



DEAKIN
UNIVERSITY AUSTRALIA

Knowledge Utilisation

Technology, Process and Simulation



Centre for Intelligent Systems Research

Centre for Intelligent Systems Research

- We aim to discover and deliver innovative research that directly benefits society through the creation of knowledge and provision of **solutions to real world problems**
- A team of 60 researchers, including:
 - research academics and post docs
 - post graduate research students
 - dedicated software and database technicians
 - mechanical workshop technicians
- State-of-the-art simulation, visualisation, robotics and haptics facilities

Centre for Intelligent Systems Research

- We develop algorithms, methods and tools to improve estimation and performance of complex systems operating under uncertainty, variability and continuous change
- This is complemented by research on next generation robotic control systems and force emulation methodologies to improve process reliability, product quality and operator safety in complex environments
- We are active in project domains including manufacturing, airports, defence, mining, warehousing, security and logistics

Selected Industry Research Partners



Australian Government
Department of Defence
Defence Science and
Technology Organisation



Air International



Australian Government
Department of Infrastructure, Transport,
Regional Development and Local Government



SIEMENS

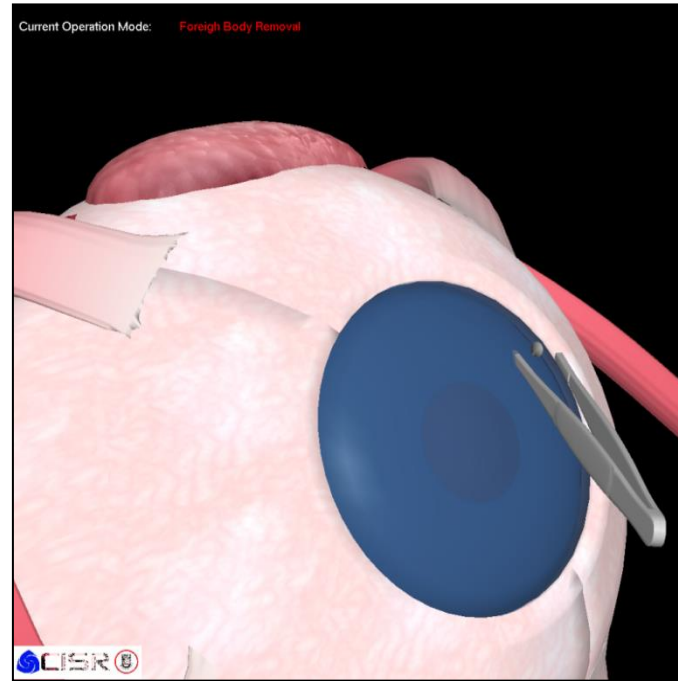
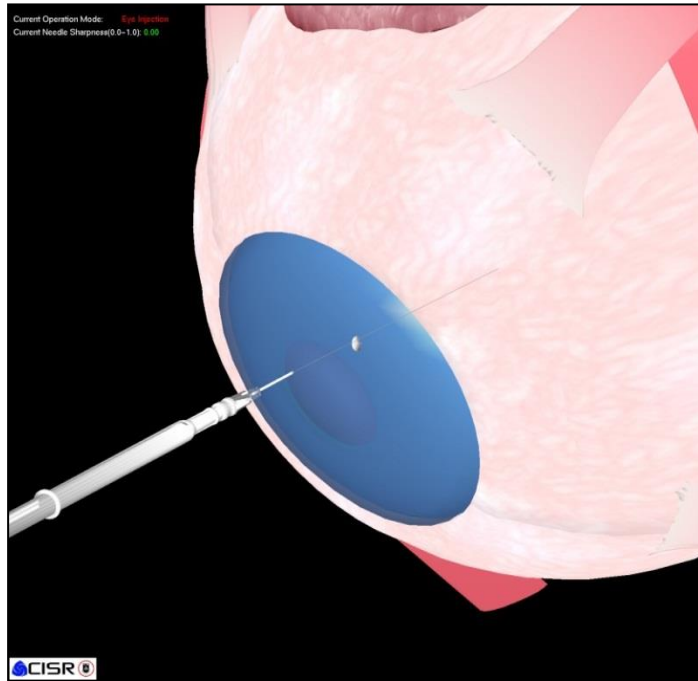
Data Capture Technologies



Haptic Interfaces allow users to touch virtual models and remote objects



Haptically-Enabled Optometry Simulation



- Interactive collision detection and force rendering
- Complex and immersive physical property definitions
- Integrated into real optometry slit lamp equipment for training
- Augmented reality enabled

Virtual Simulated Work Environments to design manual processes and train operators

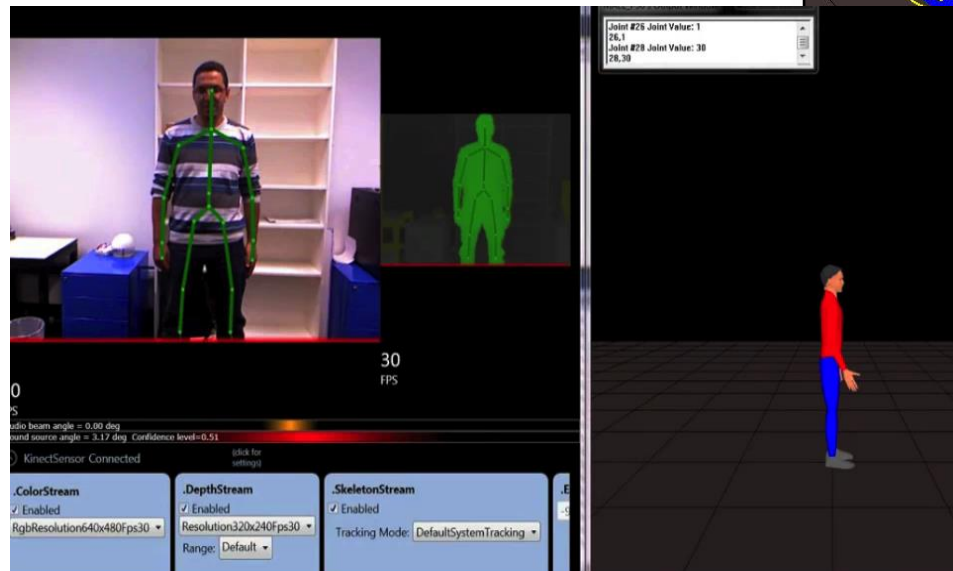
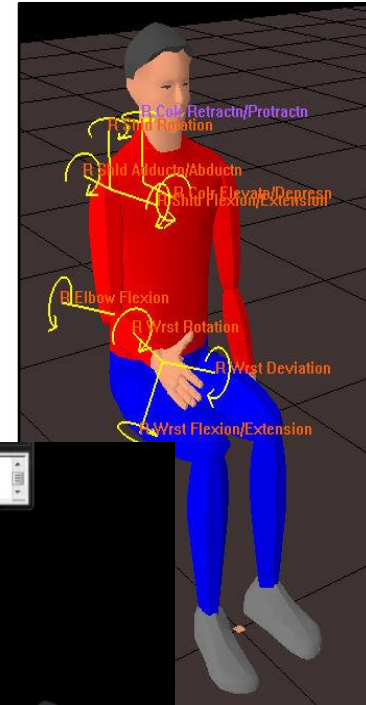


Haptically Enabled Art Realisation project to allow the blind to experience art through touch

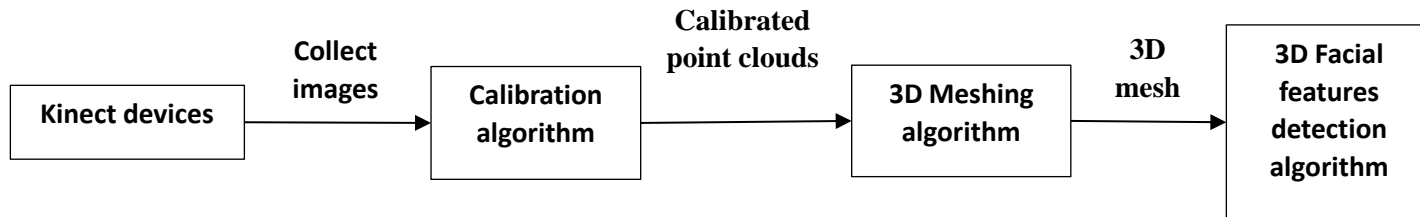


Gaming Controllers – Kinect Device

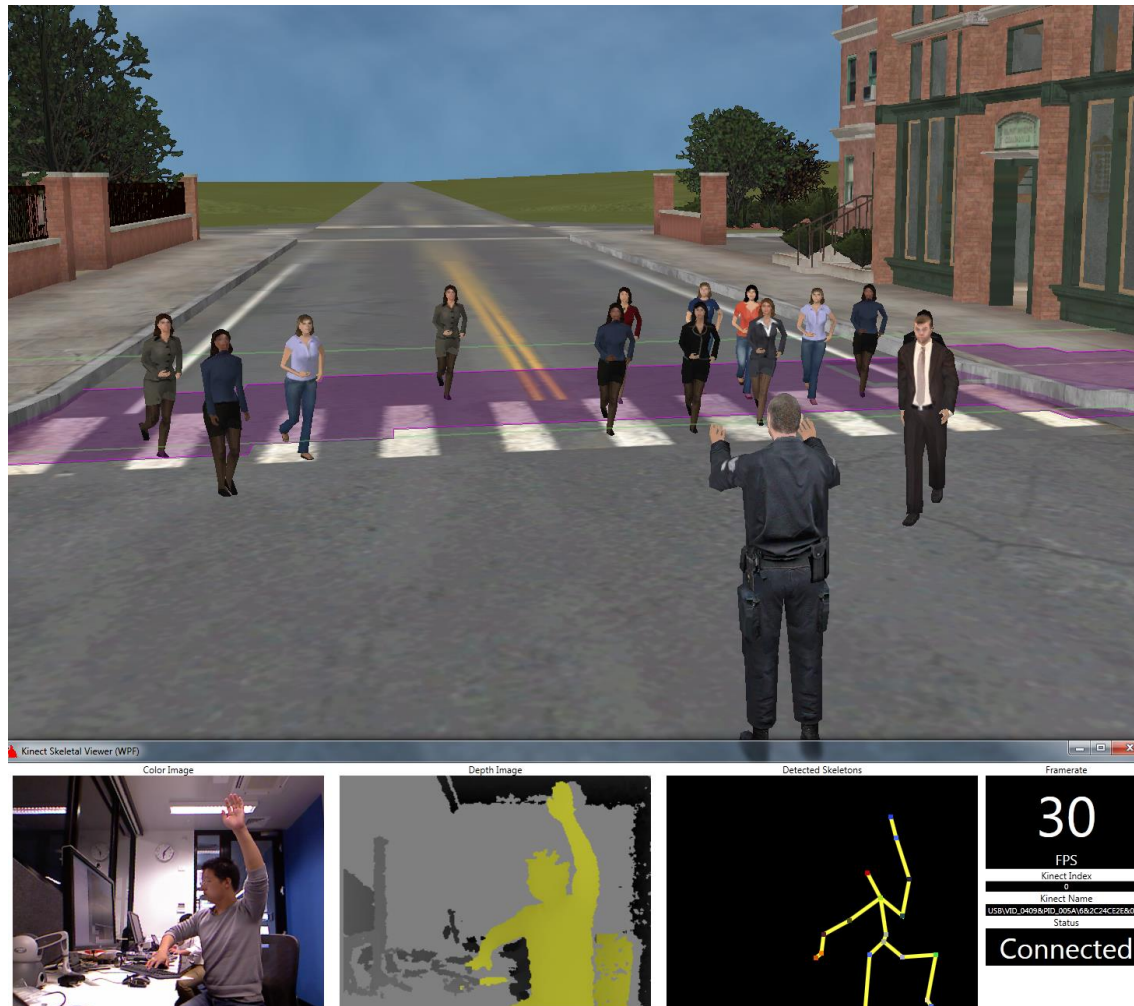
- Very affordable and suitable for low budget projects
- Perfect for small environments
- Can operate in many lighting conditions
- Structured light technology
- Projects an infrared pattern and measures the distortion
- Tracks marker-less skeletons in both 2D and 3D
- Limited resolution



