Decision Analytics and Operations Research for Policing: Progress to Date and Needs for the Field

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About Me

• Ph.D., Operations Research, MIT, 2000
  – Thesis on job-shop models, used for capacity planning of computing networks
  – Took seminar in then-emerging field of “data mining”

• Working in policing since 2007; RAND’s policing market manager
  – Primarily technology research
  – Predictive policing a key area
Outline: Decision Analytics & Operations Research (DA/OR) for Law Enforcement

Recent Progress
- “Traditional” DA/OR research and developments in policing
- Predictive policing and an alternative
- Other tech opportunities – video, SM/SNA, broadband, evidence-based policing

Needs for More
- Example needs for technologies
- Bigger questions about policing
- Thoughts on how DA/OR might address these questions
Three Takeaways for DA/OR and Policing

1. Personnel, process, and organizational changes are just as much areas for “technological innovation” in policing as hardware and software.

2. AI / data science / IoT / automation / other tech will not deliver policing capabilities in and of themselves – they are enablers, and often just incremental ones.

3. Don’t think just about modeling and optimizing existing policing systems – think about redesigning and re-engineering them to meet needs of multiple stakeholders.
   • And then you can optimize them.
OR Journals Have Not Seen That Much on Policing in Recent Years

• Between 2008-2012: 61 articles on IAOR for “policing” or “law enforcement”; 13 were highly relevant:
  – Soft OR / systems thinking for strategic planning
  – Systems dynamics
  – Staffing algorithms
  – Dynamic programming for patrol allocation
  – Cost benefit analysis

Results for 2013 and on look similar
At the Same Time, Policing Has Gone Through Multiple Crises and Evolutions

- Focus on preventing crime as opposed to responding to it
  - Change from prior paradigm
- New focus on community trust
  - Problems brought to fore since 2014
  - In our panels, trust and legitimacy has shot up be the number one objective of law enforcement, edging out crime prevention
- Financial crisis put agencies under budget pressures, with many not fully recovered

What actions are most likely to prevent crimes?

What actions are most likely to build trust and legitimacy?

How can agencies use funds most efficiently – and justify when they need more?
We Have Seen These Challenges Before

• “The basic mission for which police exist is to prevent crime and disorder... The ability of the police to perform their duties is dependent upon *public approval* of police existence, actions, behavior, and the ability of the police to secure and maintain *public respect... the police are the public and the public are the police...”
  – From the general instructions to instructions to UK Metropolitan Police Officers in 1829, popularly known as Sir Robert Peel’s Principles
A Brief Summary of Predictive Policing

Input data
May include:
- Crimes
- Disorder calls
- Suspicious activity
- Field interviews
- Time and date
- Weather
- Geography
- Gang intelligence
- Criminal histories
- Etc.

Statistical model (many types)

Estimates of future crime & criminal risk (predictions)

Interventions & assessment

Most focus to date here

Much less focus here
Predicting Robberies: Hot Spots or PP?
Predicting Robberies: Hot Spots or PP?
The Future Will Not Look Like *Minority Report*

- Predictive map was about 10% better; performance of other tools has been similar
  - Does mean that most serious concerns about civil rights and privacy violations have gone unrealized

- “*Unless the maps can start telling us where and when to go to pick up the criminals, we are just getting hot spots, and we’ve done hot spot policing for years*”
  - Paraphrase from the Shreveport Predictive Policing Experiment
  - Would need several thousand-times increases in accuracy
An Alternative: **Data-Driven Business Processes**

- **Situational awareness**
  - Provide tailored info to all levels

- **Generic**
  - Increase resources in areas at greater risk

- **Crime-specific**
  - Conduct crime-specific interventions

- **Problem-specific**
  - Address specific issues driving crime risk

Communicate with public about uses of data, along with security, privacy & civil rights protections.
An Example of Using Data to Support Planning and Operations – Chicago’s Strategic Decision Support Centers

“[SDSCs are nerve centers that] include predictive crime software that helps district leadership make deployment decisions, additional cameras, gunshot detection systems, and mobile phones to officers in the field who receive real-time notifications and intelligence data at their fingertips” – Chicago PD

Also have staffing (3 per shift), including civilian analysts

https://www.youtube.com/watch?v=54-z8_s9Nbc
SDSC Coverage To Date Has Focused on the Technologies They Contain

• Conference rooms in each district with the following on wall monitors and displays:

Genetec Citigraf situational awareness maps and surveillance camera displays

ShotSpotter Displays

HunchLab Predictive Policing Display

Also: access to CPD tools (CLEAR), including a network analysis tool and a mobile app on events, persons, and warrants of interest

Source: SecurityInfoWatch.com
Observations: SDSCs Can Support Four Levels of Planning Cycles in a District

**COMPSTAT**
- Data on delays of a month or greater
- Planning on a monthly or greater basis

**Weekly**
- Meetings on special topics like shootings
- Assigns special resources over next week

**Daily**
- Meeting on events within the past 24 hours
- Assigns resources over next 24 hours

**Real Time**
- Monitoring of radio, cameras, & dashboard,
  - Assigns resources where needed right now

SDSC staff, displays, databases, and standing room were all described as key enablers.
## Observations: Near Real-Time Monitoring, Response, and Other Ongoing Activities in SDSCs

<table>
<thead>
<tr>
<th>24x7 monitoring</th>
<th>Immediate response</th>
<th>Ongoing analyses &amp; information sharing</th>
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</thead>
<tbody>
<tr>
<td>• Calls for service and radio traffic</td>
<td>• Direct units to call, shot, and other event locations</td>
<td>• Preparing slides for briefings</td>
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<tr>
<td>• Live map of calls, units, and other data</td>
<td>• Assisting units during incidents</td>
<td>• Supporting planning at briefings</td>
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<tr>
<td>• Display of 4 surveillance camera feeds</td>
<td>• “Virtual chases”: tracking suspects across multiple cameras</td>
<td>• Crime analyses and investigations</td>
</tr>
<tr>
<td>• Shot detection</td>
<td>• Analytic support</td>
<td>• Ad-hoc information sharing: “get info out of notebooks”</td>
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Just now reaching sufficient maturity to start considering process, organization, and technology optimization questions
New Tech Opportunities: Broadband Where Devices Communicate Seamlessly and Securely Over Multiple Points of Access as Needed

• Much to be done to make this a reality, including network design and optimization

• Much to be done to make sense of all the resulting information, including comms and delivery optimization
New Technology Opportunities:
Video Analytics & Sensor Fusion Applications
(Social Media, SNA, other tech broadly similar)

Real-time monitoring
• Crimes & suspicious activity
• Hazards

Tech forensics
• Data management to support investigations

Automatic reporting
• Help describe an event
• Help capture interviews

Performance monitoring
• For individuals
• For agency performance

Crosscutting Cyber, Security, and Civil Rights Protections

As these mature, planning and optimization questions are emerging
Security, Privacy, & Civil Rights Protections Needed: Examples for Video Analytics & Sensor Fusion

<table>
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<tr>
<th>Description</th>
<th>Details</th>
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<tr>
<td>Public acceptance is for using VA/SF in law enforcement</td>
<td>Need to consult with community, officers, and other stakeholders about uses, including reporting</td>
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<td></td>
<td>Prepare for usage “going wrong”</td>
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<tr>
<td><strong>Passive sensing</strong>, not persistent surveillance</td>
<td>By securing data until it meets alerting or query criteria, systems incur lower security, privacy, and civil rights risks than “surveillance”</td>
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<td>Law enforcement predicates needed (for LE uses)</td>
<td>Focus on behaviors with criminal, hazard, or homeland security predicates; individual ID not done until required</td>
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<tr>
<td>Technical controls as for other sensitive data</td>
<td>Data integrity, access control, &amp; authentication is critical, esp. given ways video can be manipulated/fabricated</td>
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The Community Must Be Involved – Example Deliberations When Monitoring Social Media for “Worrisome Activity” Is Appropriate

**Consensus:** Wide-ranging monitoring of the public’s 1st Amendment-protected speech for uncertain purposes is **not appropriate**

**In the middle:** Communities work out what is needed given their own specifics

Discussed transparency and how to engage communities more effectively - example of Oakland, CA’s Privacy Advisory Council

**Consensus:** Monitoring a crowded event for an emergency in progress is **appropriate** – discussed success stories here

Monitoring a suspect’s posts as part of a criminal investigation is **appropriate**
“We believe that a radical reformation of the role of science in policing will be necessary if policing is to become an arena of evidence-based policies. We also think that the advancement of science in policing is essential if police are to retain public support and legitimacy, cope with recessionary budget reductions, and if the policing industry is to alleviate the problems that have become a part of the policing task. In this paper, we outline a proposal for a new paradigm that changes the relationship between science and policing.” (p. 1)
Reducing crime in places: **Problem-Oriented Policing** (starting in hot spots)
- Talk to the local community to find problems
- Follow step-by-step process (with checklists)
- Bring in needed services if appropriate

