

■ CBRN preparedness using discrete event simulation

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Agenda

- Strategic context
- Role of simulation modelling
- Aims of CRISTAL
- Case study
- Conclusions
- Questions

Strategic context

- Proliferation of **Chemical, Biological, Radiological or Nuclear** threat
- Industrial hazards
- Multi-agency operational roles following an incident
 - e.g. in the UK: Police, fire and rescue services, NHS, local authorities, Public Health England, Government Decontamination Service, armed forces etc.
- Coordinated response is challenging
- Simulation is one way of testing (and improving!) an integrated plan

■ Role of simulation modelling

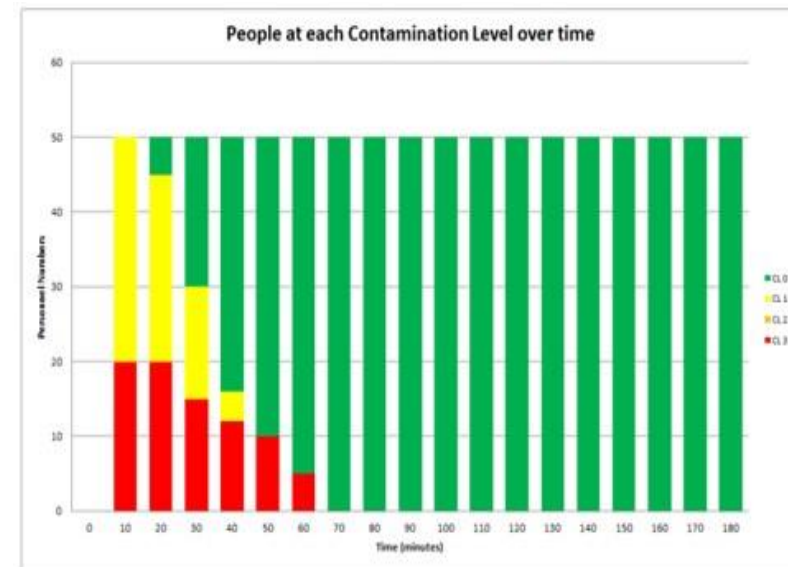
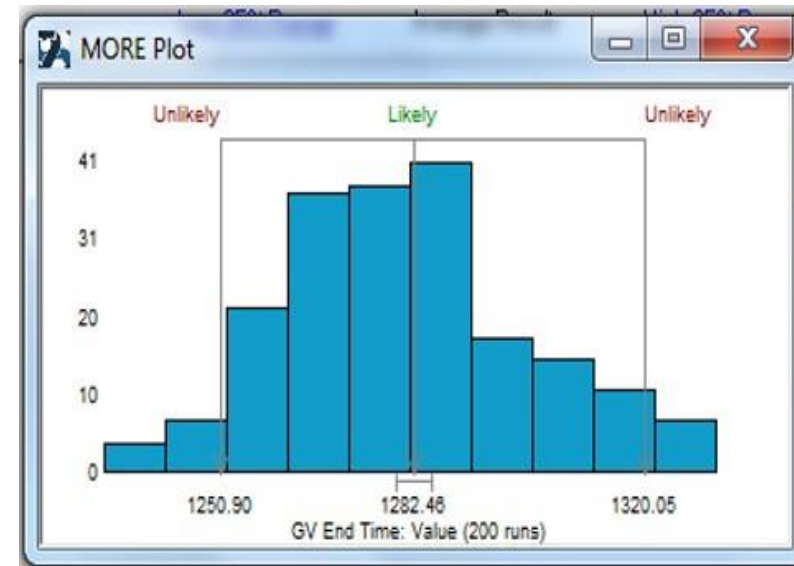
- Large number of potential scenarios
 - Impossible to run live exercises to cover all possibilities
- Plan live exercises to drive expected outcomes
 - Review simulated / live timelines to explore deviation
- Technology testing
 - What is the benefit of x?
- How sensitive is my exercise outcome to external factors?
 - Weather etc.