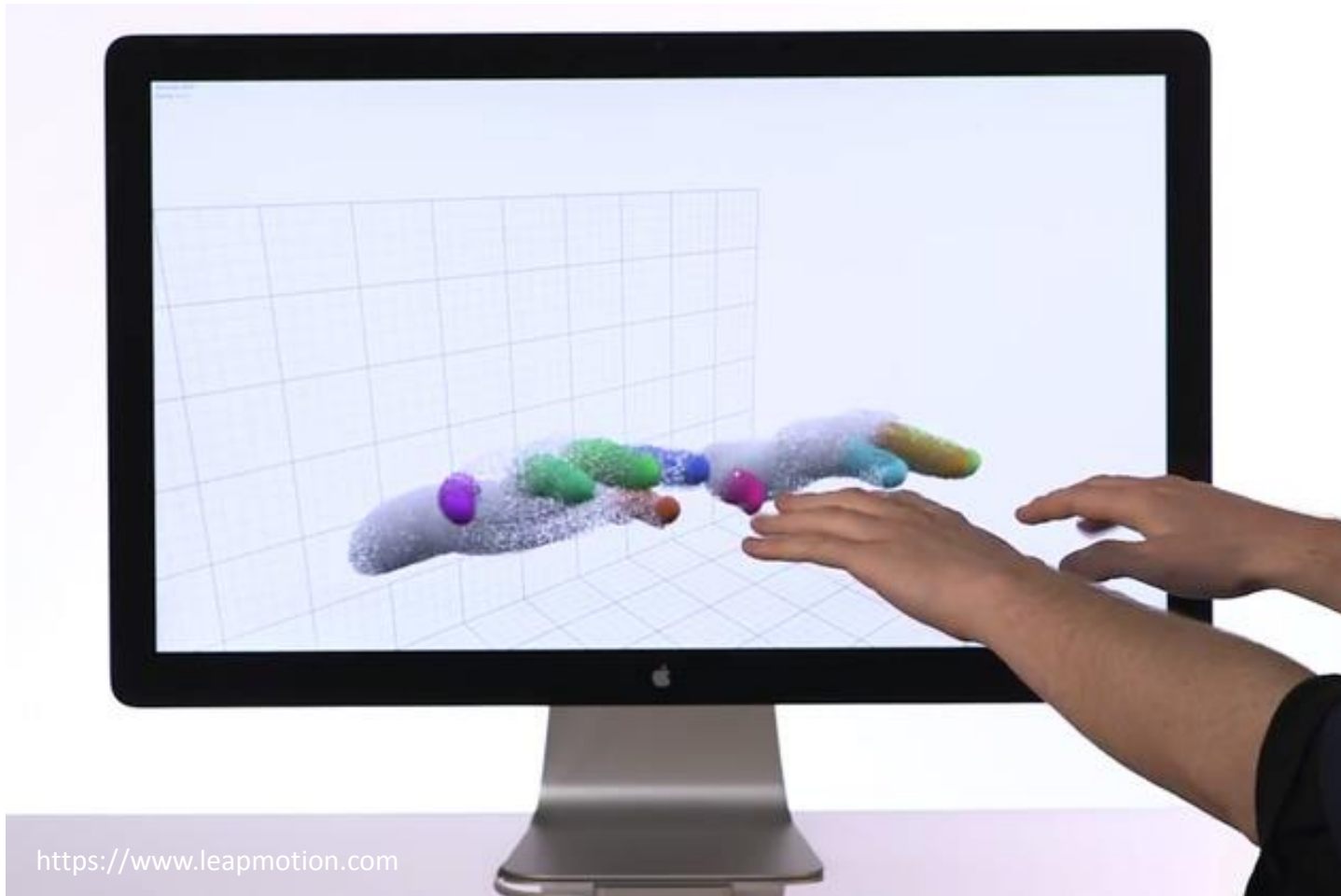
3D Biometrics using MS Kinect Device



Use of Desktop Motion Capture to Interact with Computer-based Training Systems



Leap Motion – High fidelity hand motion tracking



<https://www.leapmotion.com>

Mixed Reality environments that combine real worlds and virtual worlds

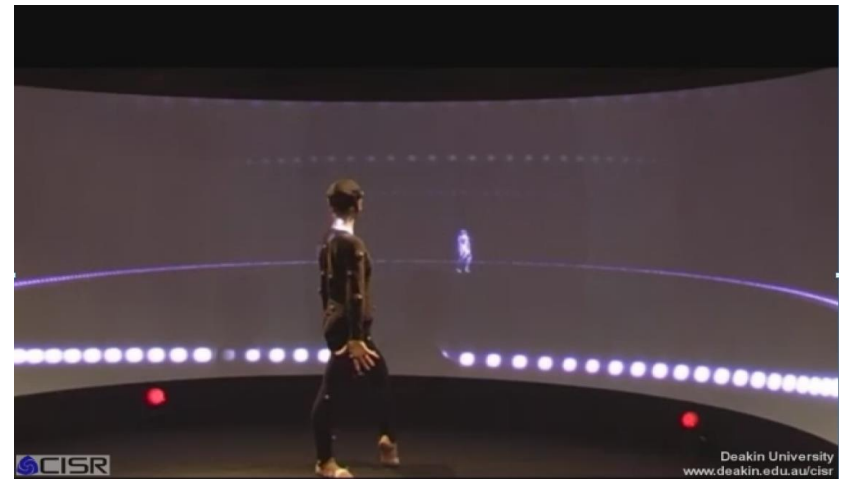


Immersive Simulation for Training

Geelong Port



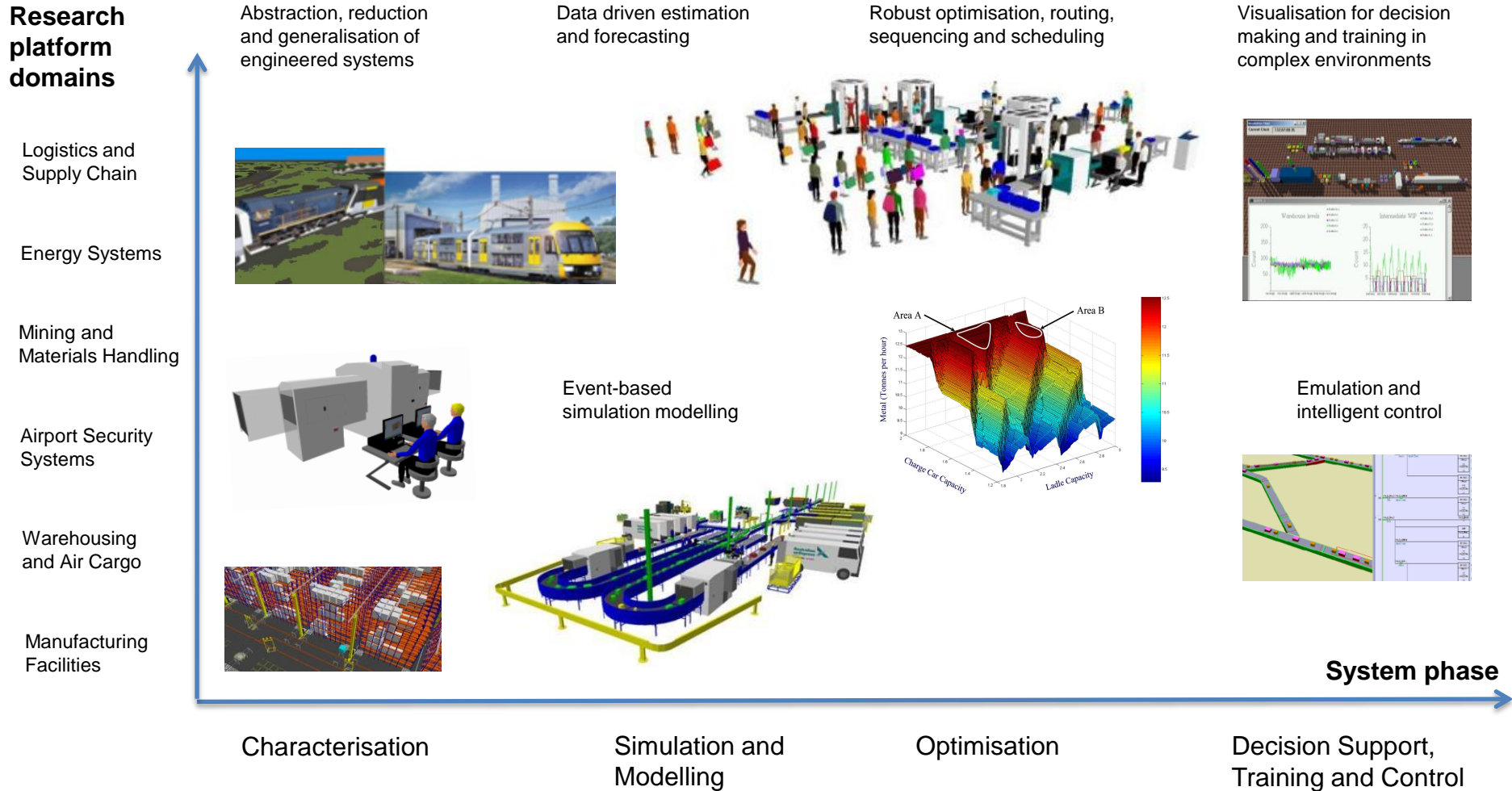
Motion Capture and Artificial Intelligence in Dance Technology



