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# A solvability-based case screening checklist for burglaries in Ireland

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## Abstract

*Burglary case screening is a way to sort burglaries with a checklist to identify those that police are most likely to detect. In this report for policing professionals, we summarise the development of the first solvability-based case screening process for burglaries in Ireland. This analysis was based on 49 534 burglaries reported to the Irish police force over 2014 and 2015. We whittled down a list of about 100 factors to a final case screening checklist of 17 questions with big data analysis, including text mining with R, variable creation with Excel formulae and regression with SPSS. After taking multiple factors into account, the top five predictors of whether a burglary will be detected after 1 day of investigation are: CCTV availability, suspect name availability, the motive is vandalism, a description of the offender's vehicle and a description of the suspect. We recommended that officers should continue to investigate burglaries with 5 or more of the 17 factors on the case screening checklist. If officers had used this checklist in 2014 and 2015, we estimate that they would have continued to investigate 49 % of burglaries after 1 day and that the detection rate would have increased by 50 % (from 9 % to 14 %). Identifying which burglaries are most solvable and allocating the most resources to those is a promising opportunity for An Garda Síochána to deliver a more cost-effective service and boost detection rates. The next step is to conduct a pilot study to test the checklist.*

## Keywords:

*burglary, investigation, solvability, predictive analytics, detections*

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## Introduction

Burglary is one of the most common crimes in Ireland with 3 % of households burgled each year (Central Statistics Office, 2010) and 26 259 burglaries reported in 2015 (Central Statistics Office, 2015). An Garda Síochána, Ireland's national police force, implemented a national anti-crime strategy named Operation Thor to tackle this problem in November 2015. To date the operation has achieved a reduction in the number of burglaries by 34 % in comparison to the previous equivalent period. However, detection rates have dropped by 21 % during Operation Thor and currently 85 % of burglaries go undetected in Ireland each year.

Burglary is an area of concern for politicians and it attracts considerable media attention. The 2015 national public attitudes survey found that over three quarters of respondents want police to prioritise burglary. One of An Garda Síochána's goals for 2016 is to improve detection rates for burglary specifically. As police numbers are only beginning to improve after a recruitment embargo that resulted from the global financial crisis, there is a clear need for efficiency gains particularly in terms of staffing levels and investigative efforts. Case screening can help us achieve various organisational goals and address stakeholder concerns.

Case screening aims to increase detection rates by focusing on burglaries that we are most likely to detect. Burglary case screening typically involves three stages:

1. investigate all burglaries;
2. sort undetected burglaries into solvable and not solvable;
3. investigate solvable burglaries.

The proportion of cases investigated after statistical screening varies across jurisdictions. For example, Danish police investigate 20 % of cases after screening and police in Denver, Colorado investigate 77 % (Garda Síochána Inspectorate, 2014). This variation could partially be due to differences between when investigators screen cases. Some may screen a case after receiving basic information from the reporting party while others may not conduct screening until they complete a specified list of investigative actions. In this report for policing professionals, we summarise the development of the first solvability-based case screening process for burglaries in Ireland.

## Method

Ultimately, we whittled down a list of about 100 factors to a final checklist of 17 questions. We summarise the methodology in terms of four main steps as follows:

### Step one

We listed and described all of the factors that might make a burglary more detectable. We achieved this by discussion between experienced crime and policing analysts, a review of the research literature and critical reflection.

### Step two

We extracted as many of these listed factors as possible from 53 494 reported incidents across 2 years of burglary data from our main policing database named PULSE. We used formulae in Excel and text mining with R to produce variables formatted for analysis in SPSS. We could only extract some factors from text data that officers wrote into the narrative field in PULSE. This open text box has no restrictions on the text that officers can enter. As there were at least 49 000 incidents linked to individual narratives, it was not feasible to explore all narratives individually, so a text mining approach was required. Our first aim was to identify specific word strings linked to a particular factor contained anywhere in the narrative in any order that were associated with an increase in detection rate. Our second aim was to categorise incidents according to the presence or absence of those words in a meaningful way. We started by searching through narratives to identify keywords that were clearly relevant to the factor. Then we produced word association lists with the R software across three categories of case selection: detected, not detected and random selection. This enabled us to compare association lists across categories to determine which words were uniquely and strongly associated with an increased detection rate. We then used Excel formulae to identify the optimal word strings based on the association lists that produced the largest increase in detection rate in comparison to cases with none of the keywords. Finally, we assigned incidents to meaningful categories based on careful interpretation of results from the previous phases (i.e. the words chosen to describe the particular factors).

