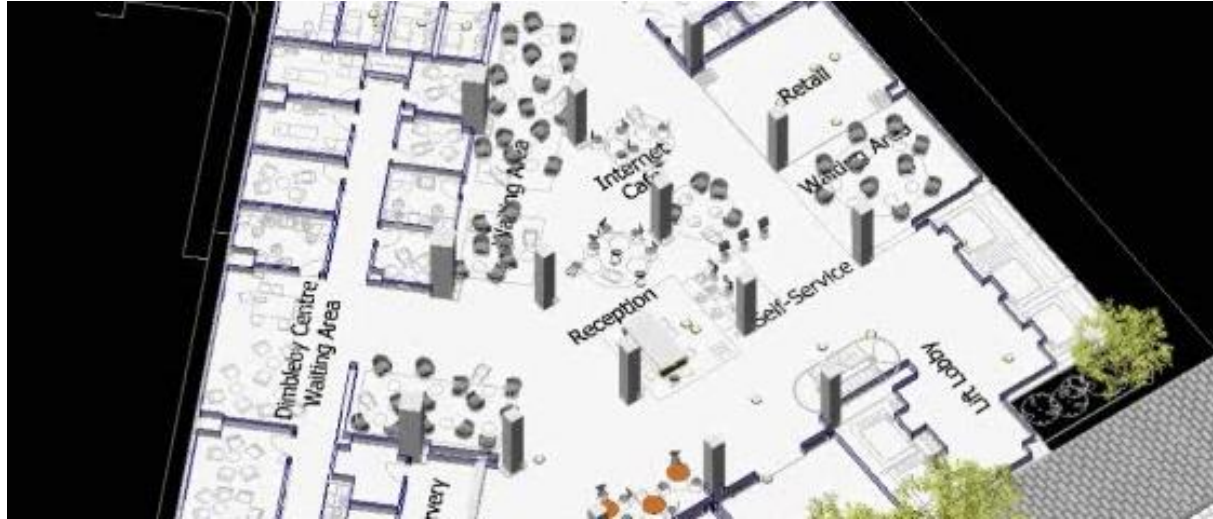


EUROPEAN HEALTHCARE DESIGN 2016 TECHNOLOGIES TO FACILITATE EVIDENCE BASED DESIGN PROCESSES



BUROHAPPOLD
ENGINEERING

Dr Becky Hayward
People Flow Consultant



**Loughborough
University**

Fraser Greenroyd
Research Engineer

THE CHALLENGE

How to make **this...**



more like **this...**

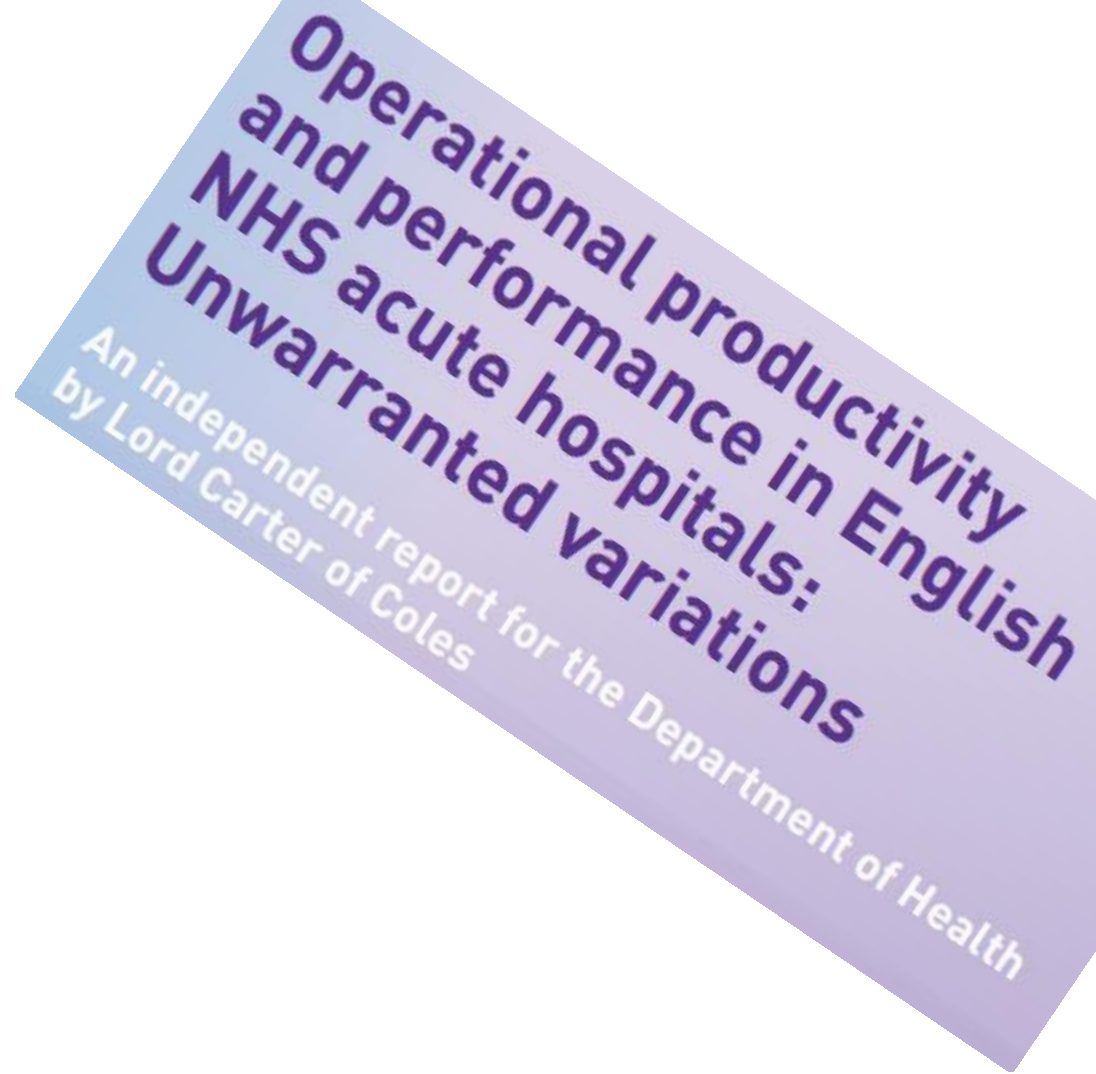


THE CHALLENGE

...whilst making **£5 billion per annum** in efficiency savings between 2016 and 2020 (Carter Report 2016)

Up to **£1bn per annum** from estates and facilities management

Up to **£2bn per annum** from better staff utilisation



(RE)DESIGNING A HOSPITAL

Optimise **this...**



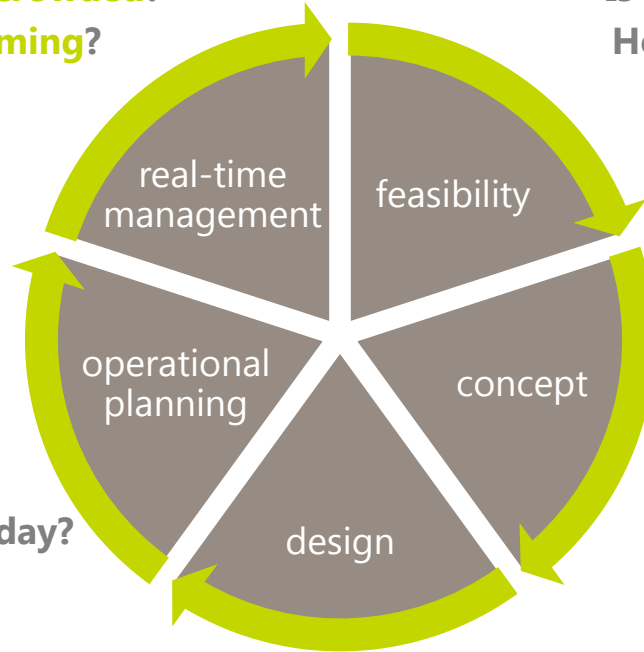
