# MOLE

Modus Operandi Locate and Evaluate

## 'Burrowing through data'

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# 1 Introduction

## 1.1 Description

MOLE stands for Modus Operandi Locate and Evaluate, and describes a computer-based system developed for crime pattern analysis.

MOLE has been developed using Visual Basic, a programming language available within Microsoft's Excel spreadsheet application. Visual Basic permits the development of powerful programmes, which interface with Excel and other systems.

## 1.2 Background

In September 199$ I was involved in the development of the Operational Problem Solving programme (OPS) on North Surrey division. The purpose was to develop a training programme for divisional supervisors, based on a generic approach to:

- Leadership
- Teamwork, and
- Operational problem solving

The Crime Reduction Officer for Northwest Surrey Division came to see me to discuss the process of profiling an active burglar on her Division. This had been achieved by:

- Developing a MO profile of the offender based on intelligence, as well as the knowledge of officers.
- Comparing the profile against MO (Modus Operandi) codes downloaded from the Surrey Police Crime Information system (CIS) into Excel spreadsheets, using currently available software.

This had been achieved by counting the frequency of MO codes using a manual process. The result was a list of offences where there was a high probability that the offender was responsible. As a result the offender received a six-year prison sentence.

Whilst the results were encouraging there were a number of problems involved, these included:

- Time and cost- whilst the initial process was based on automatically downloading data from CIS, there was no system available to continue the process, which took an operator a further 4.5 days.
- Task complexity a high degree of concentration was required because of the way in which the data is presented, making this a demanding process.

We agreed to examine ways in which these problems could be overcome using available technology.

## 1.3 Method

Enquiries revealed no immediate plan or budget for this kind of work. In order to combine limited resources we agreed to involve the Crime reduction officers on North Surrey and North West Surrey working together as follows:

1. Problem identification and solving - as a group we would carry out an initial assessment based on SARA. This would inform development through a process of formal and informal contact. The Crime Reduction officers would battle test each stage in the work place.
2. System development - I had taught myself to write computer software, and would write the system.

Through this process, described by some as 'the skunk works,' we identified the following objectives.

## 1.4 Objectives

One primary objective:

1. System - achieve the allocation of a development budget through the design of an effective and credible working system.

Three secondary objectives:

1. Process - overcome the problems associated with the original problem solving process.
2. Development - explore ways of using existing resources to develop computer systems more effectively at lower cost.
3. Front line policing - explore the means to effectively deploy computers in support of front line policing in the future.

The subject of system integration into front line policing is a wider subject and is not dealt with directly in this report.

# 2 Scope

## 2.1 Introduction

We identified the use of computer technology as a solution if:

- ❑ Large amounts of data needed to be processed quickly and efficiently.
- ❑ Problem solving was to be simplified permitting system deployment at the tactical level in direct support of front line policing.

We identified two main problems:

- ❑ System- related to systerrrdevelopment and operation.
- ❑ Deployment - related to system deployment, especially on the front line.

These are explored in more detail below.

## 2.2 System

### Cost

Experience continues to indicated that technology based development can prove expensive and difficult to manage.

Any project to develop existing, or future systems, is likely to involve significant:

- ❑ Costs.
- ❑ Development periods.

Purchase costs of commercial systems can also be high. If we were to develop such as system in the short term then it would have to be done on a zero-based budget, using existing resources. If this could be achieved successfully in a way that could be evidenced, then this would prove significant.

### Data

CIS is a computerised crime recording system, which is also in use by other UK police forces. The system currently stores hundreds of thousands of MO codes related to individual offences. Typically a single offence may involve the need to examine up to 30 separate MO codes contained in long text strings in a number of separate MO categories. There are a number of problems involved:

- ❑ Data searching - whilst CIS does have some functionality which allows codes to be searched this does not allow large scale searches across all the categories, necessary for profiling and crime pattern analysis.
- ❑ Time - whilst software does exist to download data from CIS the format requires a high degree of data re-formatting by the operator before it can be used in other processes or systems. This raises questions about timeliness and

efficiency related the number of tasks an analyst can carry out in a given time, coupled with significant costs in software, hardware and labour.

- Complexity - the manner in which downloaded data is presented makes the task of analysing it complex and demanding, in the original case up to 4.5 days. The example below shows a typical MO code string downloaded from CIS related to property stolen in a burglary:

  JEW RIN EAR BRCE NEC WRI PEND POC CUF

There are over 1500 separate codes in use. Where downloaded data is involved users have difficulty in knowing or remembering what each code means. This causes difficulty with interpretation, as well as identifying codes of interest.