Haptics, HMI and Simulation-based Training Universal Motion Simulator

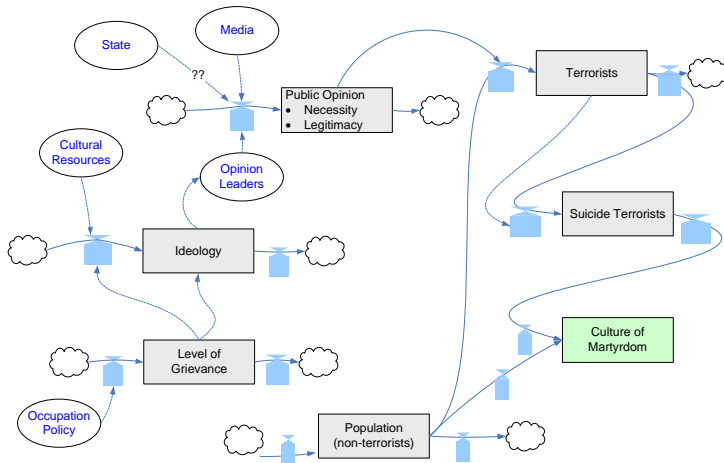


Process Modelling and Analysis

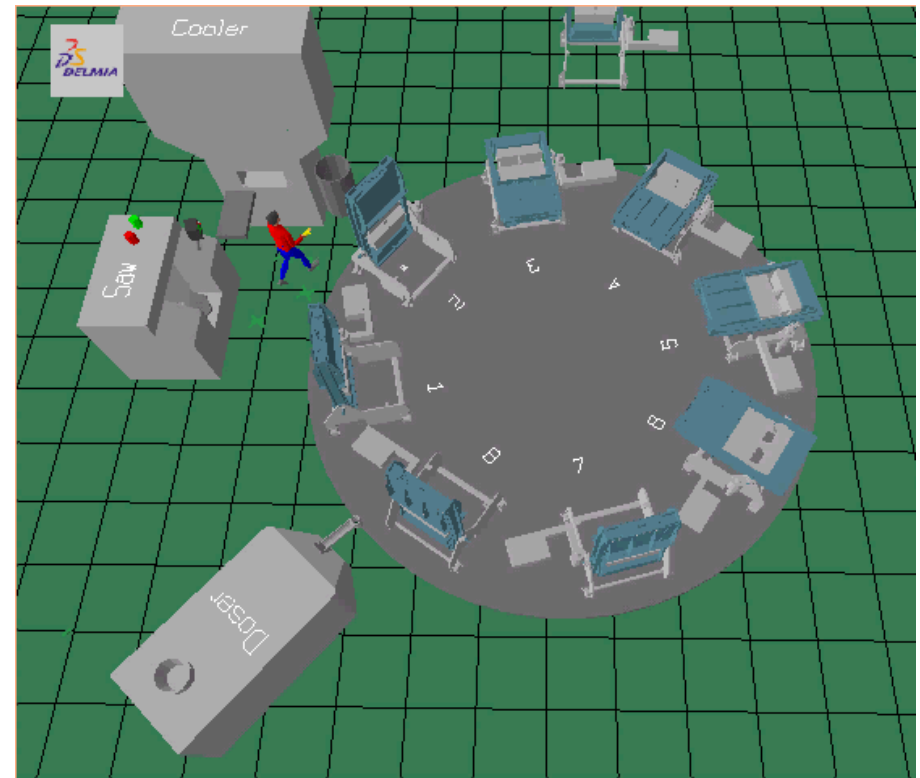


Types of Business Simulation

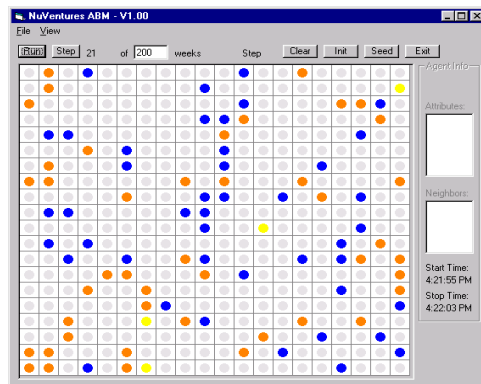
System dynamic (SD) simulation



Discrete event simulation (DES)



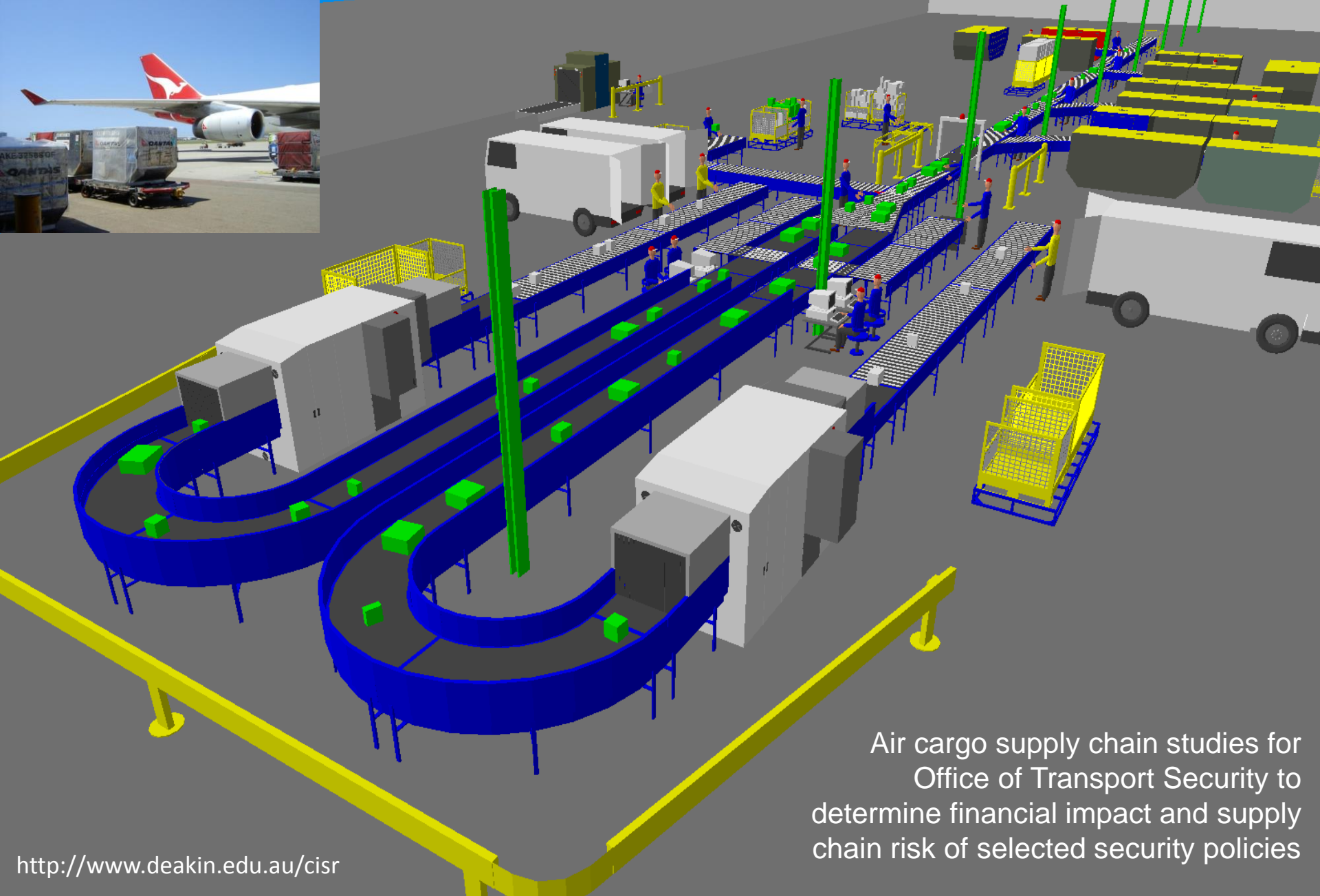
Agent-based simulation (ABS)





Manufacturing and Logistics Supply Chain Modelling

- Discrete event simulation is used to model process variability and uncertainty
- Design, planning and operation of Futuris greenfields Just-in-Time facility
- Custom schedule gave better performance than customer (Ford) sequence by 22 %
- Operators numbers optimised
- Process bottlenecks identified



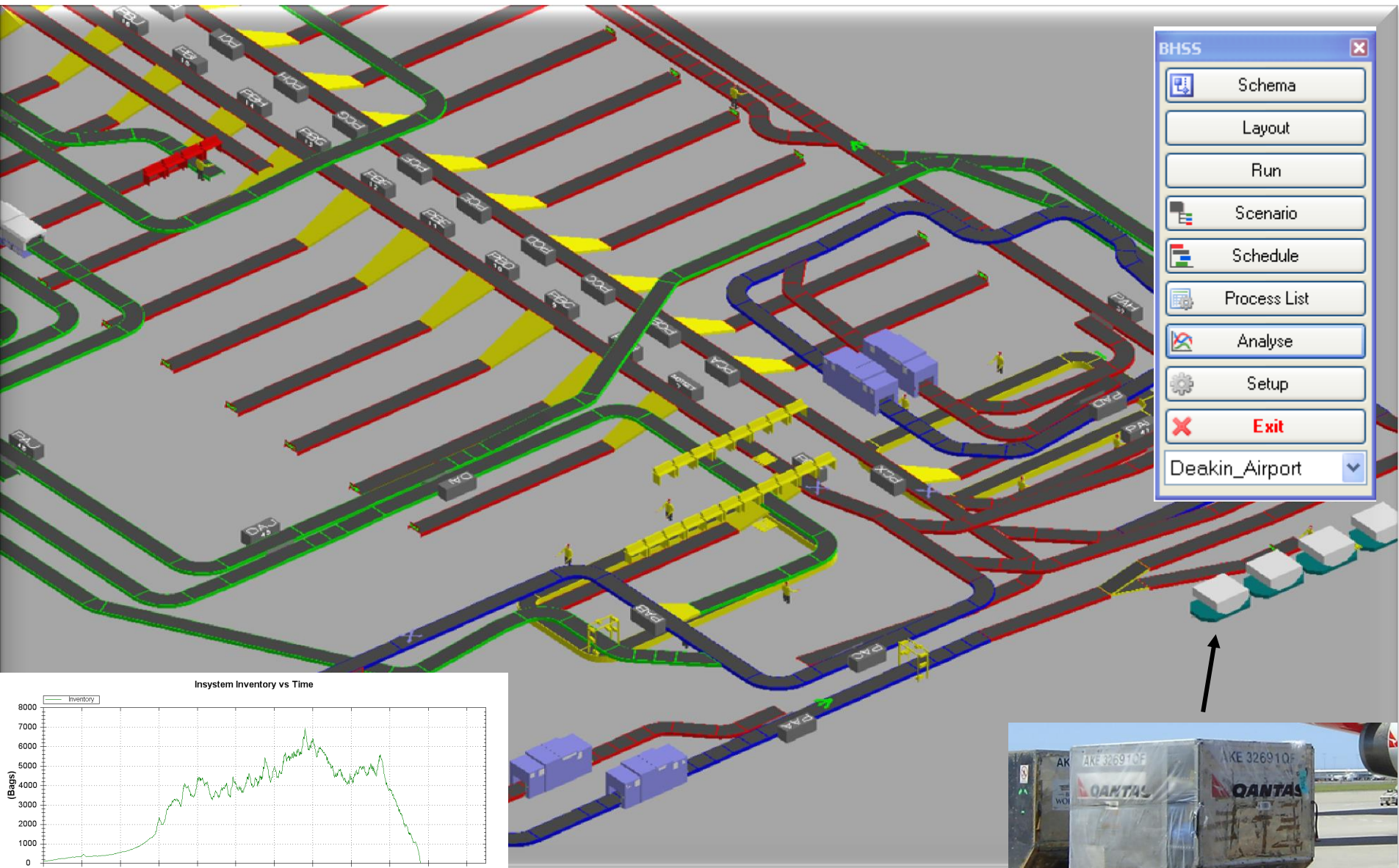
Air cargo supply chain studies for
Office of Transport Security to
determine financial impact and supply
chain risk of selected security policies

