and business to cooperative action. The FDA moved with unprecedented speed to develop regulations that required tamper-resistant packaging for selected cosmetic products, medical devices and many over-the-counter

(OTC) drugs. It did not go further, however, and include food containers, mainly because of the much greater diversity of food products and packages.

Following intensive consultations with industry leaders and consumer groups, including Ralph Nader (Robinson, 1986), the FDA regulations were published in 1983 in a record 35 days (Hyman, 1983) from their inception. The regulations were as follows (Foley, 1983):

1. Directions for opening the tamper resistant package should be in large print, in contrasting colours and placed on both sides of the product.
2. Tamper-resistant packaging should be clearly visible and should be manufactured in a colour and design scheme that is distinct from the rest of the container.
3. Component parts of the tamper-resistant packaging that need to be manipulated to break the barrier should be clearly visible and easy to grasp.
4. There should be standards for minimum break strength so that persons with physical disabilities are able to open the packages.
5. There should be a uniformity of tamper-resistant directions and mechanisms so that the ability to open one type of tamper-resistant packaging increases the likelihood of being able to open other packaging of the same type.

The two guiding principles of these regulations were that: (1) if the seal is broken, the break must be highly visible, and (2) use of the packaging should be convenient for the consumer.

FDA inspectors were required to check on compliance, although the FDA insisted that it was more interested in achieving voluntary action. In fact, businesses had much less to fear from the FDA than from product liability suits (Hyman, 1983). If nothing else, the Tylenol incident had made it clear that manufacturers could foresee that many of their products were vulnerable to attack. This brought an element of competition into the scramble to introduce tamper-resistant packaging, not only to allay customer concerns about their products, but also for legal protection, since a legal rule prevails in product liability cases in regard to how many of a company's competitors had taken precautions. In short, there arose a strong impetus, both public and private (Teresko, 1983) to introduce tamper-resistant packaging.

The FDA regulations have been updated from time to time, with an extensive set of guidelines published in 1999 (Food and Drug Administration, 1992, 1999). These generally reflect the five rules listed above, although they do extend packaging concerns to include rules about child-resistant packaging as well. Businesses have installed tamper-resistant devices on an ever-increasing range of products marketed for personal use, partly in response to new tampering scares. Recent innovations are devices that make use of optic fibres that stop shining once the seal is broken, and many other high-tech devices (Keck, 1993) for a variety of products (Dodd, 1998). Manufacturers have pursued this course in the face of research in focus groups suggesting that most consumers rate product safety last as an issue of importance, after (in order) quality, nutrition and ingredients, convenience and price (Stillwell, 1989).

While initially there were concerns about the high cost of introducing tamper-proof packaging, these have abated, with estimates running to only about one cent a container, compared to the initial estimates of ten cents (Staff, 1982, 1989). In any case,, it was recognized very early that losses could be far greater to a company in terms of reputation and care for their customer. As a SmithKline Beecham executive said, "The company's only concern is the well being and safety of its customers" (Murphy, 1991).

The Tylenol case and other incidents of product tampering taught business not only that it had a responsibility to prevent tampering, but also to think of products in much broader terms to include brand name and reputation: in effect, product integrity. Industry is now moving to design product packaging to accomplish wider security goals than simply preventing tampering by the public. There are four main types of intrusion to guard against, all of which can be defeated by using innovative technology in a single packaging system:

1. Terrorism or random attacks such as the Tylenol case.
2. Pilfering or damaging of smaller items enclosed in packaging.
3. Tampering during the manufacture.
- 4.. Counterfeiting by using technology such as attachment of holographic or other unique identifying labels.³⁸

This is a case in which a catastrophic event, followed by a series of copycat incidents (some 300), spawned widespread public, governmental and business concern. Each of these parties had a strong interest in bringing about changes that would prevent the future occurrence of this tragedy

(Hilts, 1982). This brought about an unusual level of cooperation in effecting facilitative legislation and eagerness on the part of business to produce and demonstrate tamper-resistant packaging that reassured their customers. The result has been the continued spread of tamper-resistant packaging across countries and product types (from OTC drugs, cosmetics, beverages, frozen foods [Staff, 1983], toys, multimedia,³⁹ credit cards⁴⁰ and even original works of art [Gialamas, 1997]) over the 20 years since the Tylenol event. In sum, all parties have benefited, and of course, an additional beneficiary has been the packaging industry, which has experienced a boom in the past 15 years.