These codes represent a vast and valuable resource, as well as a high level of organisational investment over a period of years. With increasing pressure to make better use of existing resources, this is a resource, which is significantly under used.

Changes in technology, as well as rules on crime reporting have identified the need to make changes to the MO code reference library in CIS. This is likely to prove expensive and presents real difficulties in adapting current and future systems.

## 2.3 Development

Developing computer systems for operational policing can present a number of difficult problems, including:

### Computers as problem solving tools

A significant number of computer based applications fail to carry out the task satisfactorily. We all have experience of this. Operational policing is complex and many of the factors involved in decision making, as well as the rules that underpin them, have not yet been identified. This means that many of the systems in use are of a type that display data only, providing tools to manipulate it in order that it may be interpreted in different ways. Such systems whilst effective often require time, skills and knowledge to operate. It is these factors which make front line deployment difficult.

### Method

Committee's are often used to develop systems, whilst this can be an effective way of problem solving, the kinds of problems involved in operational policing are difficult to identify and solve. Their relationship to each other is not always clear, or currently understood. This kind of approach may not in this case be the most effective way of solving the problem, or achieving consensus. It can prove almost impossible to understand the relationships and interactions between the different parts of a complex process. Development is often confined to a particular group or department, and there are good reasons associated with this. But this can lead to allegations of failures to consult and parochialism.

Cycles

System development is often a slow process, resulting in periods of delay, and on occasions, frustration and loss of credibility.

## 2.4 Deployment

System type

Many of the problems outlined above can lead to difficulties in integrating computer-based systems both operationally and organisationally. This is particularly the case where systems are deployed in support of front-line policing, as opposed to higher up in the organisational structure. Many commercially available computer systems require specific skills and knowledge to operate. This again does not make them easy to deploy as tactical systems at the front end.

At the present the majority, of our crime pattern analysis is carried out at force and divisional levels. Most of our significant crime analysis technology based systems are operated at these two levels, by trained staff. There are a number of good reasons for this which include:

- Cost - commercially available systems are expensive which prevents wider deployment.
- Type - the majority of systems in current operation are of a type that primarily display data in different formats to the user, who interprets that data. Operation requires time, training and experience not currently within our interests to develop at every level.

Decision cycles

Decision cycles involve the time taken to make a decision. The higher up in an organisational structure the system the more likely it is that:

- Decision cycles are extended, raising issues about timeliness.
- Information quality is effected as information passes up and down the different layers of the organisation.

This will be the case if significant systems are deployed as described above. This may be further influenced where:

- The systems in use require significant levels of data formatting, as data is transferred from one system to another.
- The management information cycle is monthly, meaning that significant decisions are only being made once a month when updated information becomes available.

A symptom of this may be 'Shark toothed' crime statistics, which show peaks and troughs, showing apparently uncontrolled problem development over a period of time. Subsequent problem solving leads to problem reduction, reflected in the figures. A flatter line may indicate higher levels of responsiveness to problem identification and solving,

coupled with shorter decision cycles. This demonstrates the ability to problem solve effectively and raises questions about why it did not happen sooner. Whilst there can be good reasons, which often includes resources, our ability to identify a problem early and make decisions quickly is an important factor in problem solving.

One way of reducing our decision cycles, as well as encouraging problem solving at all levels is to deploy these kinds of system much lower down at the front line.

Leadership and team work

The lack of problem solving tools in the front line can have a negative effect on leadership as well as teamwork. As problems apparently go unchecked this can have a number of effects including:

- Relationships - raising questions in the minds of team members about the capability of the leadership.
- Motivation - de-motivating the team, reducing its willingness to problem solve.
- Resources - as problems go unchecked the number increase having the potential to overwhelm the resources of the team.

## 2.5 Summary

The problems associated with this kind of development are significant. They are not only related to cost, methods of development and operation, but to position of systems in the organisational structure. In fact this is a very significant factor if we are to reduce decision cycles, and encourage problem orientated policing at all levels.

# 3 Analysis

## 3.1 Introduction

A similar format to that above has been used to demonstrate what options the group considered in order to achieve the objectives.