### Step three

We used univariate analysis to describe basic characteristics of the data set in terms of key individual variables of interest. We used bivariate analysis to determine if there were significant differences between detected and not detected incidents in terms of key variables of interest.

We conducted bivariate analysis between all of the identified variables to identify which variables to include in the multivariate analysis. The criteria for including a variable in the multivariate analysis were:

1. it was significantly associated to the outcome variable (detected or not detected);
2. it was not collinear with other independent variables (i.e. it does not describe the same information as other variables);
3. there was not an alternative variable in the data set that measured the same construct and was more suitable for analysis.

We conducted logistic regression because the outcome variable was dichotomous (Detected = 1, Not Detected = 0). We conducted standard multiple regression using dummy variables in SPSS to calculate multicollinearity diagnostics. We excluded variables with tolerance of less than 0.20 or 0.10 and/or a variance inflation factor of 5 or 10 from the analysis. We tested the model for interaction effects to inform the development of the screening checklist.

### Step four

We tried three different ways of translating these statistics into a checklist for use by investigating officers. In the first, we gave higher scores to factors that had more predictive power than other factors. In the second, we counted how many factors were present with a long list. In the third, we counted how many factors were present with a short list. We decided to use the third way (counting factors from a short list) as this option had the best balance between usability and predictive power. We view usability as key to police officers taking the case screening methodology on board and using it as part of their routine investigative activity. If the end users find the tool too difficult or unwieldy to use then they are unlikely to take it on board however strong its predictive power.

## Results

Table 1 shows that An Garda Síochána detected almost half of detected burglaries within 1 day after they started investigating them in 2014 and 2015. We decided to exclude cases from the analysis that were detected within 1 day of the start of the investigation because we felt a solvability checklist would not be helpful to an officer who was either on their way to a burglary in progress or who had already identified the suspect and would soon apprehend them. We believe these situations account for most if not all of the cases that police detected within 1 day of investigation.

**Table 1**

Burglaries reported in 2014 and 2015 by detection status, time period and inclusion in solvability analysis

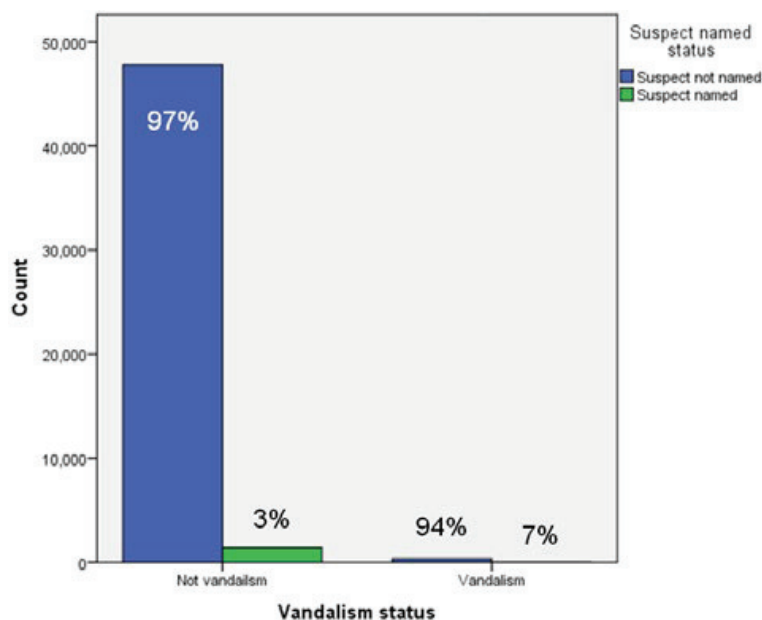
Included/Excluded	Time period	Count	% of detected burglaries
Excluded	Offender caught red handed	2193	26%
Excluded	Not caught red handed but within one day	1767	21%
Included	After one day	4338	52%
Included	Not detected	45196	-

The top five most powerful predictors of detection after 1 day of investigation were:

1. CCTV is available (+ 363 % more likely to be detected);
2. suspect name is available (+ 305 % more likely to be detected);
3. motive is vandalism (+ 290 % more likely to be detected);
4. registration number of the offender's vehicle is available (+ 286 % more likely to be detected);
5. a description of the suspect is available (+ 275 % more likely to be detected).