Case Study 4: Cheque Security in the United Kingdom

According to the Cheque and Credit Clearing Company,⁴¹ the number of cheques used for payment in the United Kingdom reached an annual total of 3.5 billion in 1990, but it is predicted that this number will decrease by about 40% by 2009 because of the rapidly expanding use of credit and bankcards. Compared to credit card fraud, cheque fraud in the United Kingdom accounts for a much smaller portion of bank services fraud, though many times more than losses to banks from simple robbery.⁴² Moreover, the amount lost to cheque fraud has decreased dramatically, even while the amounts lost to credit card and debit card fraud have increased considerably in recent years. Thus, cheque fraud losses against turnover were .145% of all transactions in 2000 compared to .33% in 1991.

In 1991, an important research report (Levi et al., 1991) prepared for the Home Office described the situation of bank services fraud as one of a "stand-off" between police and business, each waiting or expecting the other to solve the problem. The report brought to public notice the extent of bank services fraud and helped to build a coalition of interests between the interested parties, which resulted in many changes to the design and manufacture of cheques, and in their delivery and processing, which brought about the reduction in cheque fraud. By 1995, major initiatives were coming into play: the introduction of "hot cheque" files, the more widespread sharing of information concerning counterfeit cheques and suspect bank accounts, and the formation of cheque fraud squads by the police which began to work in concert with banks (Levi & Handley, 1998).

Advanced anti-counterfeiting technology also began to be introduced into cheque printing around this time, which included the following features:

1. "VOID" messages that showed when a colour photocopier was used.⁴³
2. Rainbow graduated colours (pantograph), which are difficult for photocopiers to reproduce.
3. Signature area printed on different pantograph colours.
4. Micro printing, which prints words so small they appear as lines or borders on the cheque.
5. Watermark certification of various kinds that cannot be photocopied.
6. Fluorescent fibres, especially yellow fibres on the back that will intensify under black light.
7. Authentication warning endorsement feature to alert the receiver to the security features of the cheque (Goldsec, 1999).
8. "Cut-and-paste" prevention background that will not match up if someone tears or cuts the cheque then tries to put it back together (Staff, 1994).

It is generally believed that most security features have about a three-year life span, after which they must be upgraded in order to keep one step ahead of the criminals (Cole, 2001). However in the case of cheques, it is likely that these high technology security features have worked more effectively and for a longer time, partly because organised crime has concentrated on the counterfeiting of credit cards over the same period. This may have as much to do with the following facts as with the inherent security of cheques:

1. PIN numbers were required for the use of cheque and bankcards (but not credit cards).
2. The concerted efforts made in 1993/4 to create databases that could be checked each time a credit card or cheque cashing card was used at POS (point of sales) worked better for cheque fraud than credit card fraud because merchants generally must shoulder more of the loss from cheque fraud (Levi et al., 1991); this creates a need for the merchant to make a special effort to show "due diligence" in applying proper security procedures to ensure against cheque fraud (Stephens, 1998).
3. There has been a more concerted effort on the part of police-bank-merchant cooperation in regard to cheque fraud than there has in credit card fraud (Levi & Handley, 1998).

It is reasonable to conclude, therefore, that cheque fraud prevention technology and intervention in the service delivery system have been quite successful. The different interests can be seen at work if the series of identifiable steps through which change occurred are traced:

1. *Identifying the problem as serious.* One would expect that, once a problem is perceived as serious it would naturally lead to action to solve it, but this depends on the players and their interests. In this case, cheque printers work hard at convincing their potential customers that the problems related to cheque fraud for business are serious, so that the investment in high quality security printing is highly cost-effective. But businesses in this case were slow to accept that the problem was sufficiently serious to act upon, since the fraudulent portion of turnover was very small, and in any case there was a perception that fraud was something for the police to deal with. However, police forces had limited capacity to investigate cheque frauds, and these resources were organized in a hit-or-miss way, without coordination with the banks, to respond mainly to calls from merchants. Furthermore, police do not generally regard cheque fraud as a serious problem compared to other traditional crime. Finally, consumers did not perceive cheque fraud as a problem because they were not directly affected, except in the rare case that they were targeted for fraud.
2. *Mobilizing the players.* The process of change began with the commissioning of research study by the Home Office on the problem. This produced a well documented report (Levi et al., 1991) that: (a) made a very persuasive argument that substantial losses to cheque fraud were incurred by business; (b) identified points of vulnerability in the product and service design; and (c) outlined relatively straightforward steps that could be taken to reduce these losses. The Home Office followed up this report by sponsoring a series of meetings designed to foster cooperation among the major players in order to share information, develop databases of hot cheques and suspect bank accounts. The major players involved were banks, merchants, and law enforcement. The cooperative Association for Payment and Clearing Services (APACS) had already been set up, but now gained special impetus from the momentum that was built up from these series of meetings. The secondary businesses that resulted contributed to increased speed of verification of bankcards and increased vigilance on the part of POS staff. These secondary businesses monitor many billions of cheque

transactions daily. Finally, consumers were involved through consumer education initiatives conducted by all of the aforesaid players.

