

Modelling and Analysing Cargo Screening Processes

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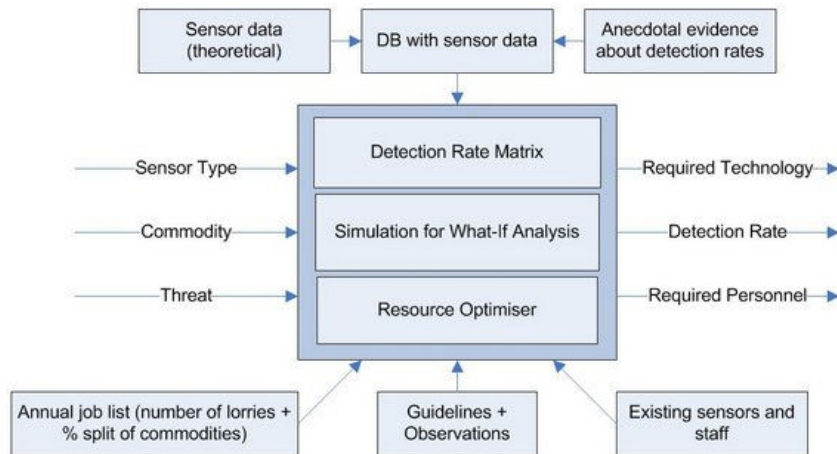
Background

- Cargo screening at airports and seaports; looking for human stowaways, (conventional, nuclear, chemical and radiological) weapons and other threads
- Efficiency of current cargo screening processes (% detected vs. % missed) is unknown as no benchmarks exist against which they could be measured
- Just adding up resources and manpower used is not an effective to assess systems where human decision making plays a vital role

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The Goal

- Develop a tool that will map the right technology and manpower to the right commodity-threat combination in order to maximise the detection rate



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Some Thought about the DRM

- What kind of and how many sensors do we need if we know how many containers pass with what commodity in a given period of time, to maximise the detection rate?

rate of detection =

f (commodity & thread combination, specific scenario)

f (commodity, threat, sensor)

f (cargo containment, commodity, threat, sensor)

where cargo containment =

f (type, wall thickness, wall density)

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How Can Simulation Help?

Standard application areas

- Insight, optimisation, communication

New application areas

- Validating known parts of the DRM
- Helping to estimate values for our DRM where we have gaps
- ...

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Questions Regarding the Modelling

- How much detail do we have to model to get some meaningful output?
- How should we model people in our system (e.g. officers or stowaways) - as simple resources or as autonomous entities?
- How can we get a good estimate on how many stowaways, weapons or drugs are passing the borders?
- What effect does the fact that we are dealing with rare events have on input sampling and output analysis?

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Questions Regarding the DRM

- Which are the most relevant indicators of sensor efficiency?
- What is the best way to develop and validate a detection rate matrix in absence of real data or when real data is incomplete, i.e. missing data for certain technology / commodity / threat combinations?
- Can we develop a framework to support the development of a DRM for different environments and threats?

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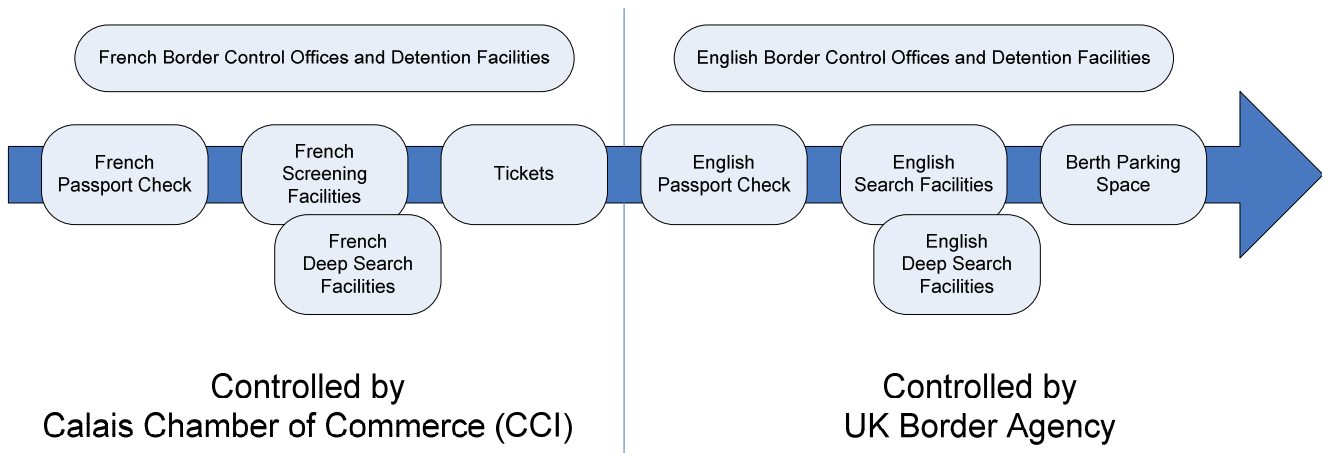
First Case Study