Aims of CRISTAL

- Better **understanding** of risks
- **Improved** decision-making & better understanding of the implications of an incident
- **Analyse** different resourcing options
- Compare different strategies
- Support business cases
- Allows **prioritisation** of resources to enable best use of available money, personnel and equipment

CRISTAL introduction

- **Discrete** event simulation (SIMUL8) with Excel input/output
- Characterises assets by **contamination** level (CL0 – CL3)
- Aims to reduce CL by applying resources (e.g. manpower, equipment)
- Incorporates the need for **PPE** and consumables
- **Generates** liquid and solid waste
- Represents shift patterns and max **exposure times**



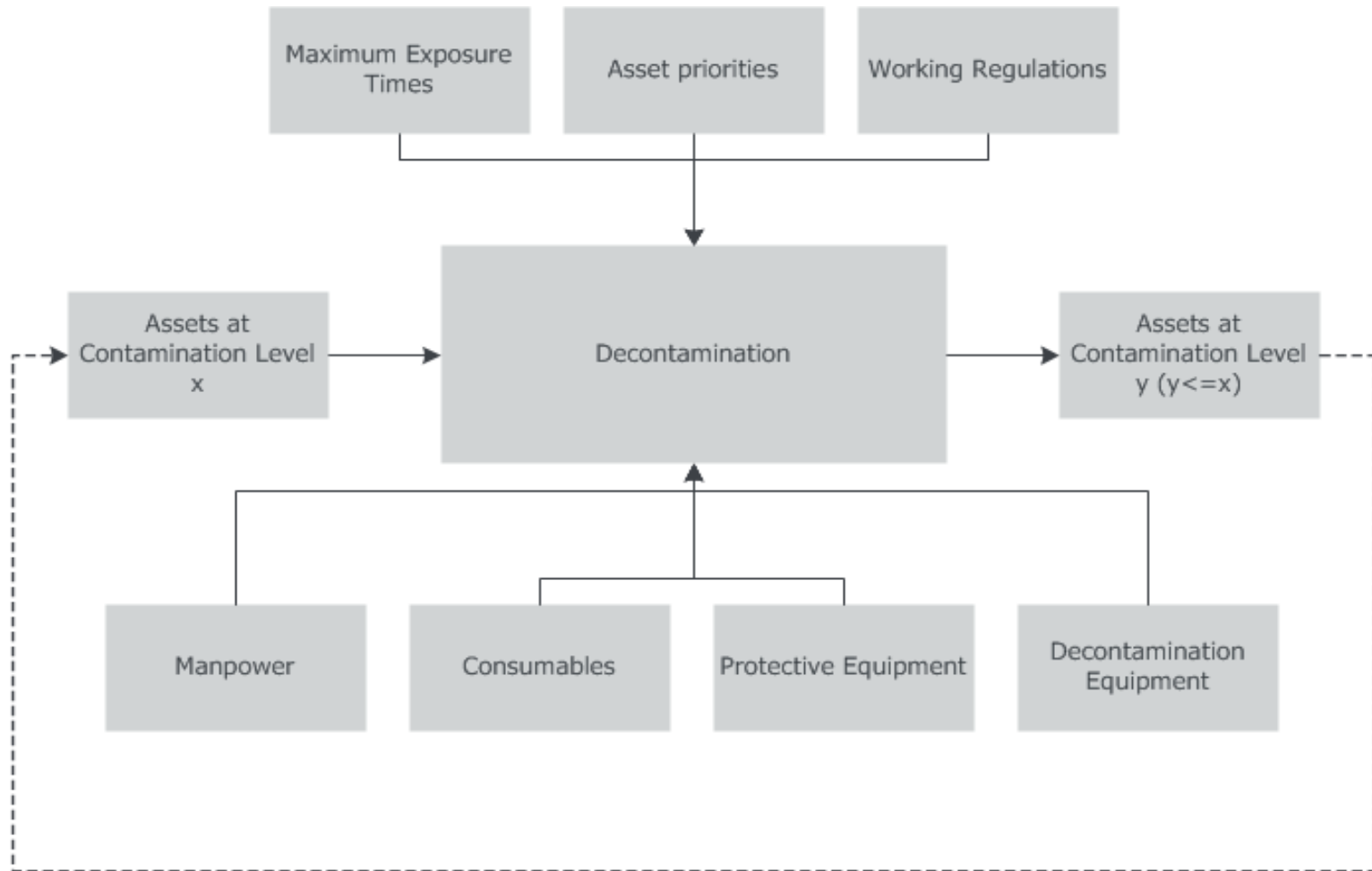
Previous CRISTAL uses

Decontamination analysis through the EDEN programme:

- Release of a **chemical** agent in a public space
- Detonation of an improvised radiological dispersion device (**RDD**) in a public place
- **Terrorist incident** at a nuclear power plant
- Small town population affected following a large scale **radiological** release



Decontamination representation

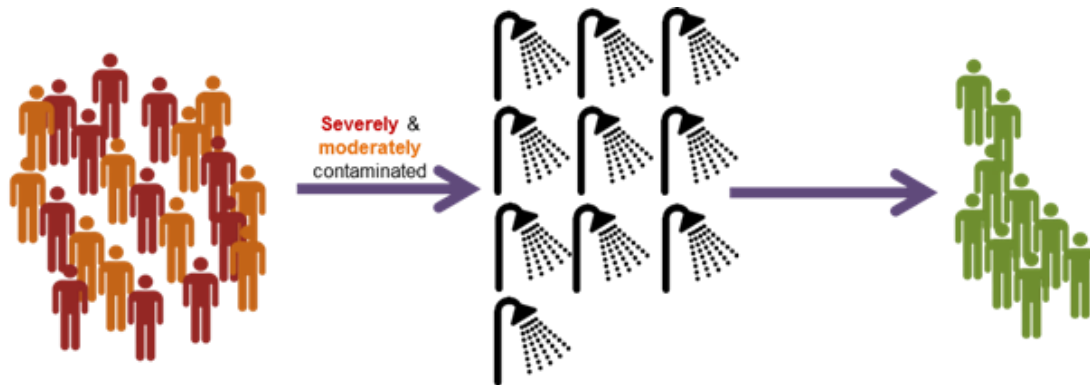


Case study one: Mass decontamination

- Small town affected by a wide area release of **radioactive** material
- 1000 people to decontaminate
- 920 **moderately** contaminated
- 80 **severely** contaminated

Case study one: Mass decontamination

Option one:

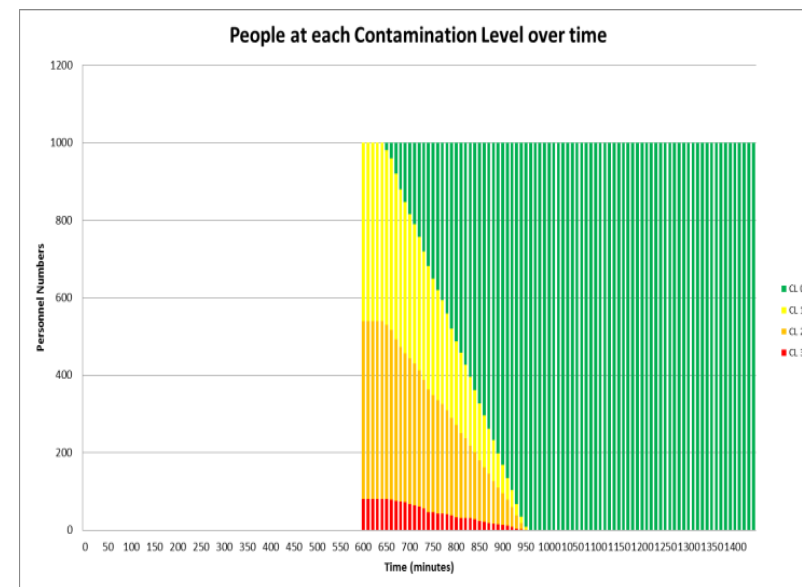
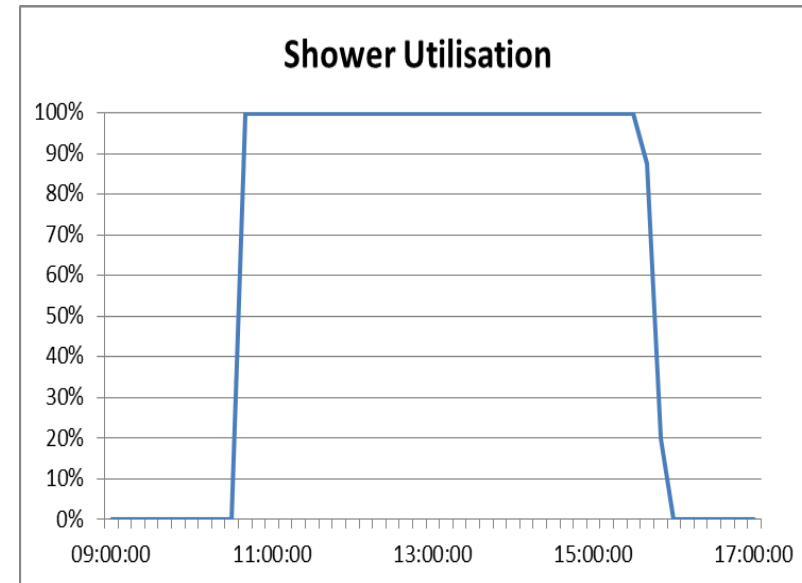