<http://www.deakin.edu.au/cisr>

Airport System-of-Systems Simulation

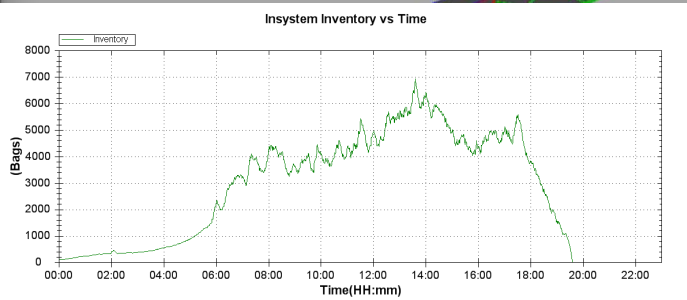
Visual simulation supports knowledge elicitation and utilisation, and helps overcome many challenges associate with process improvement in complex adaptive systems.





BHSS

- Schema
- Layout
- Run
- Scenario
- Schedule
- Process List
- Analyse
- Setup
- Exit
- Deakin_Airport

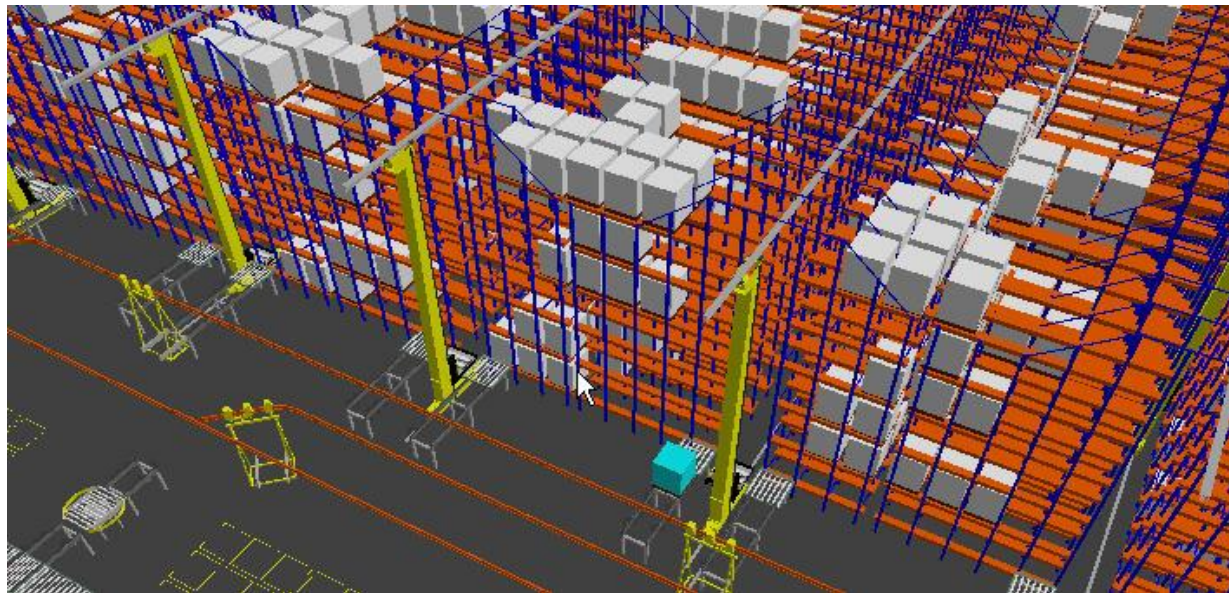


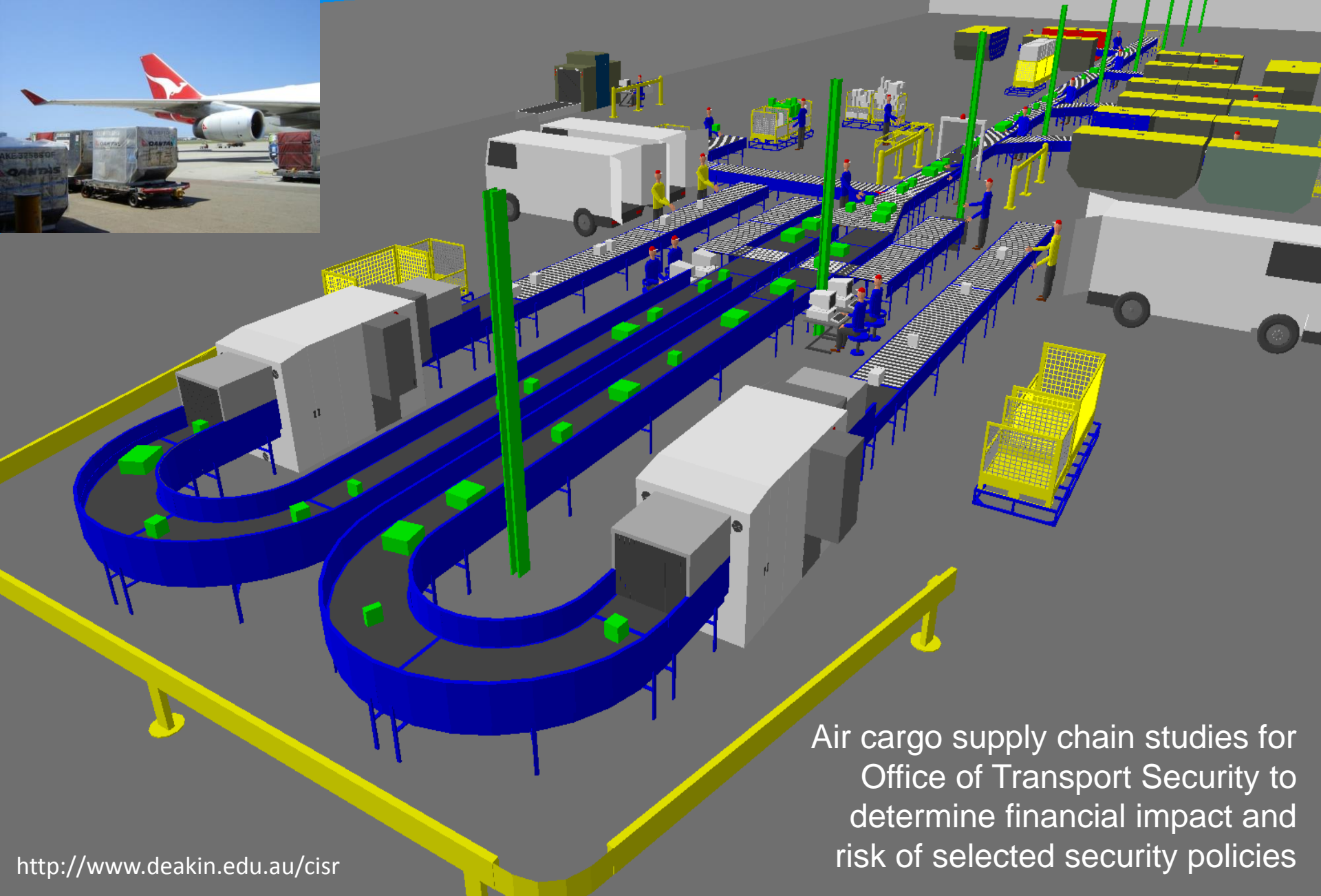
Human factors are critical in the application of model driven methods of knowledge elicitation and application



Warehouse & Distribution Centre Modelling

- Capacity, travel time, inventory and resource estimation
- Warehouse management system emulation
- Routing and flow modelling
- Power & free conveyor controller rules
- Layer picking algorithms