- Calais Ferry Port
- Single threat: stowaways (clandestines)
- 900.000 lorries/year
- 1800 positive lorries = 0.2%



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The System



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The Technology

- Inspection Sheds
 - Heartbeat Detector
 - CO2 Measurement Probe
 - Visual Inspection
 - Canine Sniffers
- Drive Through
 - Passive Millimetre Wave Scanner

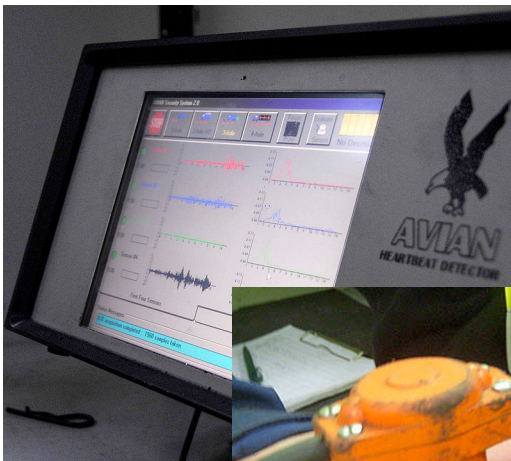
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UK Search Facilities



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HB Detector and CO₂ Probes



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PMMW



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PMMW Readings



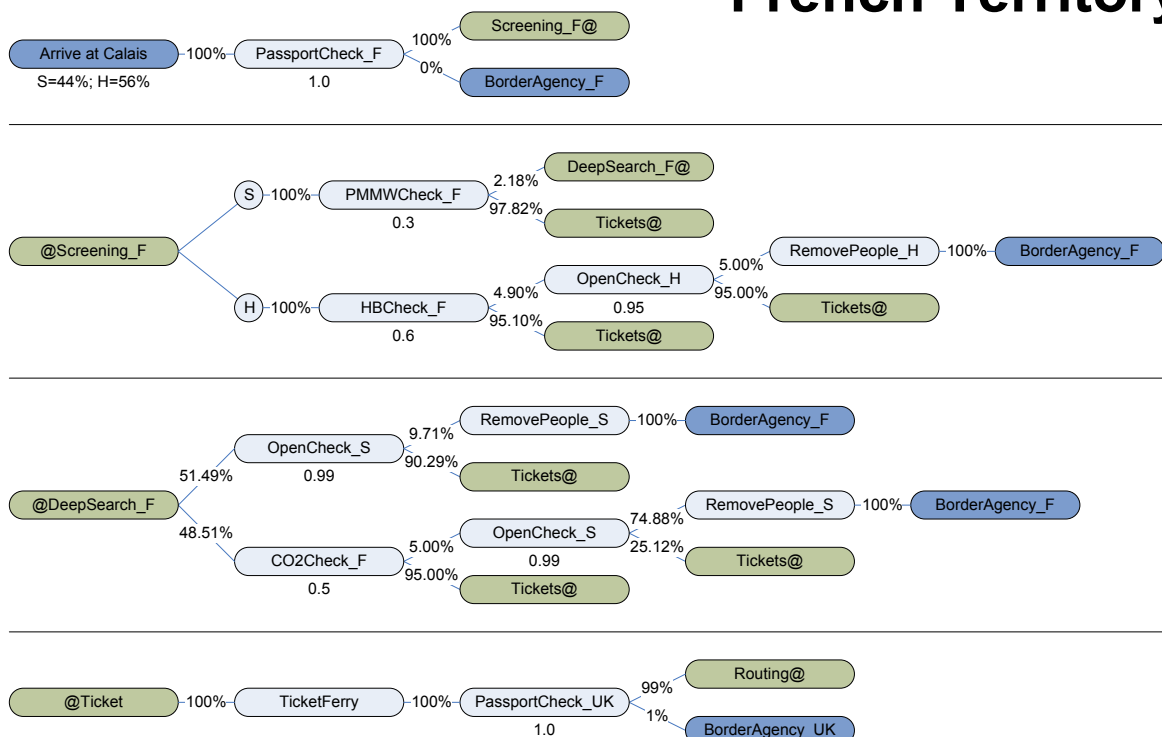
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Case Study Modelling Challenges