- 40 shower units
- One firefighter to supervise each shower unit
- Incident occurs at 10:00

Option one results

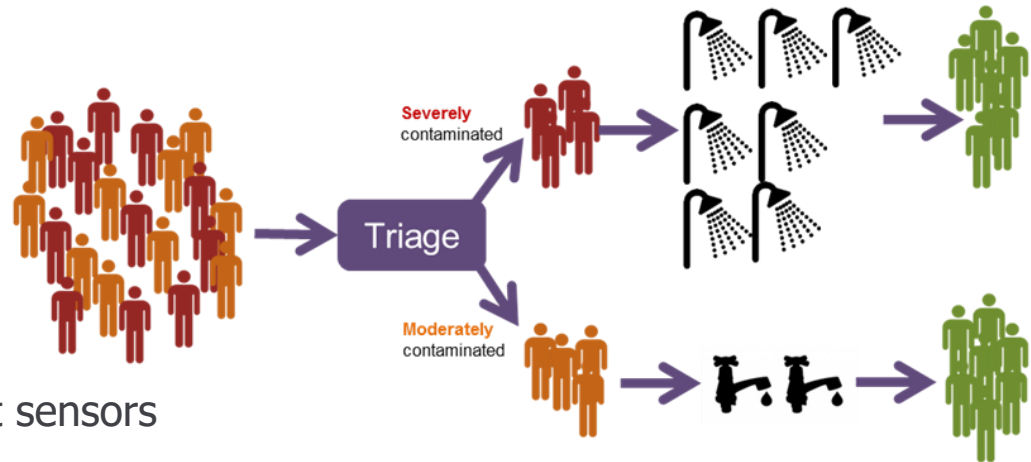
Simple case:

- Shower and manpower fully utilised for the majority of the time between 10:00 and 15:53
- Final person decontaminated at 15:53
- How to reduce this time when resources are constrained?



Case study one: Mass decontamination

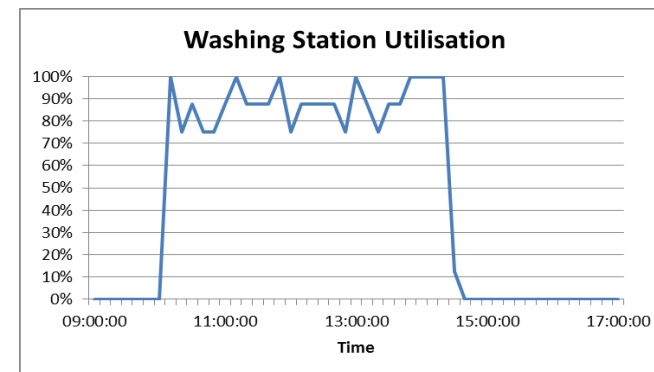
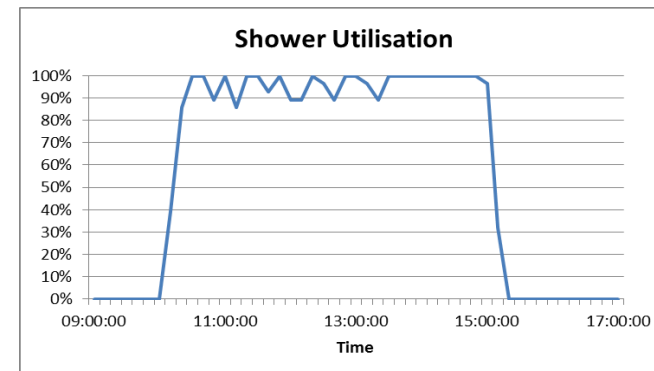
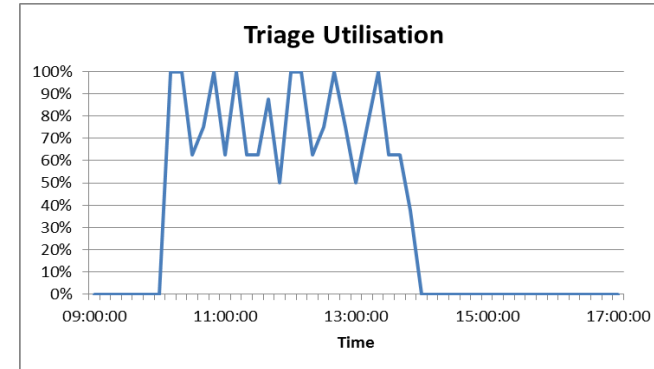
Option two:



- Introduce a triage system, eight sensors
- Severely contaminated people treated by showers
- Moderately contaminated people treated by field wash station unless showers are available
- Ratio remains the same
- Supervisory manpower numbers remain the same
- Number of showers reduced to 28; eight wash stations introduced

Option two results

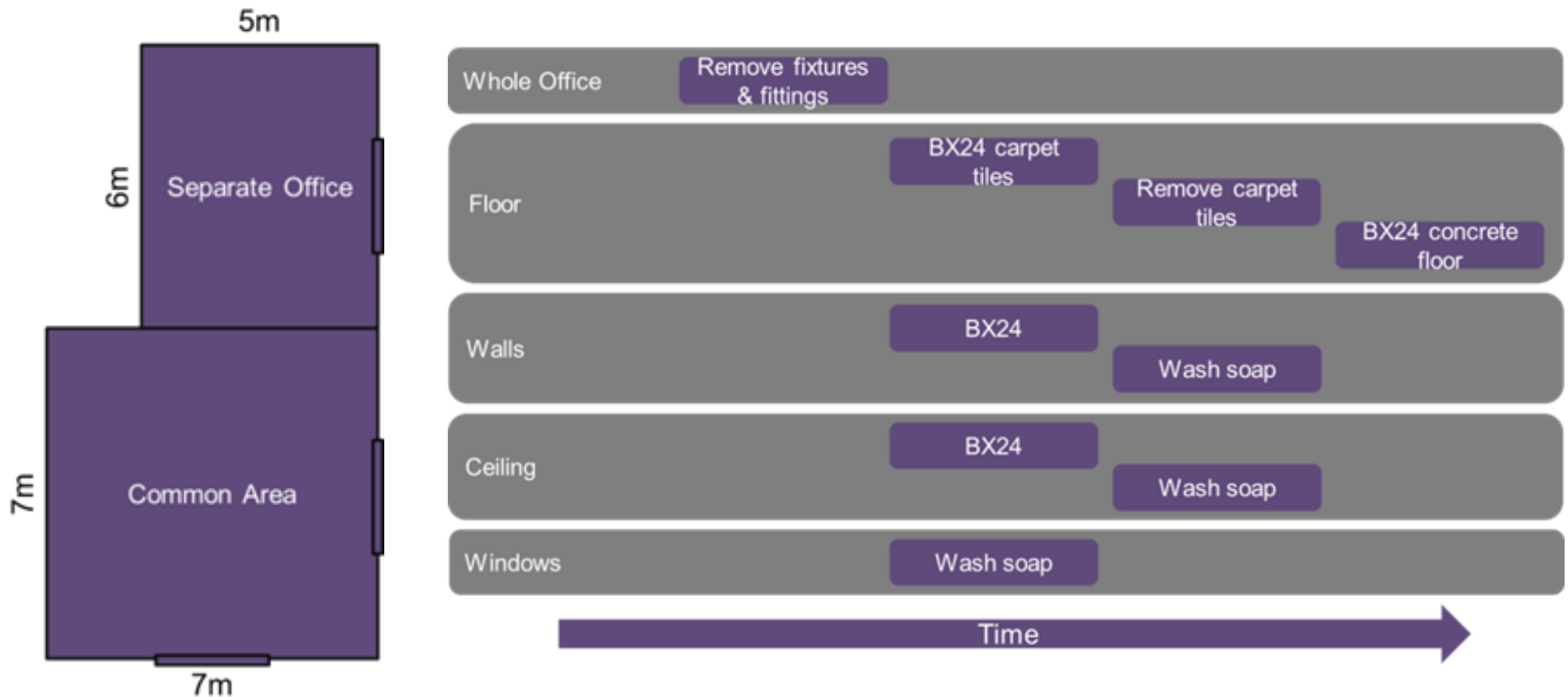
- Times to complete:
 - Severely contaminated – 15:35
 - Moderately contaminated – 15:43
- Reduction of 18 minutes (severe) and 10 minutes (moderate)
- Resource constraints limit the equipment utilisation
- Increasing manpower would reduce times further
- Then prioritise more showers, washing stations