3. *Monitoring the effects of change.* All products and services remain vulnerable to criminal attack. However, their vulnerability is relative to other products and services and their points of vulnerability. In this case, it is likely that criminals turned away from cheque fraud to the easier and more lucrative credit card fraud.

Case Study 5: Smart Guns in the United States

It is hard to say when it first became apparent that there was something wrong with the design of handguns in the United States. The classic Colt .32, a 19th century best seller, was designed to be hard to shoot. In fact, it was nicknamed the "lemon squeezer." Arguably, this was an early indication that the designers of handguns recognized that a lethal weapon should not be made too easy to use. In 1880, alarmed by a child's death at the hands of a "lemon squeezer," Colt's Manufacturing Co. developed a gun with a grip safety lever that had to be pressed before pulling the trigger. They sold 400,000 of these guns (Fields, 2000). For another 100 years, the gun industry was seen as a venerable, truly iconic industry. But by 1999 (the year of the Columbine high school massacre in Colorado), gun manufacturers were under concerted attack to redesign their lethal products to make them safer to use.

The increasing pressure brought to bear on the gun industry can be traced through a series of defining events. The first was the attempted assassination of President Reagan and the serious wounding of his press secretary, James Brady, in 1981. This was followed by the formation of a powerful anti-gun lobby led by Handgun Control and the Brady Center to Prevent Handgun Violence. Their activities culminated in the Brady Bill and other legislation that banned assault weapons. This legislation galvanized the National Rifle Association (NRA) into action. Its funds helped deliver the Congress to the Republicans in 1994 and it successfully blocked every effort at gun control legislation thereafter for many years. Even in 1999, a year of horrendous mass shootings, the NRA was rated the most influential lobby group on Capitol Hill (Birnbaum, 1999).

In May 1998, another significant event occurred when an attorney from the Castano Group, lawyers who had won huge settlements from the tobacco companies on behalf of many U.S. states, contacted the Brady Center to Prevent Handgun Violence. Until this time, lawsuits brought

against gun manufacturers claiming that their products had been "misused" (whether by children or criminals) had failed. Courts were reluctant to find a manufacturer liable for misuse of a product since this would create enormous problems for a large swath of industry. And after all, guns were *supposed* to be dangerous. However, once the connection was made with the successful litigation against the tobacco industry, the damage done by guns could be recast as a public health issue. The case was reinforced by statistics showing that most gun deaths in the United State were not criminally caused, but were accidents or suicides.

Consequently, in October 1998, the mayor of New Orleans, at the instigation of the Castano Group, filed a suit against 15 gun manufacturers and several local dealers. The manufacturers were characterized as displaying a "callous disregard" for the safety of children (Boyer, 1999). The city governments of Miami, St. Louis, and Chicago soon followed. Among the accusations made by the cities was that the manufacturers had deliberately suppressed research into "smart guns"—the technological solution to gun misuse.

These suits ultimately failed, but they served a valuable purpose in publicising the issues. The plaintiffs' lawyers understood that they had public opinion on their side: polls consistently have shown that the majority of Americans support registration of handguns, and that about half of those people who do not own handguns favour banning them altogether. The plaintiffs' lawyers busied themselves recruiting more cities and states to join their group of plaintiffs to sue the gun manufacturers. They knew from their experience with "Big Tobacco" that sooner or later a case would come up in which a jury would find in their favour.

In fact, the courts threw out a series of further cases. The first was in Chicago in 1998, and it concerned a police officer, shot on a public housing project, whose relatives charged that the gun manufacturers had nurtured a climate of violence by flooding the area with guns. The case was dismissed, but it was appealed. Next, Chicago Mayor Daley ordered a special police operation to uncover the distribution of guns and their flow into the illegal market in Chicago. This investigation was in preparation for a prosecution that would claim that the way in which gun manufacturers were flooding the market with guns was a "public nuisance"—an innovative legal argument and one with a stronger legal basis. However, the case was dismissed by a county court judge and, at about the same time, the New York Court of Appeals ruled in connection with a case brought on similar "public nuisance" grounds in Brooklyn that the gun industry cannot be

held generally liable for shootings resulting from guns bought and sold illegally (Perez-Pena, 2001).

Although these cases were lost, the game is not over. In January 2002, the state appellate court of Illinois overturned the 1998 Chicago decision and ruled that gun makers could be sued for distributing guns in a way that makes it easy for criminals and juveniles to obtain them illegally (Butterfield, 2002). While the final decision on this issue is yet to come, or maybe will never be fully resolved, there is little doubt that the mounting number of cases is placing enormous pressure on the gun manufacturers. More than 30 cities and counties have sued, or are currently suing gun makers, and the plaintiffs' lawyers claim that the outcomes of these cases are relatively unimportant. Rather, it is the relentless process of litigation that will wear down the gun industry into submission and settlement and, in effect, the litigants have already won.