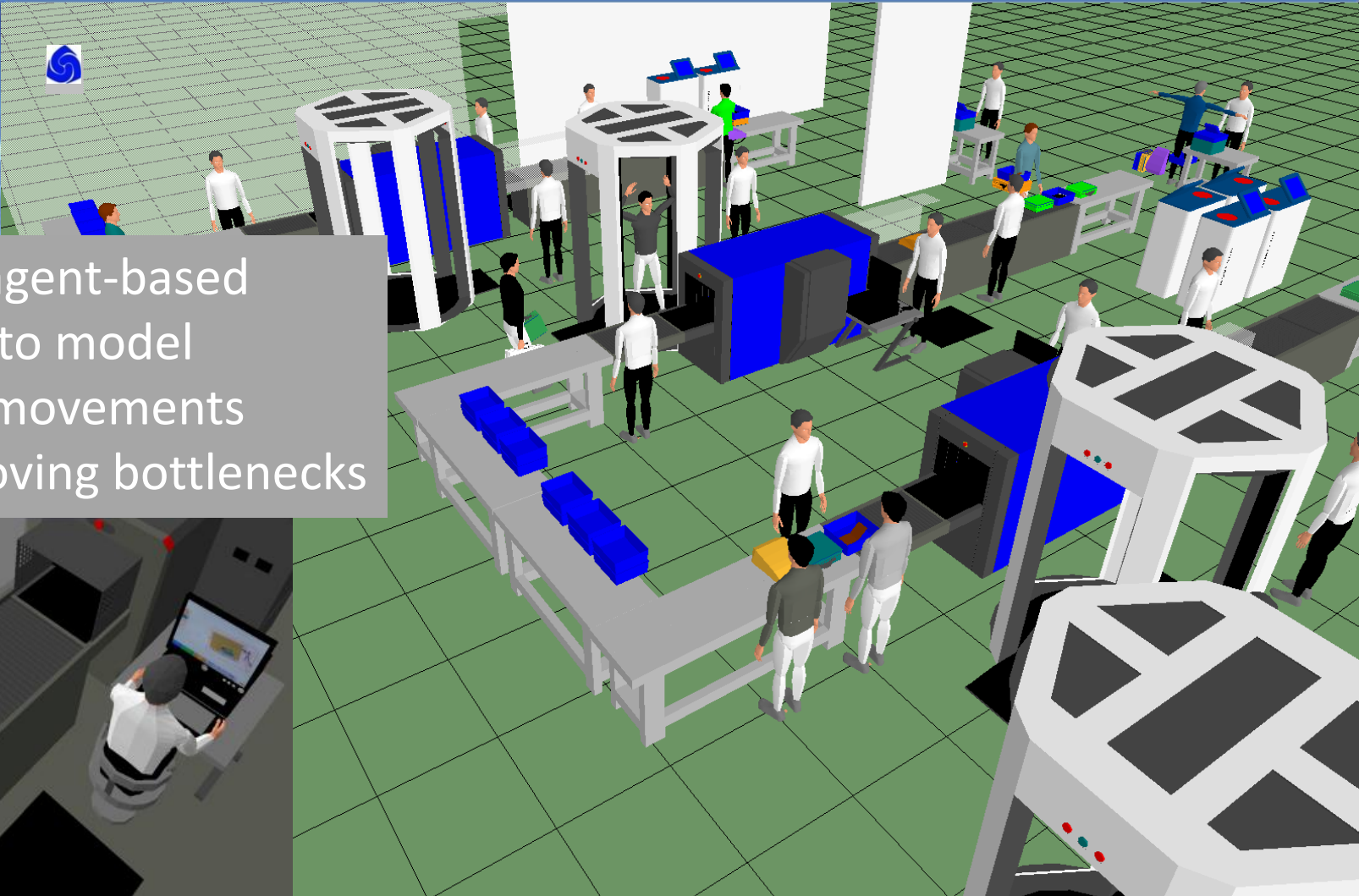
Air cargo supply chain studies for
Office of Transport Security to
determine financial impact and
risk of selected security policies

<http://www.deakin.edu.au/cisr>

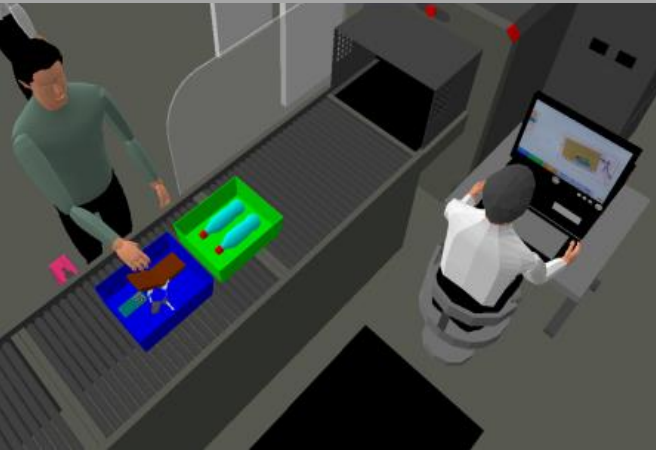


Australian Government

**Department of Infrastructure, Transport,
Regional Development and Local Government**



Advanced agent-based algorithms to model passenger movements through moving bottlenecks





CCTV Footage Analysis (LAGs)

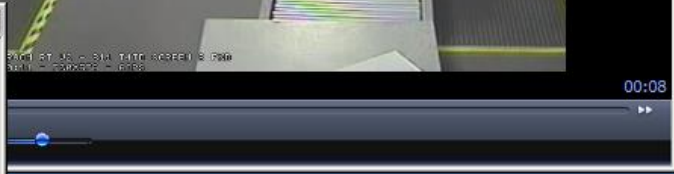
Load Video Select Camera:

Video Date (DD/MM/YY):

Video Time (hh:mm:ss) - 24 Hour:

PAX Events

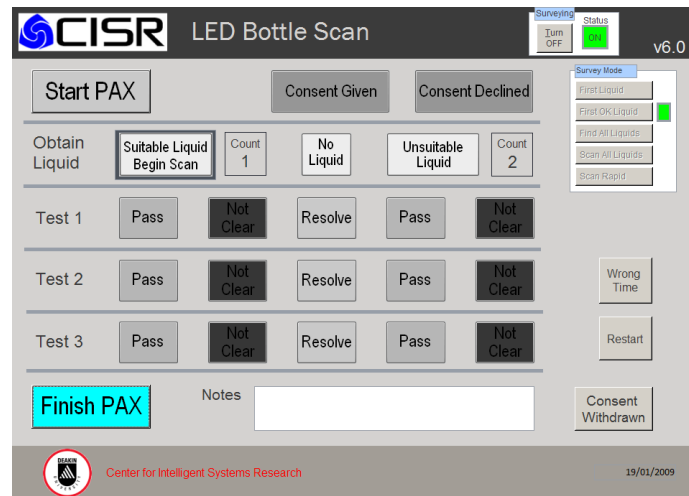
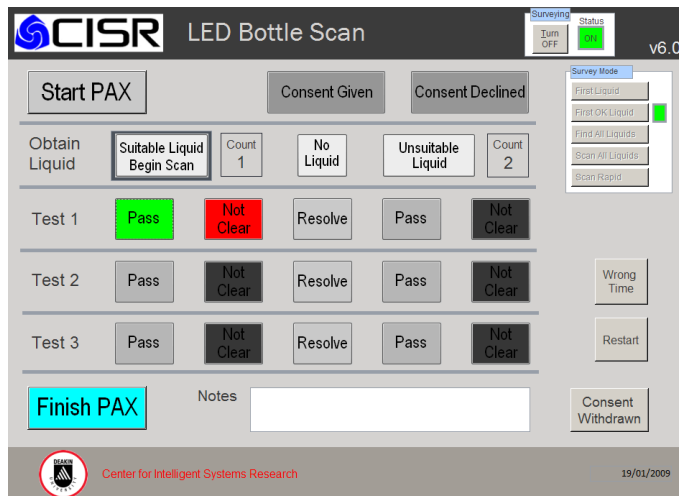
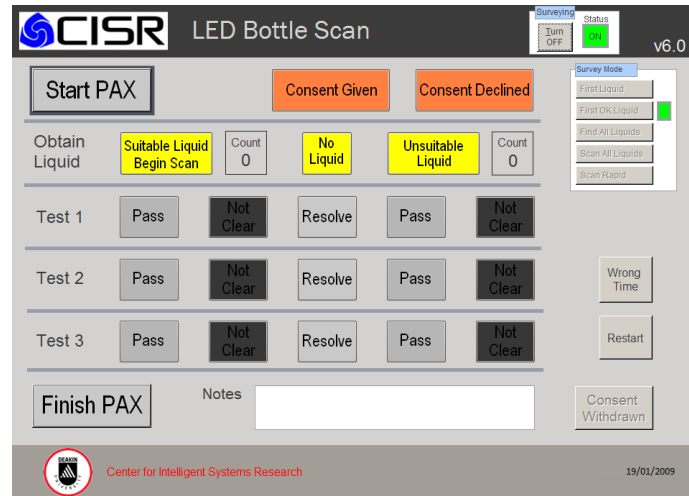
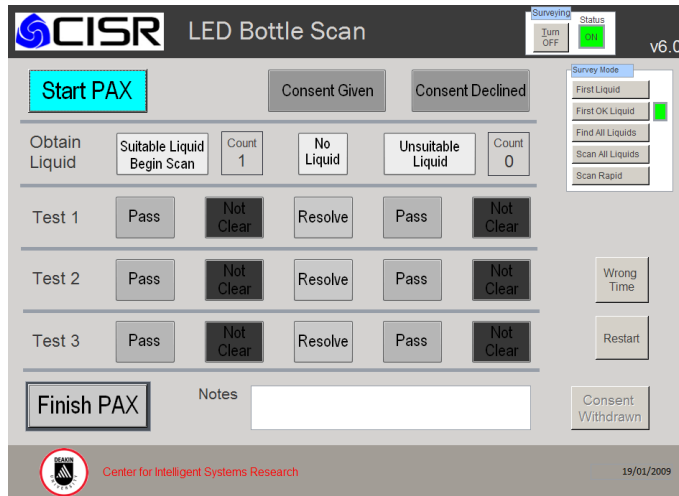
Arrive	
Start Divest	Finish Divest
Start WTMD	Finish WTMD
Start Compose	Finish Compose
Depart	



event_type_id,date,access_time,formatted_time,package_id,from_table,IsCleaned,camera,file_name
 1,20/10/2008,0.354375,8:30:18,...,0,camera_306,file_name,16:14:11
 2,20/10/2008,0.354386574074074,8:30:19,...,0,camera_305,file_name,16:14:11

Image processing algorithms and video analysis tools methods

Data collection tools to capture spatial, frequency and timing information using mobile devices



Data collection tools to capture spatial, frequency and timing information using mobile devices

CISR WTMD Capture v6.6

Surveying: Turn OFF | Status: ON

New Person

- M: PAX Male
- F: PAX Female
- C: PAX Child
- N: Non-PAX
- Wrong Time

Rescreen

- P: Pass
- A: WTMD Alarm
- R: Rescreen
- Rescreen Count: 0

Rescreen Method

- W: WTMD, Wand, Frisk, Body Scan
- Persons Queued: 0

WTMD / WAND

- D: Divest Complete, Pass, Not Pass
- Male-9, NonPax-11
- Persons Queued: 2

Frisk

- Pass, Not Pass
- Child-12
- Persons Queued: 1

Notes

Data collection tools to capture spatial, frequency and timing information using mobile devices

CISR Divest Capture - MEL v6.6

Surveying Status **ON**

Turn OFF **ON**

PAX (0) WTMD PAX

WTMD (0)

1 Tub Belt Male 2 Tubs Female 1 Bag Jacket Child Male Pocket

X-ray

Male Number of Tubs Number of Bags / Other Depart Selected

Female 1 2 3 4 -1 1 2 3 4 -1 Depart All

Child

Notes

Items Divested

Start	Stop / Count
L	Laptop
S	Shoes
B	Belt
P	Pocket
Q	Liquids
A	Aerosols
J	Jacket
O	Other - Bag
E	Other - Body
U	Umbrella