Case study two: Building decontamination

- Chemical release inside a building, adsorbed onto all surfaces including:
 - Fixtures and fittings
 - Floors
 - Walls
 - Ceilings
- Resources available:
 - Five people
 - BX24 solution
 - Soap
 - Washing equipment

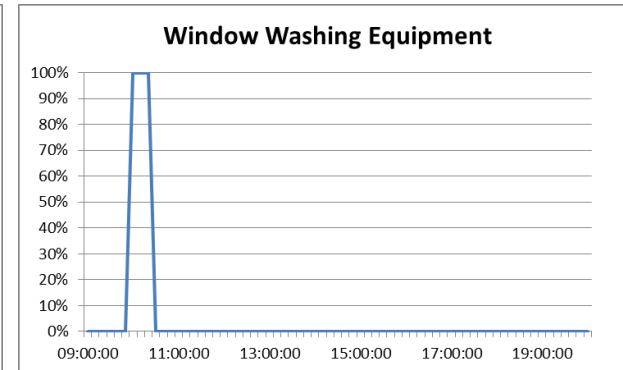
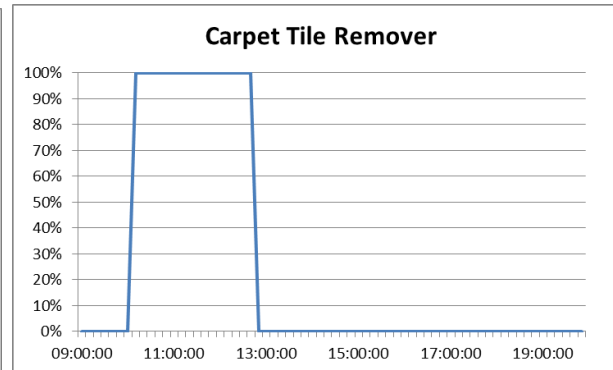
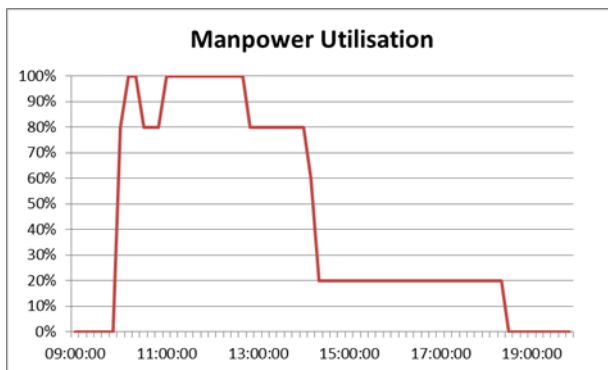
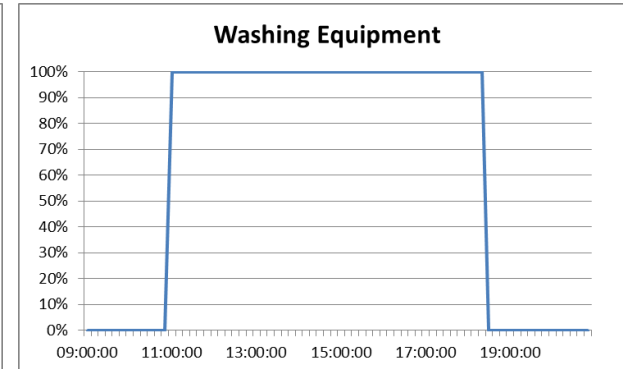
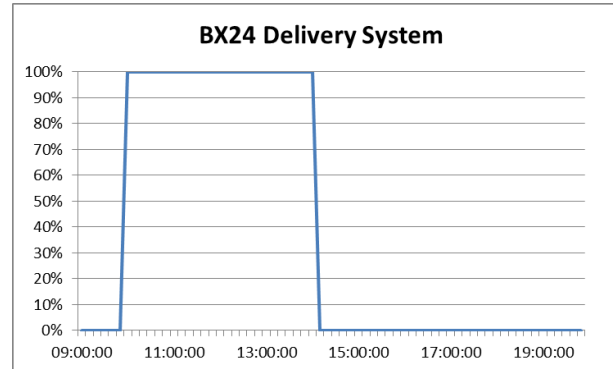
Case study two: Building decontamination