- Three different situations to consider
 - Sensor fixed; target static (sheds)
 - Sensor moving; target moving (allocation lanes)
 - Sensor moving; target fixed (berth)
- Multiple entry points for clandestines
- Human decision making
 - Routing
 - Procedures
 - Service times

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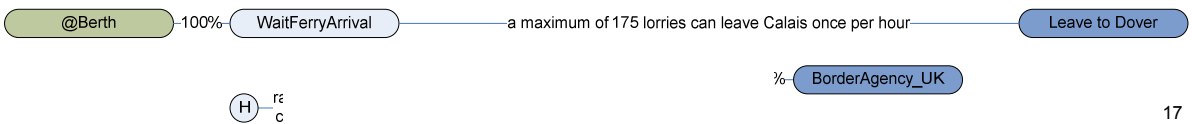
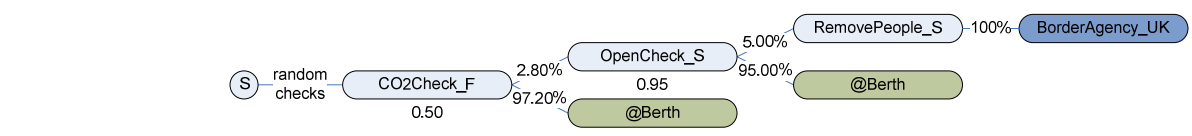
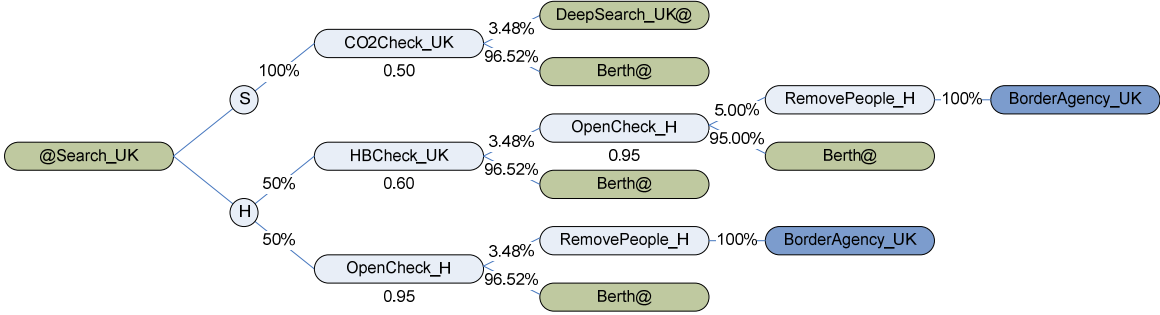
French Territory