While most of the solvability factors that we identified were unsurprising, there were some counterintuitive results. For example, we found that investigators were significantly more likely to detect burglaries with a motive of vandalism in comparison to other motives such as monetary gain or jealousy. A potential explanation for this could be that the vandalism occurred in the context of an ongoing interpersonal dispute, so the victim knew the offender. One way to test this hypothesis would be to examine the availability of the suspect's name and the motive of vandalism. Graph 1 shows that the suspect's name was available in 7 % of vandalism cases versus 3 % of cases with another motive. These differences in proportions were statistically significant, so the hypothesis that the offender's name is more likely to be available when the motive is vandalism is supported. However, further research would be required to determine if the victim knew the offender's name due to an ongoing dispute.

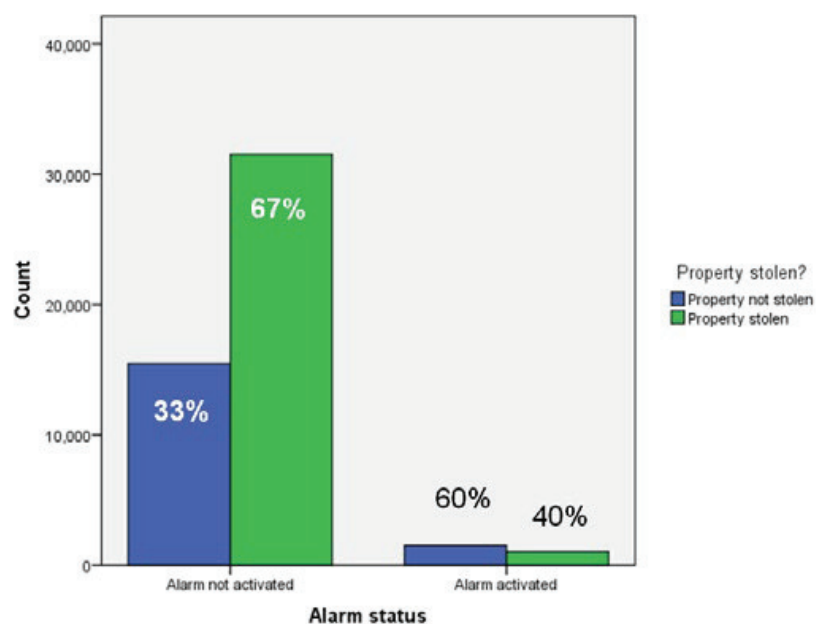
**Graph 1** — Vandalism and suspect named status in burglaries 2014/2015



Source: ????, 2017

We also found that investigators were significantly less likely to detect burglaries after an alarm was activated in comparison to when an alarm was not activated. One potential explanation for this could be that the alarm deterred the offender from entering the property so that less evidence was available for investigation. One way to test this hypothesis would be to examine property stolen and alarm activation status. Graph 2 shows that property was stolen in 40 % of burglaries in which an alarm was activated, versus 67 % when an alarm was not activated. These differences in proportions were significant, so the hypothesis that offenders were less likely to steal property when an alarm was activated is supported. However, further research would be required to determine if this was due to a deterrent effect resulting in less evidence available for investigation.

**Graph 2** — Alarm and property stolen status in burglaries 2014/2015



Source: ?????, 2017

Table 2 shows the final solvability checklist. Investigators should use the checklist by reading the statement in the first column and then selecting the value in the adjacent cells depending on whether the statement is true or false. After investigators score all of the statements they should then add each value to yield a total score.