Submit Notes

Ignore Last Divest

Wrong Time

Data Collection Mode

Sample Everyone **ON**

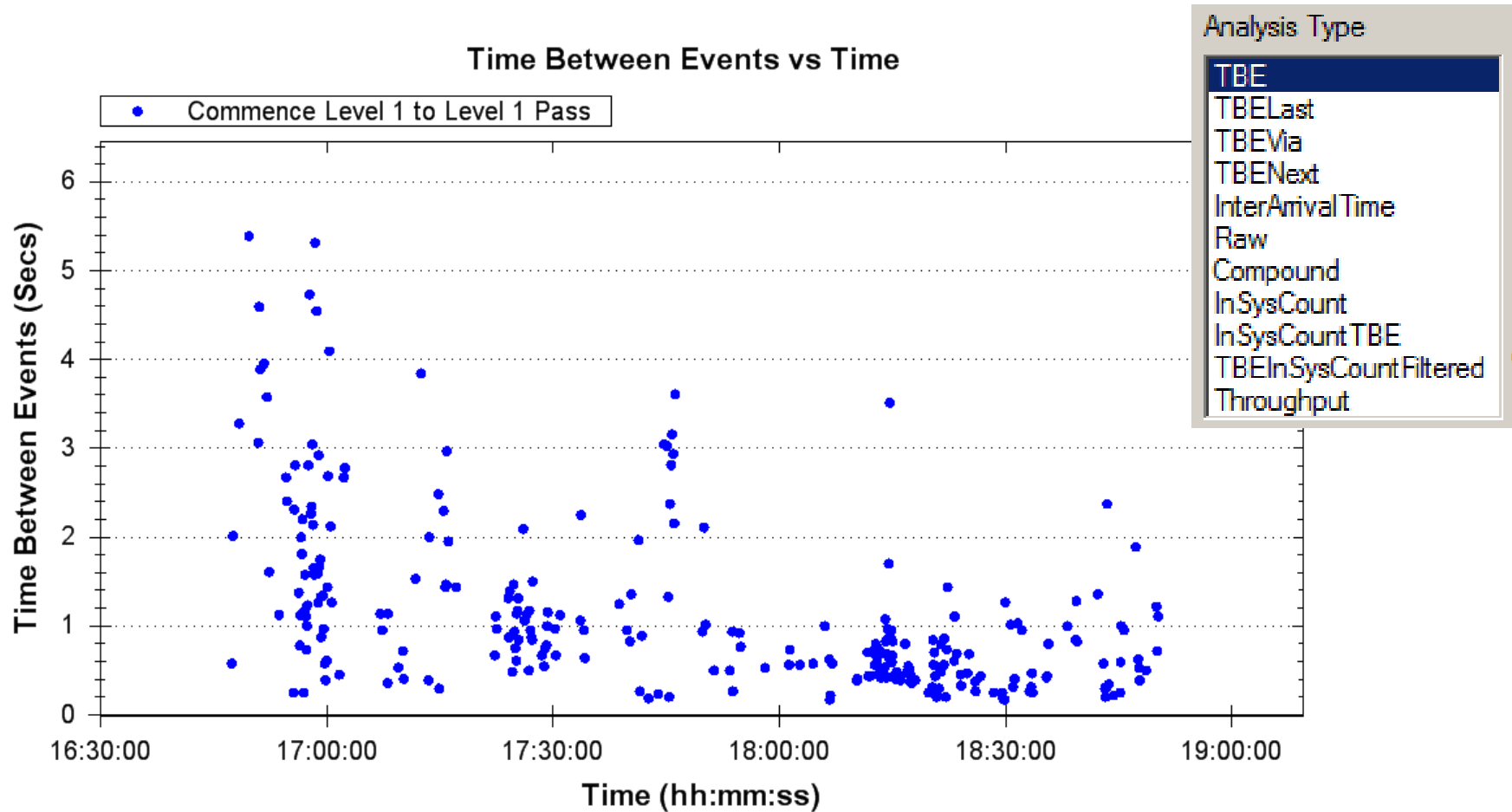
Conveyor Status

Blocked Unblocked **ON**

Select Options Select all Create Group Archive

Data Cleaning Tools

Analysis of Inter-event Times



Automated Reporting of Simulation Results using Event Profiling

The screenshot shows the Auto Analyser V1.1.5.1 software interface. The main window is titled "Auto Analyser V1.1.5.1" and has three tabs: "XML Creation", "Analysis", and "Report". The "Analysis" tab is active.

At the top, there are fields for "XML Script" (set to "Sam_13"), "Filter AC", and "Analysis Template" (set to "AnalysisTemplate_40"). An "Analyse" button is located to the right of these fields.

Below the fields, there are two lists:

- Analysis Files (.abc) 1 of 509:** A list of files starting with "1_ADL_2.0_Result", "10_ADL_2.0_Result", "101_ADL_2.0_Result", etc., up to "123_ADL_2.0_Result".
- Analysis Collection 1 of 8814:** A list of analysis items such as "1: Divest-Lane1 - Inventory - BoxPlot - Bin:1", "2: - TimeDiff - Histogram(RelativeFrequency) - Bin: HBin:2", "3: Arrival - Inventory - BoxPlot - Bin:10", etc., up to "34: Compose-AllLanes - Throughout - Histogram(RelativeFrequency) - Bin:300 HBin:1".

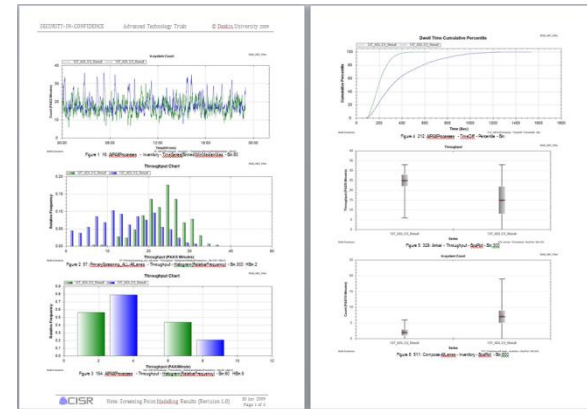
At the bottom of the main window, there are "All" and "None" buttons for both lists.

On the right side of the interface, there are several buttons: "Analyse File(s)", "Compare File(s)", "Generate Report(s)", "Generate Compares Report", "Settings", and "Open Analysis Folder". The "Settings" section includes checkboxes for "Export Analysis Raw Data", "Enable Extra Chart Info", "Generate Report", "Open Generated Report", and "Generate Single Report".

At the bottom left, there is a "Messages" section with the following text:


```

Start Time : 8:24:06 AM
Press ESC to Abort
Analysing File: 1_ADL_2.0_Result
Analysis Definition: 1 : Successful
Done with Analysis
End Time : 8:24:10 AM
    
```



Low Cost Data Collection and Analysis for Improved Quality Outcomes

Automotive Stamping Processes



Heavy Presses Performance Management

Ford of Australia Pty. Ltd. Version 2.0

Add/Edit Data:

- Add Run Data
- Add Repair Data
- ...
- View Downtime Codes
- ...
- Maintain
- Add Action Plan
- ...
- ...
- ...
- Exit Database

Reports / Charts:

Line Matrix

% Yield Charts

Action Plan List

Action Plan Charts

Hit To Hit Charts

First Time Through

Down Time

Availability

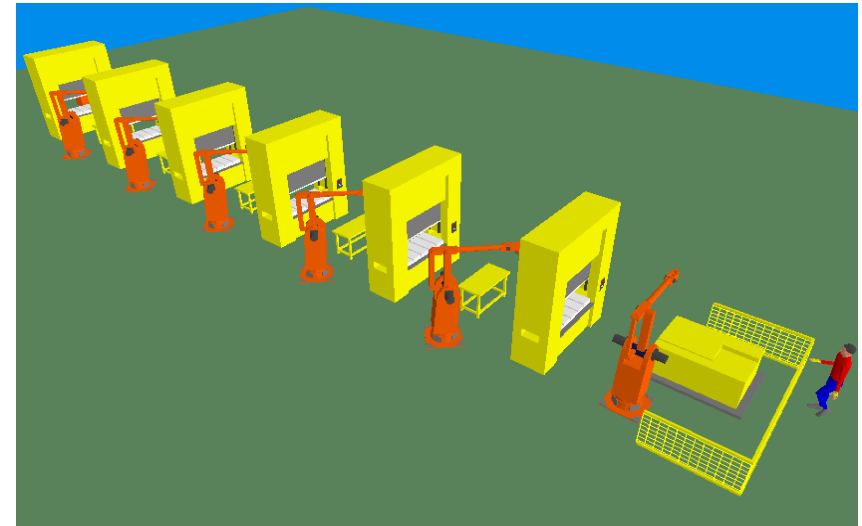
Scrap & Reject Charts

Performance Hits Per Day

Summary Charts

Shift Comments

F
P
S



Add Run Data

Use this screen to add information from each run of a part. It also gives the status of both the part.

Go Back
Add Action Plan

Exit Database

Line: 13 TallyID: 3558

Part Number: 1R23WR2AF513A44/S

Part Name: EXT R/SIDE RAIL TO W/HSE

Designed Metrics

Hourly Rate: 350 Hit To Hit: 45

Date: 10/10/2001 % F.T.T.: 100% Hourly Av.: 372

Run Start Date: 10/10/2001

SHIFT: SHIF1 RUN: RUN

Diast Data

Technical: 0 (Mins)

Buy off: 0 (Mins)

Hit to Hit Total: 0 (Mins)

Current Run Status

Hourly Av.: 372

In Process

Finished

Shift: 1 Date: 10/10/2001

Tally: 1149 Part Down times: 0 (Mins)

Scrap: 0 Non-part Down times: 70 (Mins)

Run time: 185 (Mins)

Current Shift: Hourly Av.: 372

Shift Comments

Add Downtime

Loss Type: [dropdown]

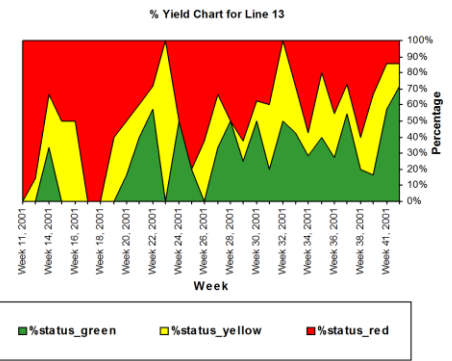
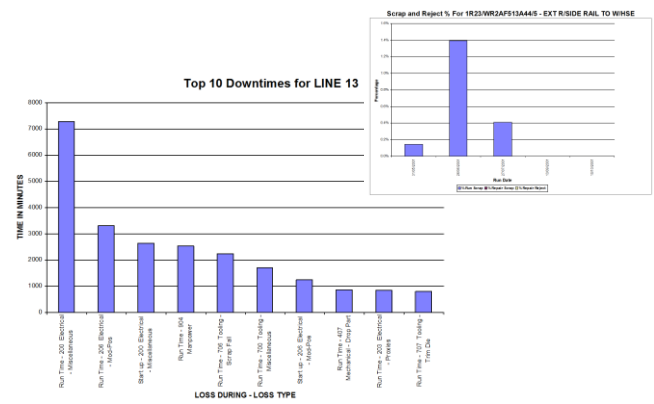
Loss During: [dropdown]