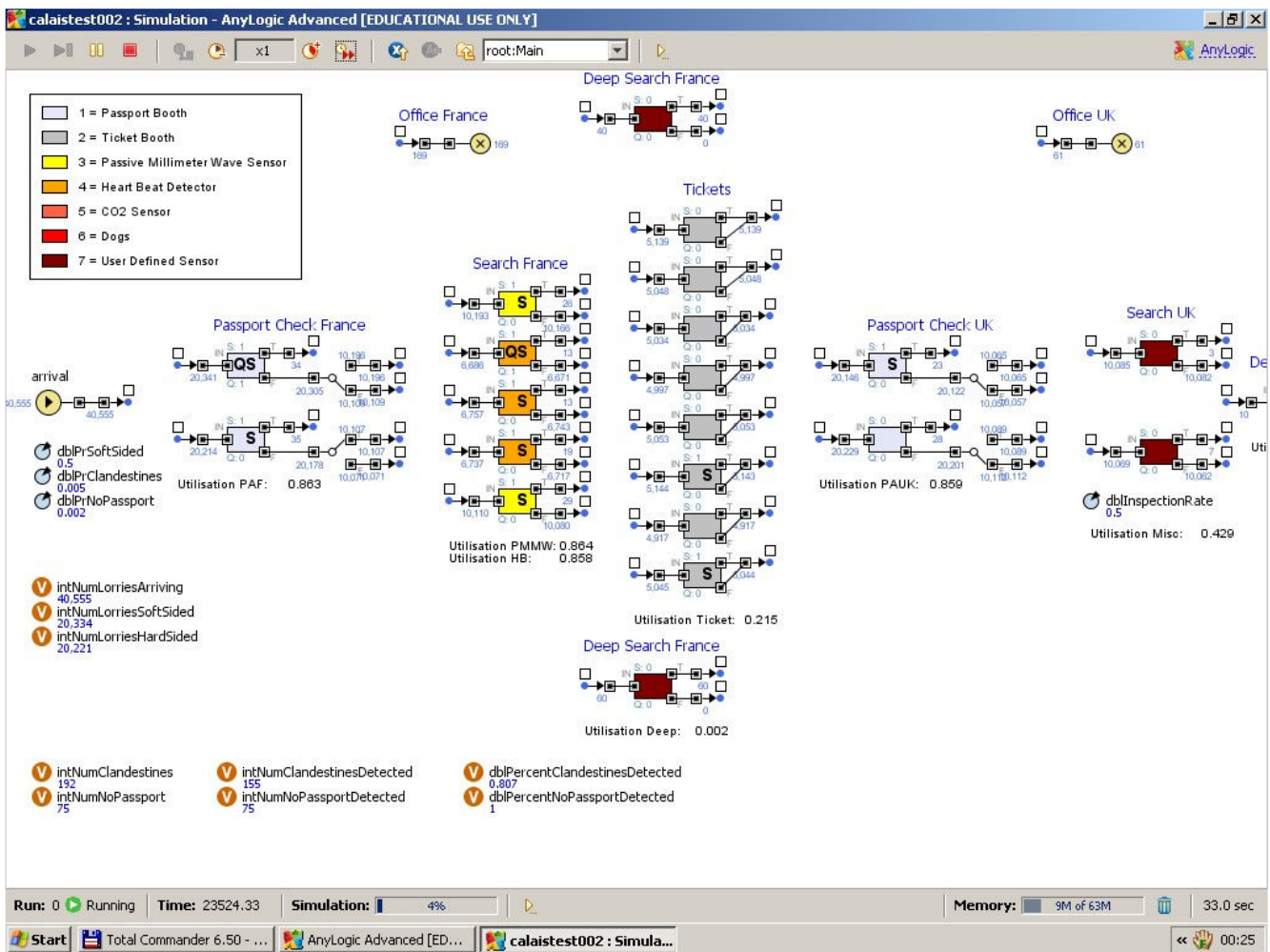
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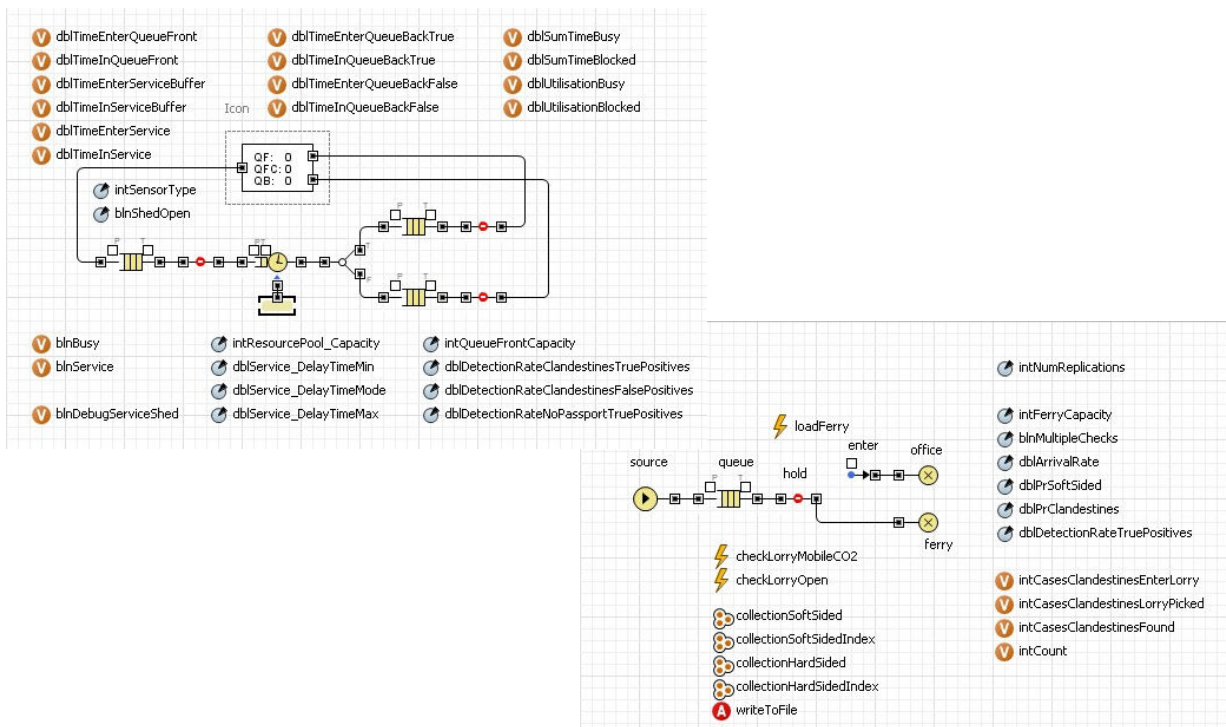
UK Territory