## 3.2 System

### Cost

The Surrey police Intranet system provides ready access to Microsoft Excel. This is a powerful spreadsheet appfcation, which comes packaged with it's own programming language called Visual Basic. Excel has a number of advantages, including:

- A development platform at no cost.
- Organisational access, making availability and later propagation and use easier.
- The means to download data from CIS into Excel was already available.
- The original work was based on this process and the data available. This would allow direct comparisons with the efficiency of the original problem solving process.
- Excel is a widely used world system. Potential users would understand and relate to it more easily.
- Using Visual Basic gave the look and feel of a larger free-standing system, enabling us to promote the concept of a future system more easily.

Zero start up costs was a significant factor in being able to start the project. The possibility of increasing the levels of automation, over the use of human operators, using Visual Basic raised the possibility of reducing the cost of the current problem solving process, as well as future system costs.

### Data

As previously identified most computer-based systems currently being used primarily provide the tools to manipulate and display data only. Human analysts are required to interpret this data through a process based on frequency identification and pattern matching. If we could identify the steps in the problem solving process used by the human operator and replicate these as automated rules and processes then a computer-based system could carry these out automatically. This would include:

- Data searching - large scale searches across a range of different categories of data at the same time and in parallel.
- Data structure - using the existing MO code library as a reference point to re-interpret that data automatically according to new rules. This would provide the flexibility to adapt to changes identified as being required in the existing MO database.

- a Data auto-formatting - in order to overcome the need for the human operator to spend time re-formatting data before it could be used all data would be auto-formatted by the system, thereby significantly reducing operator time and effort.

We felt that if we could capture the processes involved as rules en-coded into the system this would reduce the complexity of the original problem solving process, enabling it to be carried out at a speed, accuracy, and without fatigue, not achievable by the human operator.

Whilst this was an option we recognised that we should not forget:

- o The importance of maintaining the human in the loop.
- ❑ Using the output as an aid to decision-making.
- ❑ Recognising that the computer is a tool in a wider process.

## 3.3 Development

The following .approaches were considered in order to overcome a number- of problems associated with the development process:

### Computers as problem solving tools

If this kind of system development was carried out incrementally in the workplace this would have a number of advantages, including:

- ❑ Dividing the complex development task into bite sized chunks. Each chunk could then be battle tested in the operational environment, to ensure its survivability as well as it's relationship with other parts of the problem solving process.
- ❑ Allowing development to take place like an evolutionary process. As the knowledge of the environment in which it lived and functioned increased, the system would evolve new problem solving processes. The system would discard defective solutions, whilst retaining effective solutions. This would not only be efficient but would spread the risk, as well as the cost of development.
- ❑ This kind of modular evolutionary approach would reduce the chances of failure, ensuring that the proof of the pudding was in the eating. System development in the workplace would ensure a closer relationship between the system and problem orientated policing. Developing the computer system in the operational environment maintains the emphasis on the system as a tool to achieve operational objectives. Preserving the proper relationship between master and servant. Commonly the situation is reversed, and the tool becomes the master, and the master becomes the servant.

Method

System development in the workplace would have a number of advantages:

- Starting immediately with a tangible system using an evolutionary type approach we create an example system which enables committees or groups to simulate or test bed thinking from the outset. This would enable principles of leadership and teamwork to be applied with the effect of forcing logjams, as well as creating drive and energy within the project. The simulated system acts like a piece of plasticine, which is moulded into different shapes, until the final shape is found and agreed. This would allow the system to contribute not only to it's own development, but to the thinking of others as well as the development of other systems.

- This would be further enhanced if a team-based approach were adopted, involving future users directly in the development process from the start. Involving users directly in daily development would help develop system loyalty as well as system credibility in parallel to the development process. If this concept was widened to include other divisions, whilst maintaining the drive and energy of the development process, this would have the effect of reducing parochialism, as well as sharing development costs.

Cycles

A modular approach to system development would mean that we would not have to wait for an extended period for the system to start delivering. The system could start small, delivering tangible results immediately, and as it grew it's scope and profile would improve.

## 3.4 Deployment

We felt that if the problem solving rules and processes being used to solve the problem could be identified and automated within the system then this would help to overcome a number of problems, including:

- System type - a process of internal development as described above would substantially reduce cost, this combined with simplified operation would make wider deployment viable.
- Decision cycles - placing systems closer to the problem would have the effect of improving the process of problem identification and solving through reducing the time taken to problem identify, as well as increasing the problem solving rate.