Time down: [input] (Mins)

Add Downtime

Downtime History

Loss During	Loss Type	Time
Run Time	206 Electrical - Mod-Pos	40
Run Time	102 Blanks - Damaged	20
Run Time	900 Miscellaneous	10



Quality Tracking System Platform

- CISR have developed a knowledge capture and quality tracking system in collaboration with the Geelong Quality Council
- Trials have resulted in a 20% reduction in part defects for Geelong Manufacturers

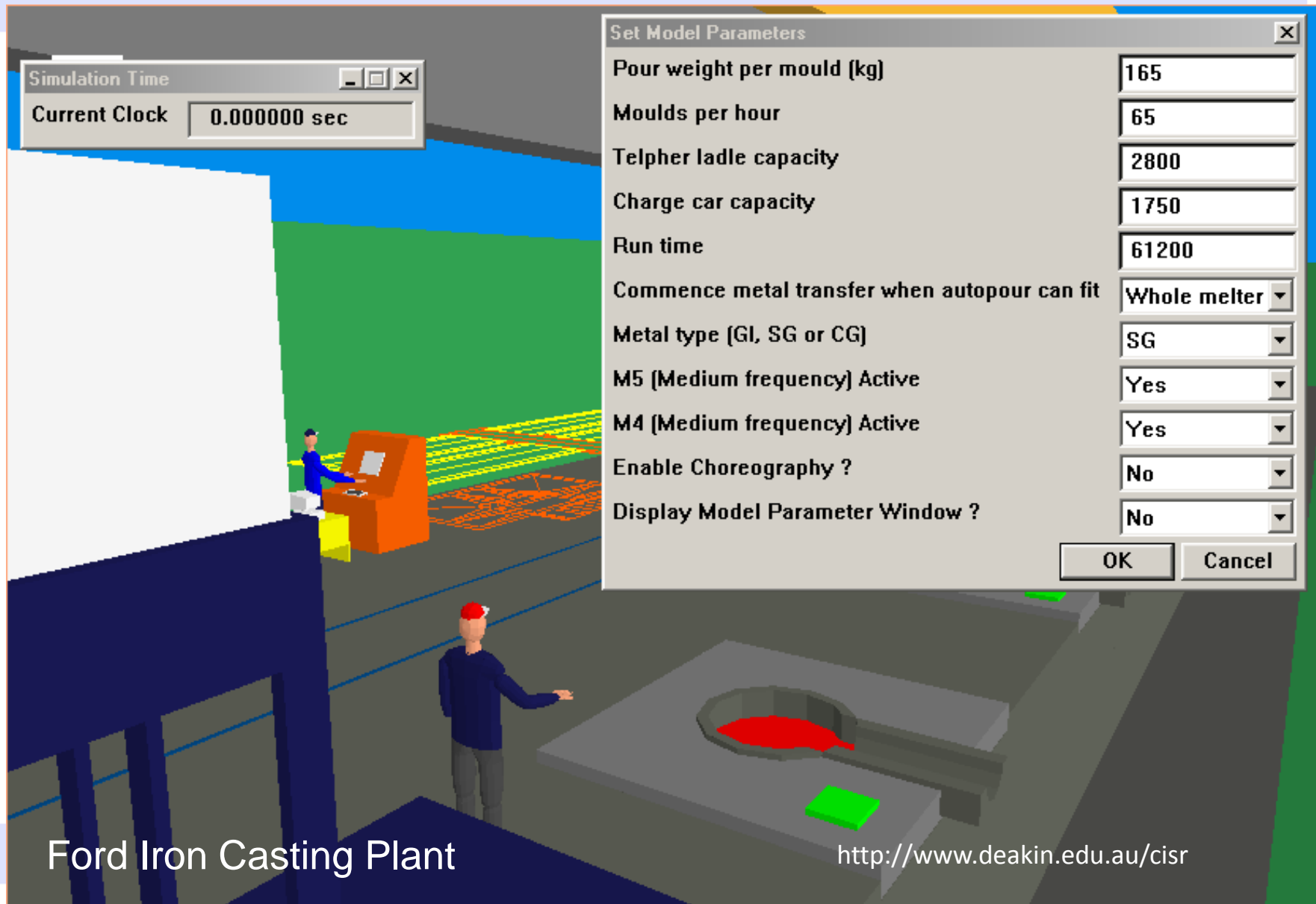


AR
AIR RADIATORS





What-if Analysis to Support Decision Making



Simulation Time

Current Clock 0.000000 sec

Set Model Parameters

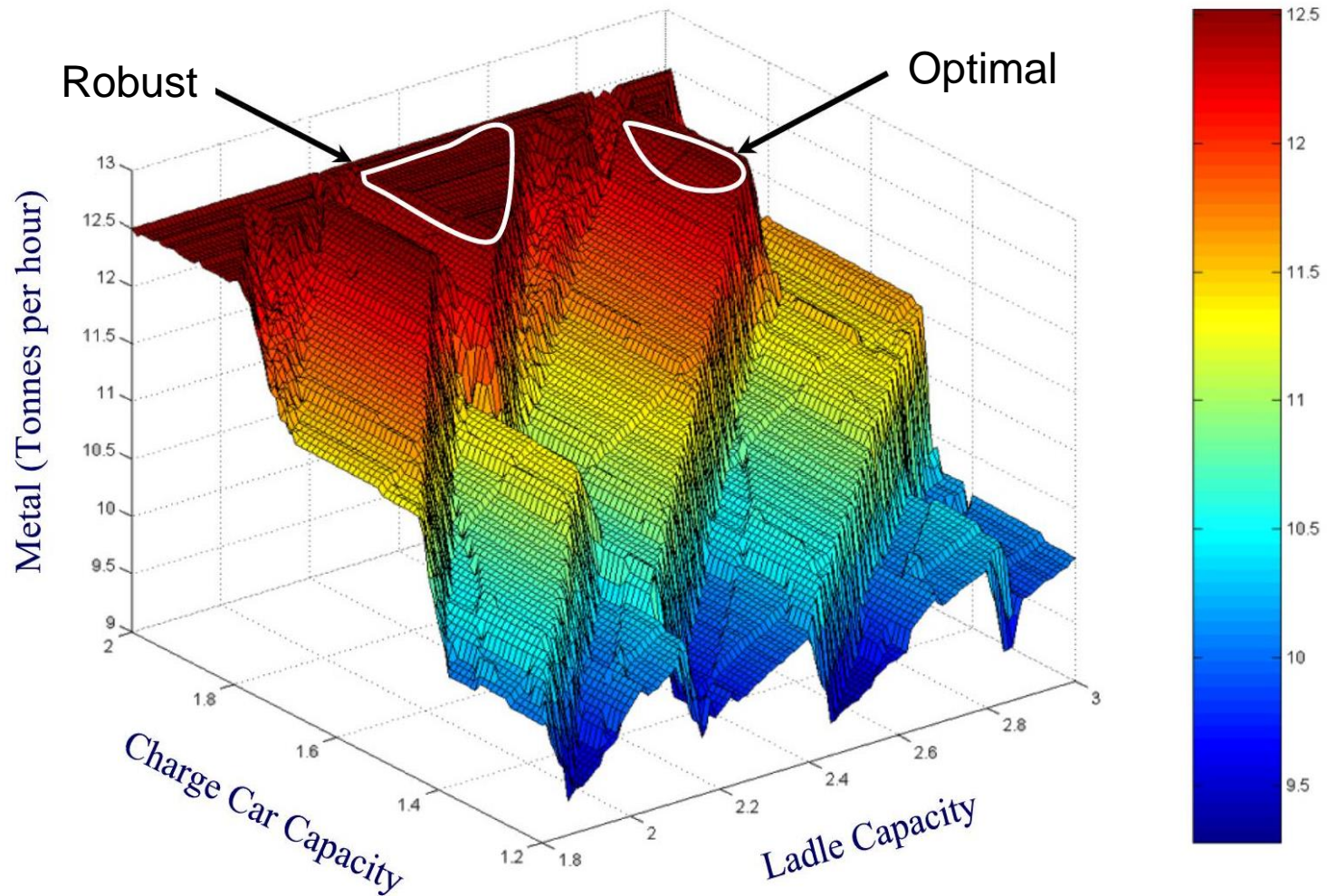
Pour weight per mould (kg)	165
Moulds per hour	65
Telpher ladle capacity	2800
Charge car capacity	1750
Run time	61200
Commence metal transfer when autopour can fit	Whole melter
Metal type (GI, SG or CG)	SG
M5 (Medium frequency) Active	Yes
M4 (Medium frequency) Active	Yes
Enable Choreography ?	No
Display Model Parameter Window ?	No