**Table 2**

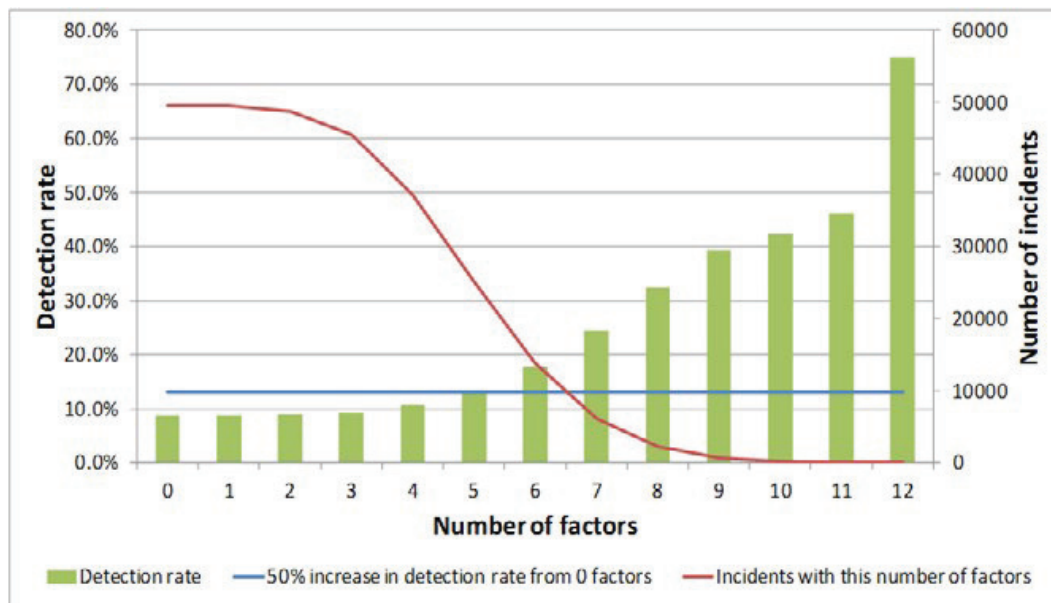
Solvability factor checklist for use by investigators to screen burglary cases

Statement	True	False
CCTV of the burglary is available for circulation	1	0
A description of the suspect is available	1	0
A name of the suspect is available	1	0
The offender used a vehicle to arrive at and/or depart from the burglary that was not stolen from the scene of crime and a description of that vehicle is available	1	0

Statement	True	False
The offender was disturbed by another person during the incident	1	0
At least one person who witnessed the crime is available	1	0
A separate incident has occurred at the same address within the past twelve months	1	0
Property was stolen from the scene of crime	1	0
Evidence is available for forensic analysis	1	0
An alarm was activated	0	1
The scene of crime was ransacked	0	1
Offender's motive was monetary gain	0	1
Burglary occurred during October to March between 1500 to 2300	0	1
The offender's exit method was through a door with bodily pressure or unknown	1	0
The offender's entry method was by forced window, slipped lock or through a door with bodily pressure	0	1
The injured party reported the burglary to Gardai	0	1
The burglary was reported by alarm activation or phone call to 999 or any other number	0	1

After scoring the checklist, the investigator will need a cut-off score to identify cases they are likely to detect with further investigative efforts. To determine this, we aimed to achieve a 50 % improvement in burglary detection rates and then worked backwards from this goal. Graph 3 shows that in 2014/2015, the detection rate of burglaries with five or more solvability factors from the checklist in Table 2 was 14 %. This is a 50 % increase from the detection rate of burglaries with 0 or more solvability factors (9 %). Therefore we recommend a cut-off score of 5.