Leadership and team work

The presence of tools which permitted members of the team to problem solve would influence the following areas:

- Relationships - improving the speed and quality of decision making would improve relationships between leaders and teams.
- Motivation - success breeds success, thereby motivating those involved
- *Resources* - *more* complex problems could be solved *more* quickly and efficiently freeing up resources for other problems as well as reducing stress in the team.

## 3.5 Summary

If we are to design and operate s.uccessful systems in direct support of front line policing then we must find ways of solving the complex problems involved. The development of these kinds of system incrementally in the workplace enables us to solve the problems involved in bite sized chunks, which can be battle tested at each stage. This not only makes effective use of those who know what the problems are, but has the effect of developing system loyalty and credibility early on in the development process. This can be very important in later deployment. This kind of approach also reduces development cost and risk.

# 4 Response

## 4.1 Introduction

The following sections summarise the main functions of MOLE and demonstrate how the group solved the problems identified.

## 4.2 Offence location

The original process involved locating matching offences, therefore initial development focused on identifying the problem solving processes involved, and replicating these in code.

The basic process involves breaking each code string into individual codes, and then comparing these against the MO-profile of the offender. Once this was completed MOLE was able to carry out the original 4.5-day process in about 3 minutes. The output represented by a numeric score, which enabled probability comparisons to be made between offences.

- By comparing the number of codes available in each offence, against the number of hits found, it was found possible to include a percentage figure with the numeric score. The percentage score being used as a means of indicating the quality of the hit or degree of certainty involved.

In order to reduce the complexity of the task a user interface was developed through the use of dialog boxes. An example of the dialog box used in the locate process is shown in Figure 1 below.

## 4.3 Offender profiling

Once the location process was completed two further issues were identified:

- ❑ The need to find a way of developing the original offender profiling process to ensure greater accuracy, and
- ❑ The possibility of applying the same locate process, to automatically generate an offender MO profile from existing CIS codes.

It was found possible to reverse the process of location, and use it to search on offences an offender was known to have committed, thereby generating an offender profile based on the frequency that MO codes occurred in known offences.

Once completed it was found that by searching on offences that an offender was known to have committed it was possible to generate a profile in minutes. The same process can be applied to profiling a series of offences where the offender is unknown. A copy of the profile user interface is shown in Figure 2.

Figure 2

The combination of the functions of profile and locate mean that the whole process can be carried out in a very short period of time, the benefits of this include:

- ❑ Profiling any type of offender using current data from CIS in a way that is timely.
- ❑ Reducing the time required for analysis, freeing up time for other tasks.
- ❑ The ability to effectively carry out this task as soon as a person comes into custody, thereby ensuring that:

1. Offences are put to offenders in the first instance.
2. This is consistent with obtaining primary detection's
3. This makes the best use of the period that often follows initial admissions.
4. We stay within the PACE clock.

## 4.4 MO Code Library

The current MO code library for CIS consists of more than 1500 separate codes. Because MOLE makes direct use of these, their importance cannot be underestimated. Without going into detail, the work done with MOLE raises a number of issues about current CIS codes, including:

- The quality of the coding, especially when crime reports are created.
- The number of codes currently in use may be more than is required to achieve acceptable levels of accuracy during profiling, or crime pattern analysis. This may permit a reduction in the number of codes, thereby reducing the time required to complete crime reports,' at the same time making the system more user friendly.
- The current codes are misleading, and open to degrees of misinterpretation by the user.

In order to overcome this MOL€ has replicated the original code library. The functionality within MOLE allows the user to adjust and adapt the original MO code descriptions in order to overcome the factors identified above, whilst preserving the original library.

User access to the code library within MOLE has been given at this time because we have found that this process will need some time to achieve the best match, and is currently one of regular adjustment. Once a good match has been achieved it is envisaged that we would restrict access.

A major benefit of this has been to provide plain English translations of the codes. This has been found to be of value for the operator, developing a better understanding of offender behaviour, especially where the system is being used interactively by the operator with an investigating officer present.

The current workplace reference for the codes is a paper one. This can take several minutes to locate a code. The user can now look up codes in seconds on the system.