Ed Shultz, CEO of Smith and Wesson saw this coming, and, in a further significant event, broke ranks with the industry in 1998 when he accepted an invitation from President Clinton to attend a Rose Garden "photo-op" to publicize the administration's proposals for mandatory safety locks on handguns. (Shultz had caught the attention of the White House through a directive he had issued in 1997 that all Smith and Wesson handguns would be issued with a trigger-locking device.) This event marked the first split between the gun industry and the NRA, which had strongly opposed the Rose Garden meeting. Then in October 1999, Colt's Manufacturing Co. announced that it would no longer manufacture civilian handguns (Miller, 2000), claiming the costs of litigation were too great to justify continued production. This was ironic, since Colt's had expended considerable capital in developing and patenting a hi-tech smart gun that could be fired only by the person who owned it.

In December 1999, the Clinton administration said that it was preparing a class action suit on behalf of all 3,191 public housing authorities seeking to recover the costs of gun violence, and to force the design of safer firearms and restrict the flow of guns into illegal hands (Novak, 1999). In March 2000, Schultz, in an attempt to defuse class action suits by some 29 municipalities, made an agreement with the federal government that Smith and Wesson would include locks on all its handguns and research and implement "smart gun" technology.⁴⁴ This was a further break with the industry, for which Smith Wesson paid dearly. It was loudly vilified by customers and sales dropped dramatically, causing it to lay off 125 of its 725 employees (Seglin, 2001).

Finally, in an action that put pressure on Smith and Wesson's competitors, Andrew Cuomo, U.S. Secretary of Housing and Urban Development, and attorneys general from New York and Connecticut, announced that they would give preferential treatment in the procurement process to gun makers who adhered to the code of conduct that Smith and Wesson had signed. Seven gun manufacturers fought back with a lawsuit charging that Cuomo and his co-defendants were illegally trying to influence where law enforcement agencies bought weapons (Fields, 2000).

Events had not been kind to the NRA during this steady collapse of the gun industry. It had been taken over by a doctrinaire minority, which resulted in loud, uncompromising pronouncements. This was exacerbated by a huge mistake when it released a strident fund-raising letter that labelled officers of the Bureau of Alcohol, Tobacco and Firearms as "jackbooted government thugs." Unfortunately for the NRA, this letter was released the very day after the 1995 Oklahoma City bombing. Many politicians resigned their membership (former President George Bush among them). The NRA set about cleaning up its image, invited women to join, placed Charlton Heston (a famous movie star) at its head, championed gun safety education, and continued to lobby rural democrats and republicans. As a result, NRA membership has increased in recent years, though overall gun ownership has not. Male gun ownership has dropped well below 50%, and the manufacture and importation of guns has dropped some 20% since the 1970s (Birnbaum, 1999).

Case Study 6: The V-Chip for Televisions in the United States

The U.S. Congress first held hearings on the subject of television violence and its effects on children in 1952, but it was not until the mid-90s that any significant steps were taken to regulate program content. There had been much public debate during the 1994 election about the amount of violence on television, and considerable effort was made to evaluate the extensive research concerning the connection between television violence and the violent behaviour of children. While that connection remains controversial (ACLU, 1996), President Clinton in his 1996 State of the Union address challenged the television industry to develop a system for rating television programs. Less than one month later, Congress passed the bipartisan Telecommunications Act 1996, which among its many provisions contained two important ones relating to violence: (1) that industry

submit a voluntary system of parental guidelines for rating television programming; and (2) that technology be installed in television sets to allow parents to block violent programs. The Federal Communications Commission (FCC) was charged with the responsibility for implementing these requirements, the second of which was eventually met by the invention of a device, the V-chip, that could read program ratings information from line 21 of the television transmission (the same line used for closed captioned information) and that also allowed a user-friendly way of blocking programs (Federal Communications Commission, 1997).

Advocates of the V-chip included individual politicians, as well as various parental and education groups including Kidsnet, the Kaiser Family Foundation, Children Now, the National Education Association, and the Academy of American Pediatrics. Opponents of the V-chip, or more accurately the ratings system, included the American Civil Liberties Union (ACLU), as well as a number of the most prominent broadcasting associations. The ACLU advanced the argument that the government was infringing on the First Amendment rights of broadcasters (ACLU, 1996) and the broadcast associations echoed this complaint (Stern, 1996). However, the essential resistance to the FCC was focused through Jack Valenti, the chairman of the Motion Picture Association of America (MPAA), on behalf of the entertainment media. He responded to the FCC demands for a rating system with an age-based ratings system that was basically the same as that already used by the motion picture industry (Fleming, 1996). Advocates criticized this solution on grounds that it was too vague. Eventually, Valenti (1997) returned with a revised six-category system that was a hybrid of age-based and content-based information, which the FCC accepted (Federal Communications Commission, 1998).