OK Cancel

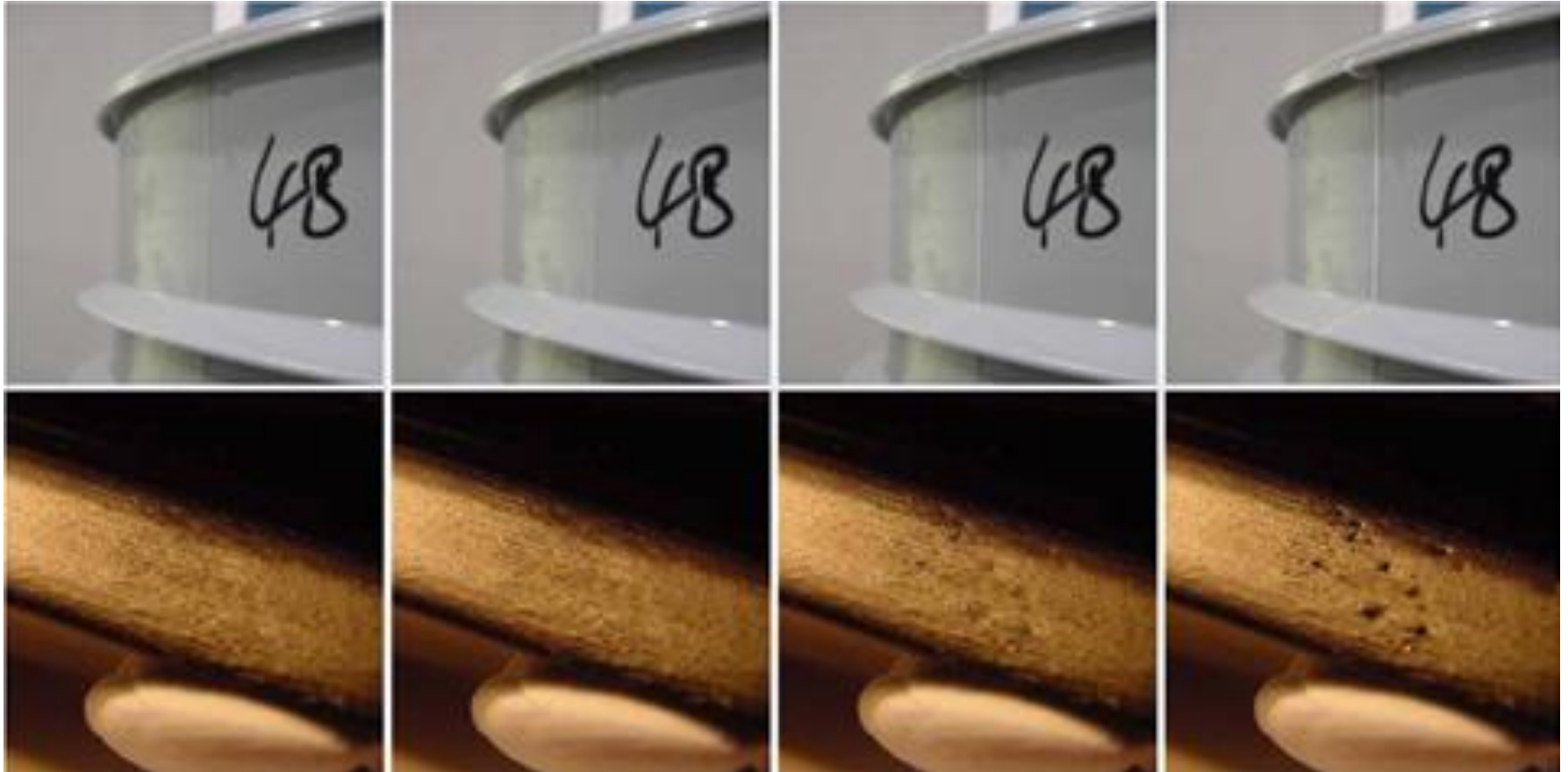
Ford Iron Casting Plant

<http://www.deakin.edu.au/cisr>

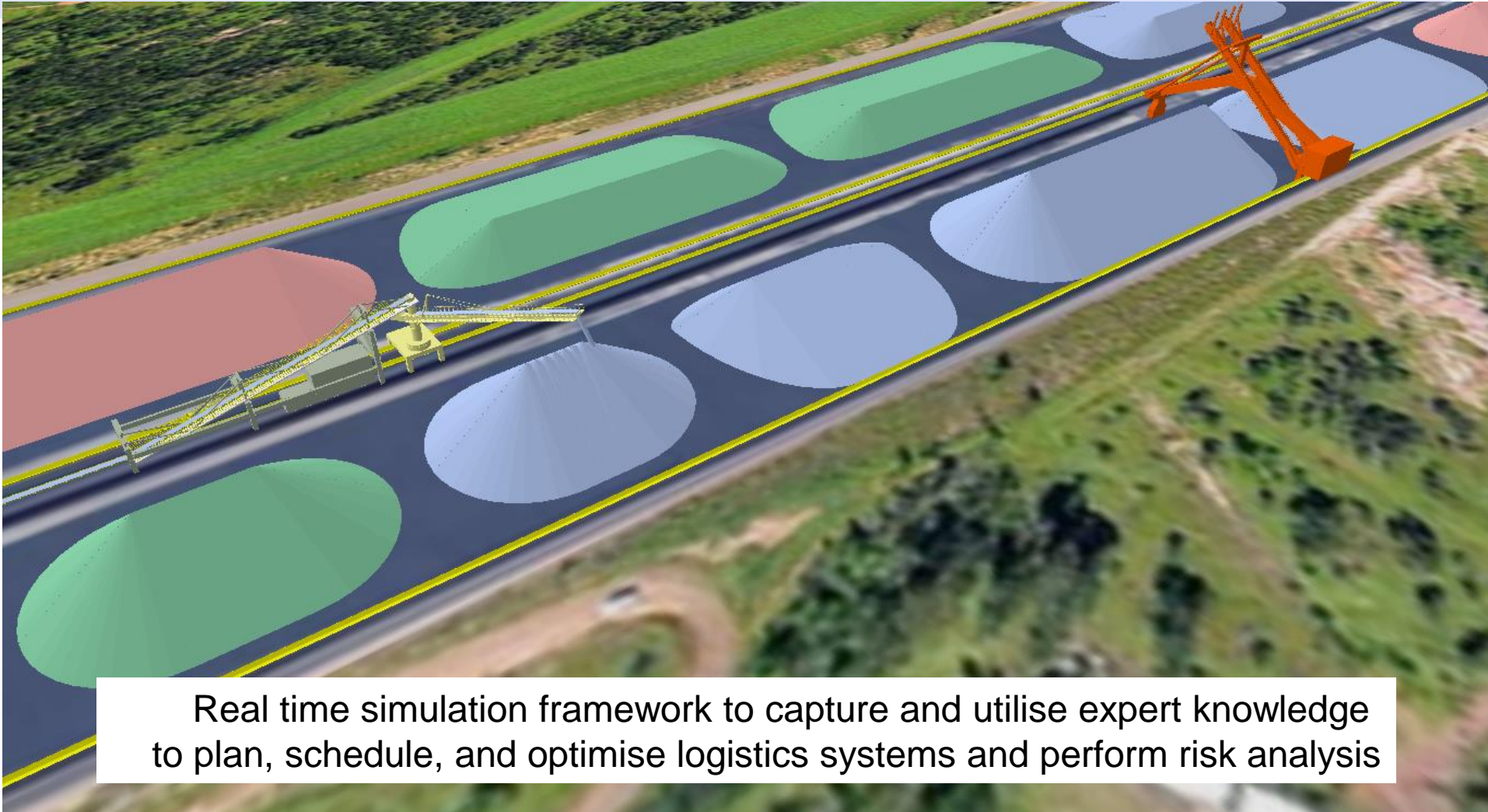
Fitness Landscapes - Robust Optimisation



Prediction and Image Processing to Visualise Quality



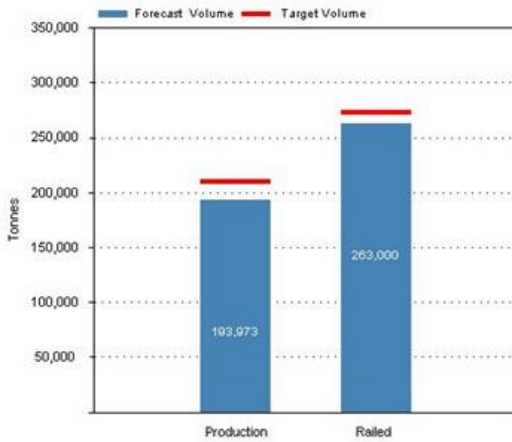
Simulation-based Operational Decision Support



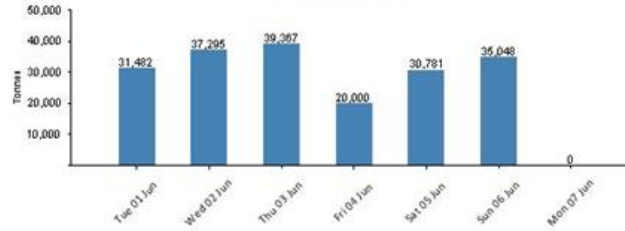
Real time simulation framework to capture and utilise expert knowledge to plan, schedule, and optimise logistics systems and perform risk analysis

Dashboard Visualisation of Simulation Results

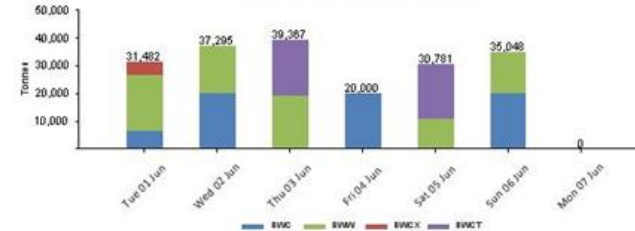
Weekly Summary



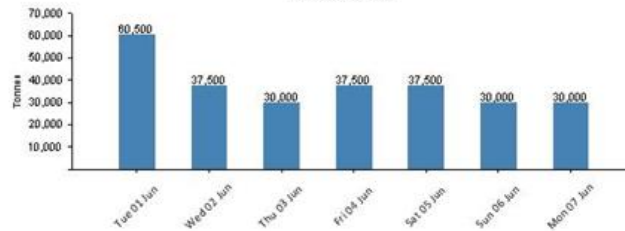
Tonnes Produced



Daily Production by Product Type



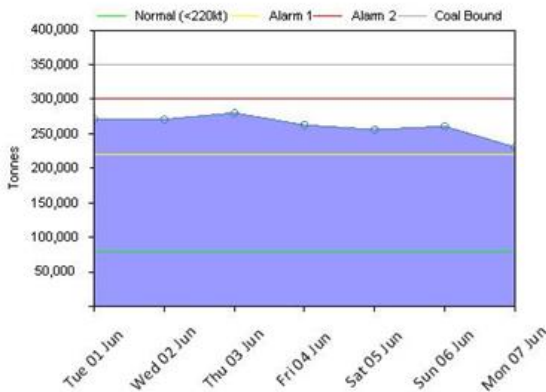
Tonnes Railed



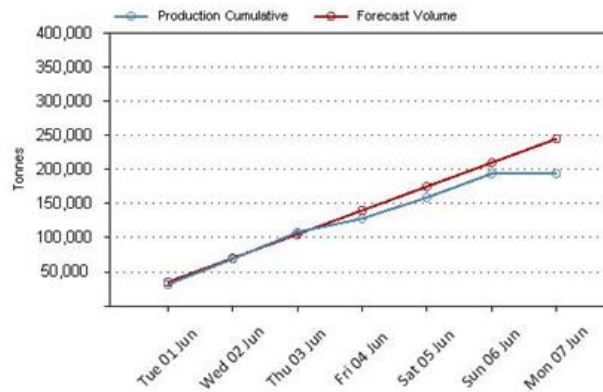
Daily Railed by Product Type



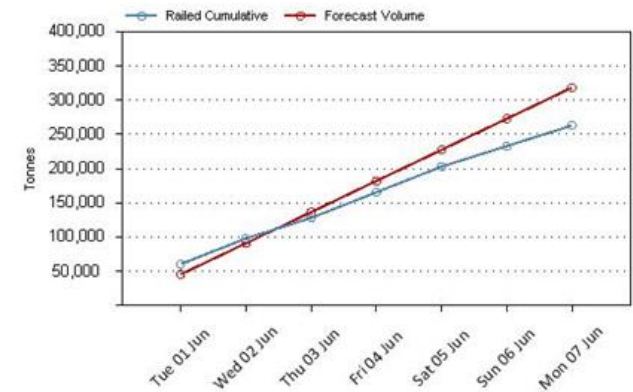
Stockpile Inventory



Production Cumulative



Railed Cumulative



For further information, please contact:

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