

The weakest number in the model

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In a 2014 study by Warner and colleagues, police dispatchers needed up to 45 seconds in half of all cases. In that time they assessed the situation and decided how urgent a call was. Our time-budget model assumes that assessing a drone and deciding to act against it takes about as long. Nobody has measured such a decision in counter-drone defence, so the number is borrowed. This piece checks how far that transfer holds and what happens to the results when the number changes.

Every reaction-time model has a link that carries the most weight and about which the least is known. In our model of a human-in-the-loop procedure, that link is the decision to engage. Detecting and classifying the target take seconds and can be measured. Verifying whether a flight is authorised is also uncertain, but the model sidesteps the problem by varying its median from zero to ninety seconds. The decision median stays fixed in the model, so its accuracy has to be checked separately.

WHAT WARNER AND COLLEAGUES MEASURED

The authors analysed 456,804 calls in two police dispatch centres and measured the time taken to prioritise each call. That is the time in which a dispatcher gathers information under a structured protocol and decides how urgent the matter is. The median, the value below which half of all calls fall, was 45 seconds. Prioritisation took less than 60 seconds for 67.5 per cent of calls and less than 90 seconds for about 86 per cent.

The transfer has a basis, because the measurement concerns a human decision under time pressure, on incomplete information, inside an organisation with a procedure. It also rests on a very large sample, although two differences separate it from our case. The dispatcher decides how urgent a call is, not whether to use force. Nor does the dispatcher have to check whether the law allows the decision.

WHAT OTHER DATA SAY

The same family of studies covers medical and fire dispatch. In medical dispatch, calls of the same high priority level had median prioritisation times from 27 to 82 seconds, depending on the incident. In fire dispatch, the medians of individual centres ranged from 43 to 85 seconds, and for the most urgent calls the median was 18 seconds. All these studies come from one research community, linked to the designers of the dispatch protocols, and that is worth keeping in mind.

Standards say something different from measurements. NFPA 1225 sets a target of processing a call within 60 seconds in 90 per cent of cases. The authors of the medical dispatch study state plainly that their results do not support such rigid thresholds.

At the other end of the scale are police simulator studies of the decision to shoot. They measure fractions of a second, but in a situation where the officer already has the weapon aimed, sees the threat and checks no regulations. Published human decision times therefore stretch from a fraction of a second to more than a

minute. A site operator's decision to bring down a drone lies somewhere in between. Nobody has measured where.

Police simulators
decision to shoot, weapon already aimed

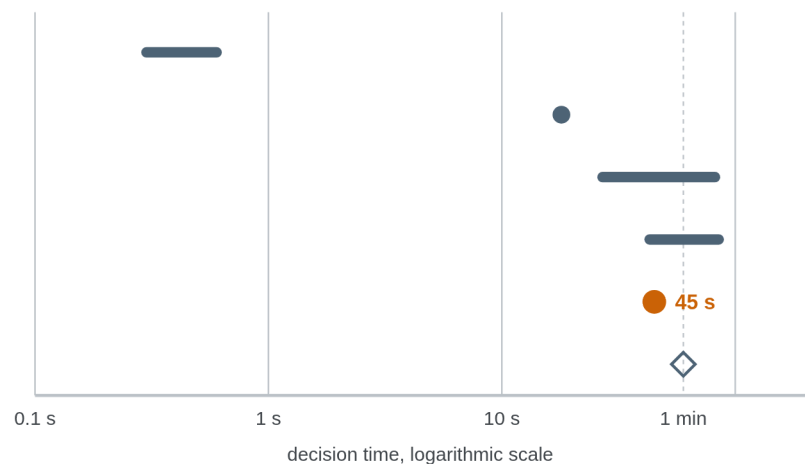
Fire dispatch
median, most urgent calls

Medical dispatch
medians by type of incident

Fire dispatch
medians of individual centres

Police dispatch, Warner 2014
median, the value used in the model

NFPA 1225 standard
target for 90 per cent of calls



Published human decision times on one axis, on a logarithmic scale. The data come from different studies and measure different things, so the chart shows the spread, not a ranking. Sources are listed below the text.

WHAT HAPPENS WHEN THE NUMBER SHIFTS

The model makes it possible to test how much the result depends on this assumption. The table shows the chance that a human-in-the-loop procedure finishes in time when a medium-speed target is detected at two kilometres. The rows vary the decision median and the columns the verification median.

Median decision	Immediate verification	Verification 45 s	Verification 90 s
immediate	99.9%	67.4%	19.7%
15 s	98.7%	42.6%	8.1%
30 s	88.1%	21.6%	3.0%
45 s	67.7%	10.5%	1.2%
60 s	47.1%	5.0%	0.5%
90 s	20.4%	1.3%	0.1%

Illustrative model, 20,000 draws per cell with a fixed random seed. The code for this table is in the model package available for download.

The table shows something more important than the value of 45 seconds itself. What counts is the sum of the two medians, decision and verification. When together they stay within about 25 seconds, more than 93 per cent of procedures finish in time. At a sum of 30 seconds the figure falls to between 88 and 92 per cent, depending on how the time is split. Every further ten or twenty seconds in either of them brings the result down quickly.

WHAT THE NUMBER LEAVES OUT

The dispatcher in Warner's study works in a familiar place, with a familiar protocol and in conditions known from thousands of shifts. The decision to bring down a drone over an industrial site is rare and taken under stress and legal uncertainty. It is often taken at night, sometimes without a procedure agreed in advance. Each of these factors lengthens the time, although none has been measured. One factor shortens it. When the rules of engagement are set in advance and the operator only confirms that their conditions are met, the decision takes a few seconds.

CAUTIOUS OR OPTIMISTIC

The value of 45 seconds is cautious compared with an officer's reflex decision in a simulator. It is optimistic compared with the decision of an organisation facing a drone over its own ground for the first time. The model's conclusion does not depend on which assessment is closer to the truth. Even a decision in 15 seconds with verification taking 45 seconds lets fewer than half of the procedures finish in time. The weakest number in the model shifts the result without reversing it.

Model code and inputs (ZIP, Python)

Declaration of interest. The author is the founder of Silesian Advanced Systems, a team developing an autonomous counter-drone system ahead of incorporating a company. This gives him a commercial interest in the subject. The model and its inputs are published so that the reasoning can be checked independently.

SOURCES

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