It is interesting to note that opposition to the FCC was focused almost entirely on the ratings system, not on the V-chip itself. Although some TV manufacturers claimed that the "best V-chip is a parent with a thumb to turn off the TV" (Kirkpatrick, 1997), their opposition soon disappeared when it came to estimating the cost of installing the device in TVs (about \$3), and it became apparent they might even profit from this added device.

In May 1999, the FCC announced the formation of a special V-chip task force charged with working with consumer groups, industry, entertainment producers, and parents to ensure that the V-chip technology was properly implemented (Federal Communications Commission,

1999a). In June 1999, it was able to announce that all major television manufacturers had met or exceeded the deadline to have half of all new models with screens larger than 13 inches by July 1, 1999 equipped with the V-chip (Federal Communications Commission, 1999b). Six months later it announced that all the major broadcasting organizations were encoding their programming to work with the V-chip and that the broadcast networks had begun to run public service announcements to inform parents of the V-chip use and capabilities (Federal Communications Commission, 2000a). The FCC emphasized that these accomplishments had resulted from the task force working closely with industry and trade group partners.

The FCC was pleased to count consumers among its partners, but in fact consumers were only represented by particular interest groups. Direct input from the parents who would be expected to use the V-chip was not systematically sought. The only early indication of consumer attitude was reported in a survey conducted in 1997 (well after the V-chip had been set into motion), which found that, while 57% of the consumers favoured the idea of blocking objectionable programming, only 30% thought that the technology would do a lot of good for children (Gerson, 1997). Other indications soon appeared that consumers might not have been as impressed with the V-chip as were the politicians. In a 1998 poll, 65% of parents said they would block objectionable TV shows if they had a V-chip in their home, but 69% said they were not likely to buy a V-chip box to use with their current TV (Staff, 1999). One retail chain reported that its 18 stores had sold only two units between them, while others said they had sold none. In August 1999, the Kaiser Foundation reported that only 39% of consumers had heard anything at all about the V-chip (Rarey, 1999) and a year later reported that the situation had not improved. By this time, about 15 million V-chip equipped sets were either in homes or at retailers (Williams, 2000).

The FCC blamed the network broadcasters for failing to promote the V-chip, perhaps with some justification (Federal Communications Commission, 2000b). In the first three months of 2000, the four networks aired public service announcements promoting the V-chip a total of 59 times, roughly 90 seconds worth a week (Barnhart, 2000). However, in mid-2001, after they claimed to have made a special effort to promote use of the V-chip, the *New York Times* reported that the parental use of, or

interest in the V-chip was still dismal, with only 7% of parents surveyed reporting that they ever used the V-chip to block programs (Rutenburg, 2001).

One reason for the V-chip's lack of success is that, because it is the same for all television sets, it breaks an important rule of retailing: always have a feature that one's competition does not have (Barnhart, 2000). Thus, there was no business reason to promote TVs by advertising their V-chip capability. It might be argued that if parents had demonstrated a strong interest in V-chip technology, then the industry would have developed competing ways to respond to such a demand. But when the manufacturers looked at sales data, and talked to their retailers, they understood that the V-chip was dead as a sales promotion device. It was clear that, even after substantial attempts to educate parents about the V-chip, they do not care about it and find little use for it.

Case Study 7: Redesign of Banknotes Worldwide

Governments monopolize the manufacture of currency in most modern nations,⁴⁵ though this was not always the case. For example, during the U.S. Civil War, there were some 1,600 state banks all printing their own notes, which created ideal conditions for counterfeiting. Detailed information on the losses due to counterfeiting is not freely available. It has been claimed by the U.S. Secret Service that the value of counterfeit U.S. currency *seized* has declined from \$110 million in 1988 to \$24 million in 1993. In addition, it estimated that the value of counterfeit money in *circulation* had risen from \$11 million to \$19 million (Houston, 1994). Considering the enormous number of banknotes in circulation, these amounts are tiny and are also low in comparison to the estimates of losses to other types of fraud (see credit card and check fraud case studies).

There are two reasons why there is relatively little counterfeiting: (1) governments devote special resources to tracking down and preventing counterfeit notes from getting into circulation,⁴⁶ and, (2) producing convincing copies of banknotes is particularly difficult and expensive because of the high level of protection the banknote printing industry has maintained concerning its trade secrets and manufacturing process.⁴⁷ This is remarkable when one considers that the organizations printing banknotes are a mixture of government and private companies that not only print for the domestic market, but also print notes for many other countries. Some of

these companies also print other high security documents such as lottery tickets, and stock and bond certificates.