**Graph 3** — Detection rate and number of factors by number of incidents 2014/2014 based on the solvability checklist

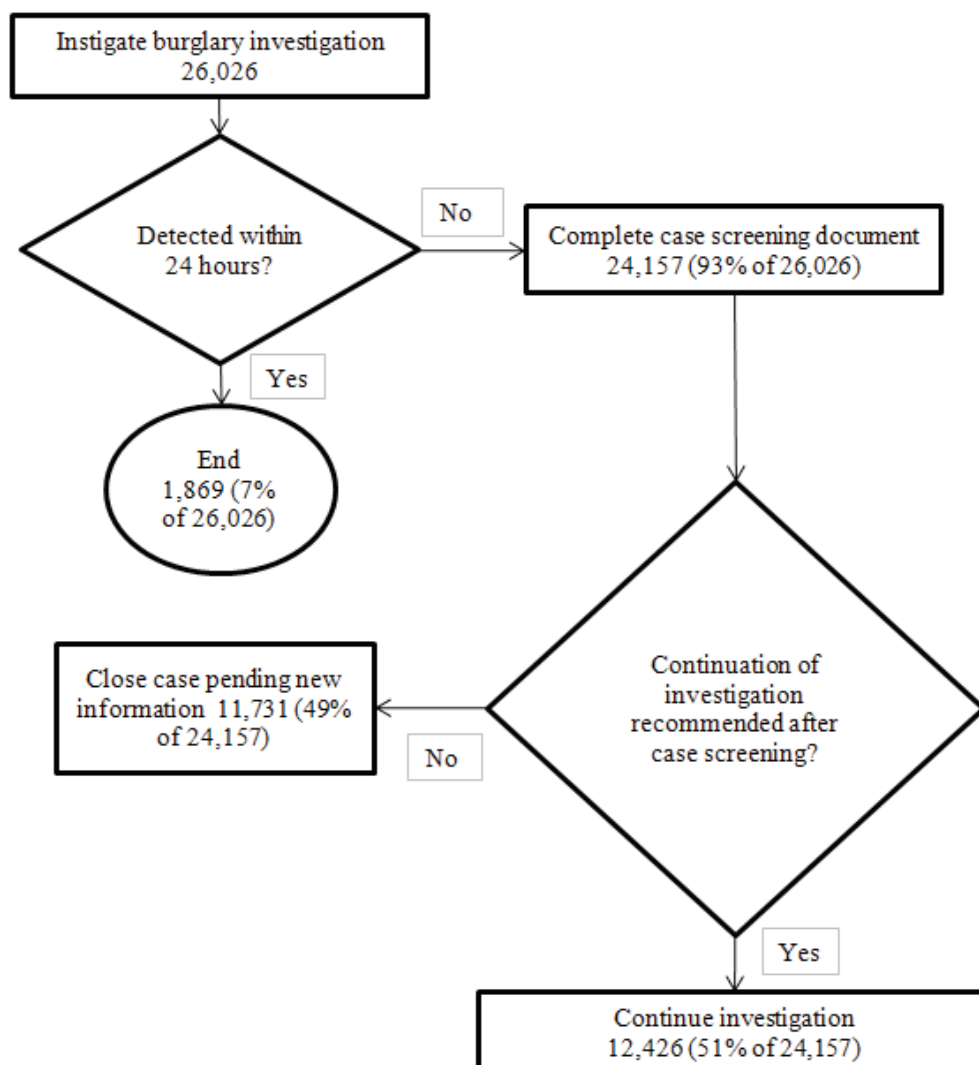


Source: ????????, 2017

Graph 4 shows what would have happened in 2015 if An Garda Síochána only investigated burglaries with a cut-off score of 5 or more on the solvability checklist after 1 day of investigation. This graph shows that officers would have screened 93 % of burglaries with the solvability checklist and that they would have continued investigating 49 % of those burglaries.

It is important to note that An Garda Síochána should investigate some burglaries regardless of how likely they are to detect them. These include burglaries in which offenders steal ammunition, firearms, explosives or other dangerous materials or burglaries that threaten state security or are of interest to intelligence services. Investigating police officers should have a final say on whether to continue an investigation irrespective of how likely they are to detect the burglary.

**Graph 4** — Process flow chart based on 2015 data if An Garda Síochána only investigated burglaries with a cut-off score of 5 or more on the solvability checklist after 1 day of investigation



Source: ??????, 2017



## Discussion

### Summary of results

After taking multiple factors into account, the top five predictors of whether a burglary will be detected after 1 day of investigation are CCTV availability, suspect name availability, a motive of vandalism, a description of the offender's vehicle and a description of the suspect. We translated all of the predictors into a checklist to help police officers decide whether they should continue to investigate a burglary based on how likely they are to detect it. If officers had used this checklist in 2014 and 2015, we estimate that they would have continued to investigate about 50 % of burglaries after 1 day and the detection rate would have increased by about 50 % (from 9 % to 14 %).