## 4.5 Offender Profile Library

The generation of code profiles of individual offenders has meant that these can be saved in a library. This is now being done, and there are a number of benefits, which include:

- Saving time and resources through repeat profiling.
- Substantially reducing the time required applying profiles to a series of current offences.
- Developing the capability to automatically search a library that may consist, of hundreds of profiled offenders, regularly against current offences. A county based library would overcome problems were offenders are operating across divisional boundaries. This would evolve a more strategic approach to crime pattern analysis, and could be carried out on a regular or scheduled basis. This kind of function could easily be achieved within the current project.
- Sharing profiles with others.

Current crime pattern analysis has a high level of geographic orientation. It is generally carried out on a divisional or departmental basis, and is confined to boundaries. This kind of

approach does not necessarily take into account the fact that offenders themselves do not operate within the same geographic boundaries established by the organisation.

With high degrees of mobility, offenders operate effectively within a wide area, across a number of boundaries. This kind of divisional, or boundary based approach to problem identification gives a limited view. It looks at one slice of the cake only. Surely it is better to see the whole cake; this would be the icing.

This must disadvantage us, and may also account for difficulties on occasions in identifying high concentrations of certain types of crime, because the offenders are operating across wider geographic areas. A more strategic approach based on an offender library should help to overcome this. This introduces another way providing another weapon in the armoury.

## 4.6 Other functionality

We are continuing to modify, as well as develop new functions, as our understanding of the problems involved increases. This has led to a modular or tool box based approach, providing tools to solve different parts of the process. In addition to those described above, the following currently exist within MOLE:

- Time/Date Profile — Time and date profiling.
- Code Find -- Code lookup.
- Print Reports -- Automatically generating reports and profiles.

MOLE functions are accessed through the toolbox shown in Figure 3 below

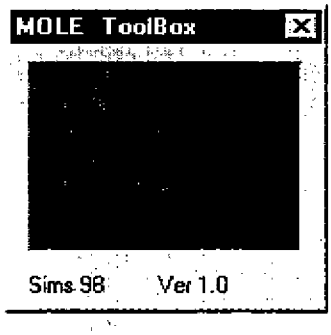


Figure 3

## 4.7 Summary

The modular approach to the design of the different problem solving tools associated with MOLE provided the team with the ability to break the process down into identifiable parts. This meant they could be more easily understood and placed in context, with the flexibility to merge or separate modules, as our understanding improved.

# 5 Assessment

## 5.1 Introduction

In assessing the MOLE project so far it should be viewed as the first of a number of steps along the road to a final system. We believe the first step has not only significantly impacted on the problem identified, but allowed us to see further horizons and possibilities.

## 5.2 Objectives

The following are the achievements of MOLE against the objectives set.

**Primary objective:**

2. System - achieve the allocation of a development budget through the design of an effective and credible working system.

   Achievements:

   1 Surrey police have agreed that MOLE will form part of the development budget for the year 2000 and £14,000 has been allocated to the project.
   2 The project has attracted outside interest. We have agreed to work with a company specialising in developing computer-based intelligence through the use of neural networks, as a means of further developing the levels of automation involved.

**Secondary objectives:**

Process - overcome the problems associated with the original problem solving process.

Achievements:

1. MOLE has reduced the original task from 4.5 days to minutes.
2. MOLE has evolved a simple user interface, reducing task complexity.
3. MOLE has captured the problem solving processes employed as code within the programme. As others are identified they are captured and coded into the system.
4. Has improved our understanding of CIS, providing solutions to problems identified.
5. Is capable of profiling and locating thousands of records in minutes.
6. Is the only system currently in use, which makes direct use of, and comparison of the vast resources available within the MO codes held by CIS.

Development - explore ways of using existing resources to develop computer systems more effectively at lower cost

Achievements:

1. MOLE is a zero cost system developed with a zero based development budget.

Front line policing - Explore the means to effectively deploy computers in support of front line policing in the future.

Achievements:

1. By creating a viable crime analysis system which simplifies and reduces the tasks involved makes it possible to deploy the system in the frontline. The next step will be to deploy the system on the Surrey police Intranet, making it available at every level.

## 5.3 Summary

Whilst the name MOLE describes a system capable of burrowing through large amounts of data quickly and efficiently, it also describes the fact that in a number of cases the development and deployment of technology systems is a blind process, requiring high levels of investment and costly human support.

If we can reduce this, whilst maintaining the human in the loop, we will be able to deploy effective systems at every level which encourage the leadership and teamwork required for problem orientated policing.

Ian Sims