The first line of defence in security of the bank note is the design of clearly visible, *overt* features that ordinary people can easily detect. The rule of thumb here is that there should be as many as possible of these features at different levels, so that if one is defeated others will still prevail. They should also be durable and designed in such a way that there is room to add new features, should these become necessary. For example, the new Euro notes contain:⁴⁸

1. *Security threads*. When the banknote is held up to the light, a dark line becomes visible.
2. *Watermarks*. When the note is held up to the light, picture and value of the banknote become visible.
3. *Foil holograms*. On the front of the low value notes there is a hologram foil stripe. When the banknote is tilted, the euro symbol and the value of the banknote appear.
4. *Iridescent strips*. These appear on the reverse side of the banknote. When the banknote is tilted under a bright light, the iridescent stripe shines and slightly changes colour
5. The higher denominations also have a *foil patch* and *colour shifting ink*.

In fact, Australia's use of polymer substrate banknotes moves even closer to the production of a self-authenticating bank note: security features that are so clear that anyone will immediately see them, yet they cannot be counterfeited (Curtis, 2000). The second line of defence is *covert* features, dependent on printing technology (deep engraving, latent images, fountain prints) and materials used (inks and paper or paper substitutes), that are not apparent to the ordinary user, or even the sophisticated counterfeiter, but which are readable by machines.

Many redesigns of currency have been forced by inflation,⁴⁹ so countries with weak economies are particularly hesitant to redesign their banknotes lest this be taken as a sign of impending devaluation. However, even countries with strong economies are reluctant to change their banknotes, because the value of their currencies depends heavily on public confidence, and this confidence depends on familiarity with the currency. This is why governments embark on extensive public education campaigns when they

do introduce a new design (Reserve Bank of Australia, 2000) or a completely new currency such as the Euro (Staff, 1998b). The United States has a special problem because the dollar's strength makes it universally exchangeable and it is hoarded throughout the world.⁵⁰ When the U.S. government released its redesigned \$100 bill in 1996, it had to take special steps to allay fears of the Russian government that the old notes would still retain their value (Federal Information Systems Corporation, 1996).

Governments redesign their banknotes to improve security for the following reasons:

1. Specific events act as "wake-up calls." For example, a so-called "supernote" surfaced in Lebanon in 1995, where it was estimated that (US) \$2 billion in counterfeit notes had been manufactured (Skidmore, 1997). Similarly, a major counterfeit scare in Australia caused that country to embark on a complete revision of its banknotes (Australian Institute of Criminology, no date).
2. Losses due to counterfeiting have gradually risen to an unacceptable level through an increase in counterfeiting.
3. International pressure to update currencies that are perceived as too easily copied. This may have helped push the United States into changing its notes in 1995, the first change since 1929.⁵¹
4. A currency "arms race" among countries that are improving the security features of their banknotes. It is surely not a coincidence that the following countries all embarked on redesign of their banknotes (often the first changes in years) at around the same period, from the late 1980s through to the end of the 1990s: U.S.A.; Australia (Note Printing Australia, 2001; Australian Institute of Criminology, no date); Canada (Gazin, 2001); Japan (Staff, 2000a); Mexico (Gregory, 1994); United Kingdom;⁵² Vietnam (Staff, 2000b); Switzerland (Studer-Walsh, 1995).
5. Changes in technology that make it easier for counterfeiters to copy banknotes. Recently, the most important technological innovations have been low-cost colour copiers and inkjet printers coupled with personal computers and scanners (Hecht, 1994). The advent of the colour copier, in particular, has had the important effect of directing the attention back to the importance of overt security features.



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NOTES

¹See Ekblom (2000) for these and other examples of early product changes.

²See for example: www.designagainstcrime.org.uk; Erol et al., 2002

³Shover, 1996 shows how successive improvements made to safes in recent decades have led to the virtual extinction of safecracking.

⁴Theft and illegal use of these phones continues to be a problem in Britain (Harrington & Mayhew, 2002).

⁵BMW Australia was the world's first car manufacturer to spray all new cars (from September 2001) with up to 10,000 microdots each carrying the vehicle's unique VIN, though other manufacturers in Australia quickly followed BMW's lead (National Motor Vehicle and Theft Reduction Council, 2001b).

The pain reliever OxyContin is a time-release tablet prescribed widely for terminally ill cancer patients and others suffering severe chronic pain. If bitten to break their seals, these pills can offer 10 times the strength of a single dose. The company making them, Purdue Pharma, has been asked to repackage them to prevent this misuse by drug addicts. The company has responded by limiting distribution of the tablets in large quantity packages, much as the sale of Aspirin in the U.K. is limited to no more than 30 tablets at a time. It is also developing a chemical additive (similar to that used previously with a time release drug) that will deactivate the narcotic once the seal of the capsule is broken (see <http://www.injury-lawyer-network.com/oxycontin.htm>).