- Consider two cases: $P(\text{clean}) = 100\%$ and $P(\text{clean}) = 75\%$ for each activity

Buildings scenario – 100% effective

Asset type	Start time	Finish time
Walls	10:00	16:00
Ceilings	10:00	18:32
Windows	10:00	10:22
Floor	10:00	14:18

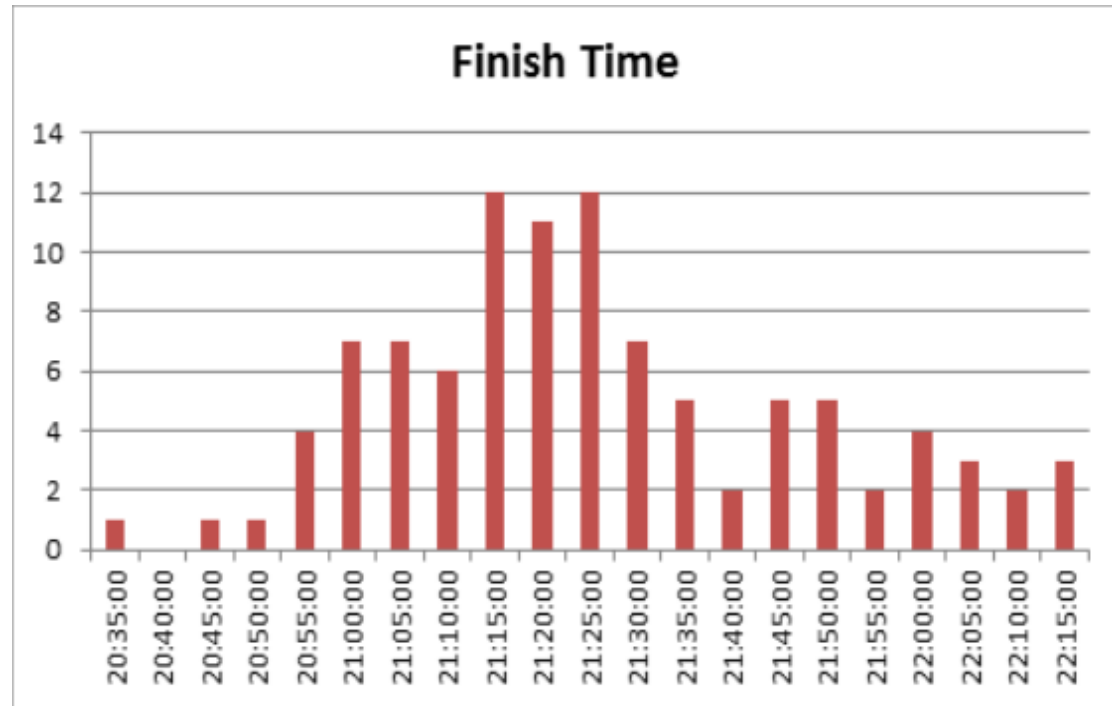


- Washing equipment is the **constraint** in the system, rather than manpower

Buildings scenario – 75% effective

	Start time	Finish time
Min	10:00	20:35
Max	10:00	22:15
-95%	10:00	21:19
Mean	10:00	21:23
+95%	10:00	21:28

- Long tail on the distribution
- Significant time increase over baseline
- Spread dependent on 'effectiveness' and time for each activity
- Enables exploration of the trade space



Summary

- Simulation is **complementary** to live exercises
 - Ensure exercises are well planned with anticipated outcomes
 - After action review
- CRISTAL enables rapid assimilation of the **benefits** of different manpower, equipment and procedure options
 - Agent agnostic
 - Flexible with respect to scenarios
 - Cost/time trade offs
- CRISTAL would ideally be used in the planning/**preparedness** stages prior to an incident
- May be linked with **dispersion**/dose models to better represent reality

■ Any questions?

■ **Thank you**

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