### Comparison with previous literature

A fundamental assumption of this analysis is that An Garda Síochána can achieve the optimum cost-effectiveness ratio by allocating the most investigative resources on burglaries that they are most likely to detect. Coupe (2014) supports this assumption by showing that police detected 30 % of burglaries that were highly solvable and had maximum resources allocated to them, versus less than 5 % of burglaries that were highly solvable but had minimum resources allocated to them. Therefore, resources matter because they 'enable the unlocking of the solvability information which is the source of the evidence that leads to case detection' (Coupe, 2014, p. 2). Identifying which burglaries are most solvable and allocating the most resources to those is a promising opportunity for An Garda Síochána to deliver a cost-effective service and boost detection rates.

In general, we found that An Garda Síochána is most likely to detect burglaries with more evidence linked to the suspect(s) than burglaries with weak or no evidence. This is highly consistent with previous research, as many studies investigating solvability factors have demonstrated that police are more likely to solve cases with better evidence across a variety of crimes such as burglary, violent assault, rape and homicide (Coupe, 2014). In addition, many of our solvability factors were similar to those previously found in burglary solvability studies. For example, Paine (2013) also found that police were more likely to detect residential burglaries in Thames Valley, UK if a description of the offender was available, if the offender was disturbed and if police recovered forensic evidence such as DNA. There were also some differences between factors identified in the current study and in the study by Paine (2013) but these are largely due to differences in data quality, database features and recording practices. Coupe (2014) reported that many solvability factor studies for burglary have found that factors related to suspect identity information are most likely to lead to detection and this is highly consistent with the current analysis.

Experienced officers in Ireland probably have an intuitive sense of whether they are likely to detect a burglary. Previous focus groups with Irish police officers found that some were investigating over 250 crimes each and they expressed a view that over 200 of those would

never be solved (Garda Síochána Inspectorate, 2014). So it could be that officers are already pretty good at rating how solvable a burglary is and that there is no need for a formal statistical screening process. However, Coupe (2014) reports a large variation between cases that police screen out across jurisdictions for the same crime based on officer perceptions. This suggests 'the potential of some solvable cases may not be fully exploited, while resources may be wasted on less solvable ones' (Coupe, 2014, p. 4). Therefore, a formal screening process based on statistics could enhance any informal screening process that officers use already.

### **Strengths and limitations**

This is the first solvability-based case screening process for burglaries in Ireland. We included almost 100 factors from roughly 50 000 cases across a 2-year period in the analysis. As with many solvability-based studies, the data we analysed was not originally constructed for research purposes. This led to a series of data quality challenges and a need to balance the requirements for conducting statistical tests with the demands of real-world analysis in an operational environment. We responded to this challenge by using big data text-mining techniques, using various quality checking procedures throughout the analytic process, evaluating the reliability of factors, excluding poor quality variables when possible and proposing a pilot test of the checklist.

### **Practical implications**

An Garda Síochána should test this case screening process. To date, we are not aware of any randomised controlled trials to determine the effectiveness of solvability-based case screening that have been published in Ireland or elsewhere. A randomised controlled trial would be the most scientific way to find out if this case screening process works but it would be extremely challenging to conduct in an operational context. An Garda Síochána should use other ways to test the case screening process if a randomised controlled trial is not feasible, such as introducing the screening process in one or more An Garda Síochána areas with similar areas used as controls. This pilot study would also be a good opportunity to address many of the data quality issues that we identified in the current analysis.

Ensuring the best possible likelihood of police officers using the case screening checklist as part of their normal routine is also part of the development of this tool. Feedback from An Garda Síochána as to their views on the reasoning behind the screening product, how they find the usability of the developed checklist and changes that might make it more likely to be used routinely by them could be derived from focus groups with these potential end users.

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