⁷The New York City Taxi and Limousine Commission has for years "grappled with ways to make meters tamper proof (Pierre-Pierre, 1995, p. B1).

⁸One example that recently came to light concerned changes contemplated for prepayment fuel meters and token vending machines after employees of the supplier were found to have tampered with them (Macharia, 1999).

⁹Hill, 1986; Staff, 1988. The need to replace coin meters was underlined at a crime prevention seminar held at 10 Downing Street in January 1986 (Tirbutt, 1986).

¹⁰In addition to incorporation of anti-counterfeiting measures, these documents need to be linked to an on-line database allowing real time access for enforcement agencies (Jill Dando Institute of Crime Science, 2002).

"See for example: www.scrip-safe.com

- ¹²Natarajan et al. (1996) describe a variety of modifications made to pay phones in drug-dealing areas, including blocks on incoming calls, blocks on coin operation at night and installation of phones with rotary dials (that cannot be used to call pagers).
- ¹³New car license plates have been adopted so that "it is virtually impossible to tell whether the driver comes from Bosnian-Serb Republic or from Muslim-Croat Federation" (BBC News Online, 1998). The old plates used the different scripts for Moslem, Serb or Croat regions, which led to danger for people travelling away from home.
- ¹⁴In some other cases, however, the link between the preventive action and the intended preventive benefit depends on untested assumptions. For example, monogramming a dressing gown might deter thefts by some hotel guests, but could increase thefts by others who wanted a souvenir. Again, despite assumptions to the contrary, the vast majority of parents might simply not bother to make use of the V-chip to prevent their children from watching violent TV programs.
- ¹⁵Bullet-proof partitions were made compulsory for all New York City licensed taxicabs in 1994. Various policing measures were also introduced at the same time. Robberies of cab drivers fell from 3,675 in 1993 to 1,089 in 1996 (Sullivan, 1997). This was a substantially greater drop than for robberies overall in the city during the same period, which fell from 86,001 to 49,670.
- ¹⁶See chapters in Felson and Clarke (1997).
- "This is a more detailed classification than used by Lester (2001) in a review of product change for the Australian Institute of Criminology.
- ¹⁸See also: www.research.linst.ac.uk/dac
- ¹⁹As mentioned, these can be difficult to identify. Product tampering, for example, poses a threat to public safety, but it also presents a severe economic threat to retailers and manufacturers of foodstuffs and pharmaceuticals. In other cases, however, the main victims can be more easily determined. For example, the costs of car theft have been shown to fall mainly on the public, who must pay more for insurance and who can be severely inconvenienced by the loss of a vehicle (Field, 1993), while those of credit card fraud fall mainly on financial institutions, who generally indemnify the retailers and cardholders.
- ²⁰The multiple jurisdictions in the United States sometimes result in legal confusion, as when the banks challenged the right of the New York City Council to impose regulations on ATM machines on the grounds that banks were subject to federal controls (Guerette & Clarke, 2003).
- ²¹Immobilisers are electronic devices that isolate two separate circuits that the vehicle requires to run. They come into automatic operation 20-40 seconds after the ignition is turned off. The EU is also working on a Standard to govern immobilisers that can be activated by remote control after a vehicle has been reported stolen.
- ²²No formal evaluations of immobilisers have been published, though statistics from Western Australia (National Motor Vehicle Theft Reduction Council

- [2001a]), the United States (Wollenberg, 2000) and the U.K. (Brown & Thomas, 2003; Vehicle Crime Reduction Action Team, 1999) suggest they are effective.
- ²³A newspaper story carried the following headline: "Home Office study urges manufacturers to help curb a crime trend that leaves teenagers at particular risk" (Travis, 2002).
- ²⁴These measures include: blocking of calls from phones reported stolen; blocking of calls associated with a stolen SIM card; pooling of information among die five companies about stolen phones and SIM cards (Baird, 2002).
- ²ⁱ*Design against Crime* had four objectives (www.designagainstcrime.org): (1) constructing a database of best practice case studies; (2) developing teaching packages to support the teaching of design against crime from school through to degree level; (3) holding a design competition for higher education institutions; and (4) disseminating information and providing training on crime-resistant design for design professionals.
- ²⁶An important exception is the report produced by IPPR with the support of business and reproduced in Chapter 2 of this volume. This clearly recognises that business products and services can cause crime and it argues that, consistent with Corporate Social Responsibility (CSR), businesses have an important role in crime prevention: "The case for a company to act is strongest the greater their product or service plays in causing crime, and the greater the contribution that the company could play in reducing the opportunity for crime, compared to the contribution of other players" (Hardie & Hobbs, 2002, p. 6).
- "The U.S. Wireless Telephone Protection Act 1998 criminalized the use, possession, manufacture or sale of cloning hardware or software.
- ²⁸A detailed discussion of this point, together with prescriptions for developing a knowledge base of crime prevention is offered by Ekblom (2002).
- ^wIgnition interlocks are fitted to the cars of convicted drunk drivers in many jurisdictions in the United States with some degree of success (Beck et al., 1999; Marques et al., 1999a,b), but not into cars at manufacture.
- ^{'''}Economical devices have been patented that permit operation of spray cans only when tethered to an electrical outlet. This renders them useless for spraying graffiti, but still allows the spray cans to be used for legitimate painting jobs. Without a law banning the sale of ordinary spray cans, no market would exist for the devices (Ingram, 1996).
- ¹ www.Senter.nl/t&s/crimi
- ¹²The Home Office Police Scientific Development Branch allocated £5.5 million from March 2000 to fund a series of demonstration projects, "The Chipping of Goods Initiative," to show how property crime can be reduced through the retail supply chain using radio frequency identification (RFID) technology (Adams & Hardey, 2000).
- "Pease (1998, p. 44) describes how new television sets could be protected by this technology: "Digital TVs have a uniquely identifiable microprocessor which can be interrogated remotely. Stolen TVs can thus be electronically deactivated, e.g., by using a Ceefax page containing the numbers of stolen TVs which is