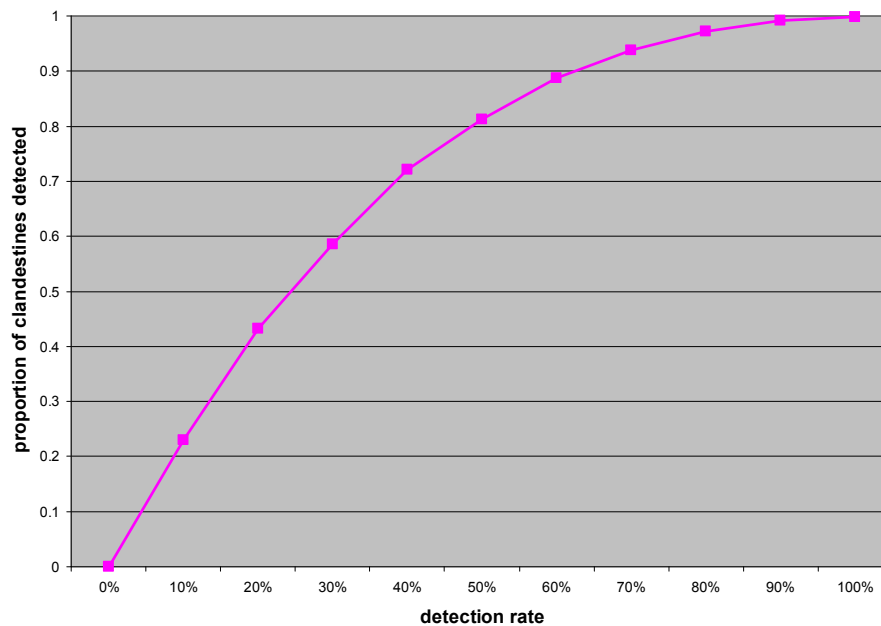
The screenshot displays the AnyLogic Advanced software interface. The main workspace shows a simulation model with several sub-diagrams: 'Office France', 'Search France', 'Passport Check: France', 'Tickets', and 'Deep Search France'. A legend on the left identifies components like '1 = Passport Booth', '2 = Ticket Booth', '3 = Passive Millimeter Wave Sensor', etc. The bottom status bar shows 'Selection X=-3, Y=560'. The taskbar at the bottom includes 'Start', 'INFORMS pos v001.ppt', and 'AnyLogic Advanced [...]'.



Inspection Shed Object + Berth Activities



Detection Rate vs. Clandestines Detected



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Conclusion

- We have developed a first draft model of the case study system; we have used many assumptions
- We are using this model to define the data requirements for our main data collection
- Currently we are working on some mechanisms to add more realism to the model
 - Considering peak times and congestion
 - Considering response of officers to congestion

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Comments or Questions?