Reducing violence: **Focused Deterrence** (e.g., Boston Ceasefire / NNSC Group Violence Intervention)
- With an upfront intervention meeting
- With community involvement
- With full team using step-by-step process

Solving more crimes: **Homicide Process Mapping**
- BJA-sponsored guidebook on needed processes, org structures, and resources
- From agencies solving 80%+ of homicides

Improving relations: **Legitimacy Policing**
- *Procedural justice* in interactions (citizen participation, perceived neutrality, respect, trustworthy motives)
- *Ongoing dialogue* in formal meetings and in day-to-day interactions

What not to do: zero tolerance / aggressive policing  
(however, *targeted order maintenance* has a role)
Examples of Emerging Technology Issues (from NIJ’s Future Internet Technologies Workshop)

- **Self-driving and flying vehicles** – how will we interface with them?

- **Internet of Things / widespread cameras** – how do we take advantage of the volumes of data? How do we ensure security, privacy and civil rights protections?

- **Intelligent agents** – which tasks can they support, really?
  - E.g., scene and interview capture; report-writing assistance; prioritizing tasks and workloads

At the Same Time, Many Core Technology-Related Needs Remain Underserved

• Longstanding needs to improve the sharing and use of information
  – And reduce info overload in the process
  – *N.B.*, communications interoperability is still a major problem

• Longstanding needs to help agencies learn about technologies, develop better requirements and acquisition, and use them more effectively, in general

• Longstanding needs for non-materiel improvements to policing practices and processes, as well as education on them
  – EBP helps here
Top Issues Facing Policing – Can DA/OR Help on This Much Broader Range of Problems?

- Community relations and trust
- (Localized) spikes in crime and unsolved cases
- Terror attacks and other security issues
- Officer health, safety, and wellness
- Recruiting & retention
- Overcoming limited resources
- Gaps in policing knowledge
On Gaps in Knowledge – Can DA/OR Help Overcome This Practitioner’s Objections to EBP, Including Mathematically?

1. “EBP is too slow in making determinations to support operational problem-solving…
2. “EBP produces no new solutions and may even narrow the range of solutions available…
3. “Social scientists focus on subtle effects at high (aggregate) levels; problem-solving focuses on much more obvious effects but at lower levels…
4. “Ironically, greater influence for EBP may reduce the rate of experimentation in policing… [by artificially restricting what kinds of experiments are allowed]” (pp. 8-9)
There is a Growing Willingness to Ask Big Questions About Policing – Can DA/OR Help Address These?

| We need to ask big questions about what justice really looks like in America and what it should look like |
| We need to identify both what should be done and what should not be done |
| We need to involve the full range of community, advocacy, and service provider stakeholders, not just “traditional” agencies |
| We need to get control of what our future systems will do – right now, vendors are making most of the decisions |
Perhaps The Full Range of Communities of DA/OR Could Help with These Questions

- Analytics (e.g., applied OR)
  - From theory to real world

- Information systems research
  - Assist in providing IT & sensors

- Decision analysis
  - Help agencies decide what to do “right now”, given all the uncertainties

- Marketing science
  - Improve knowledge and support for police operations and crime prevention

- Group decision & negotiation
  - Gain community knowledge and buy-in

- Service science
  - Becoming core to what policing is

- Behavioral OM & organizational science
  - Improve personnel and agency processes and structures

- Health
  - Health & safety gaps are high-priority
  - Also perceptions that public health perspectives can help policing

Adapted from the INFORMS subdivision list
Summary: DA/OR Efforts Are Needed to Understand and Resolve Big Questions in Policing

- Predictive policing has not lived up to the hype – broader data-driven processes appear more promising
- Seeing tech opportunities – and needs for civil rights, privacy, cybersecurity, and community involvement with them
- Using data “scientifically” (EBP and enhancements) appears very promising
- Need help to address tech challenges – just how do you talk to a self-driving car?
- Need to advise agencies for “today” – what strategies to run, how to run and sustain them, and what to buy and how to use them, today
- Need help in framing and answering fundamental questions on what policing should do and be
  - Should consider the full range of DA/OR subdisciplines on these

And remember the three takeaways:
- People, process, and orgs, not just technologies
- Technologies are enablers, not ends
- Re-envision, don’t just optimize
Questions?

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