scanned automatically at switch-on. If a TV finds its own number, it switches itself off, and remains unusable."

^MAlthough Shepherd et al. (1990a) report that most glasses in pub assaults are shattered on impact with the victim, one of the writers has observed in 1950s Australia, the preference of breaking the glass or bottle first.

¹⁸Barasch v. The Bell Telephone Company of Pennsylvania, 201 E.D. 1990, 202 E.D.1990, S. Ct. Penn. (1992).

"Telecom Privacy Digest Fri, 03 May 1991, Volume 2, Issue: 051. Moderator: Dennis G. Rears. Today's topics: Twisting the phone system against the unwary; ACLU Position on Per-Line Blocking? Caller-ID—New Twist on an Old Capability; Blocking (http://www.infowar.com/iwfrp/cpd/CPD-z-Telecom/V2_051.txt).

"These matters are covered in the following directives and recommendations:

European Parliament and the Council of the European Union Directive 95 // of the European Parliament and of the Council on the protection of individuals with regard to the processing of personal data and the free movement of such data (adopted by the European Council of Ministers 25 July 1995). This directive sets out a general framework for domestic private sector data protection legislation in the member countries.

Commission of the European Communities Amended proposal for a European Parliament and Council Directive concerning the protection of personal data and privacy in the context of digital telecommunications networks, in particular the Integrated Services Digital Network (ISDN) and digital mobile networks. This directive mandates minimum privacy protection standards for the provision of Caller-ID services.

Council of Europe Recommendation No. R (95) 4 on the protection of personal data in the area of telecommunications services, with particular reference to telephone services (adopted 7 February, 1995). This recommendation arose out of the Council of Europe Convention for the Protection of Individuals With Regard to Automatic Processing of Personal Data (No. 108 of 1981).

⁵⁸Lambourne (1992). (It is estimated that 70% of all drugs sold in Africa are counterfeit.)

³⁹<http://www.watermarkingworld.org/intro.html>

⁴⁰Credit cards, bankcards, and cheque cards are a special case considered elsewhere in this report.

⁴¹Cheque and Credit Clearing Company is a subsidiary of APAC (Association for Payment Clearing Services): <http://www.apacs.org.uk/>

⁴²Larabee (1999). (The annual cost of nationwide cheque fraud for the USA is estimated at \$4 billion, compared to compared to \$68 million for robbery.)

⁴³<http://www.printerm.com/fraud>

technologies available for smart guns include simple trigger locks with keys, fingerprint-activated locks, a wristband or finger ring transponder activated lock, PIN requirements and smart displays that show when a gun is loaded and when it is locked.

⁴⁵Though in Scotland banks still issue their own notes.

- [^]In fact, most counterfeit notes do not reach circulation, but are seized before reaching the market (Federal Document Clearinghouse, 1994b). (Testimony July 13, 1994 by Robert J. Leuver).
- ⁴⁷Federal Document Clearinghouse (1994a). (Testimony July 13, 1994 by Morris Weissman).
- ⁴⁸<http://www.bnb.be/EU/E/page6.htm>
- ⁴⁹Federal Document Clearinghouse (1994b). (Testimony July 13, 1994 by Robert J. Leuver).
- ⁵⁰Federal Document Clearinghouse (1994b). (Testimony July 13, 1994 by Robert J. Leuver).
- ⁵¹Federal Document Clearinghouse (1994b). (Testimony July 13, 1994 by Robert J. Leuver)
- "Aldersey-Williams (1998). (See also the Bank of England web site: <http://bankofengland.co.uk>).

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