To maximise **this...**



WHAT ARE THE QUESTIONS?

Is my waiting area becoming **crowded**?
How is my hospital **performing**?

Is there a **need** for a new hospital?
How much **site space** will it need?



How many **staff** do I need?
How many **patients** can I see in a day?

What are the **clinical adjacencies**?
How many **rooms** do we need?

How **wide** do my corridors need to be?
Which layout is best for **wayfinding**?

APPROACH



APPROACH

Define
the problem



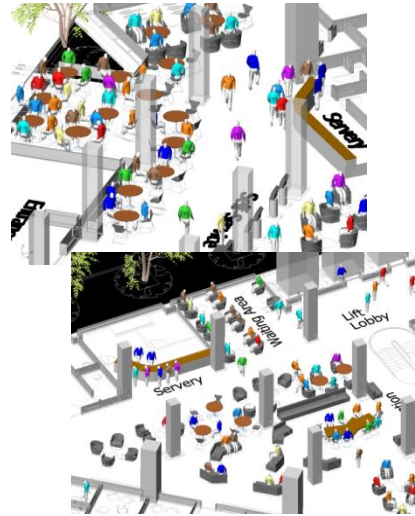
Develop
understanding



Optimise
solutions



Benefits



Enhanced patient
experience

Optimised space
utilisation

Improve operational
planning

SO WHAT'S ACTUALLY HAPPENING?



Gastro



Pain Clinic



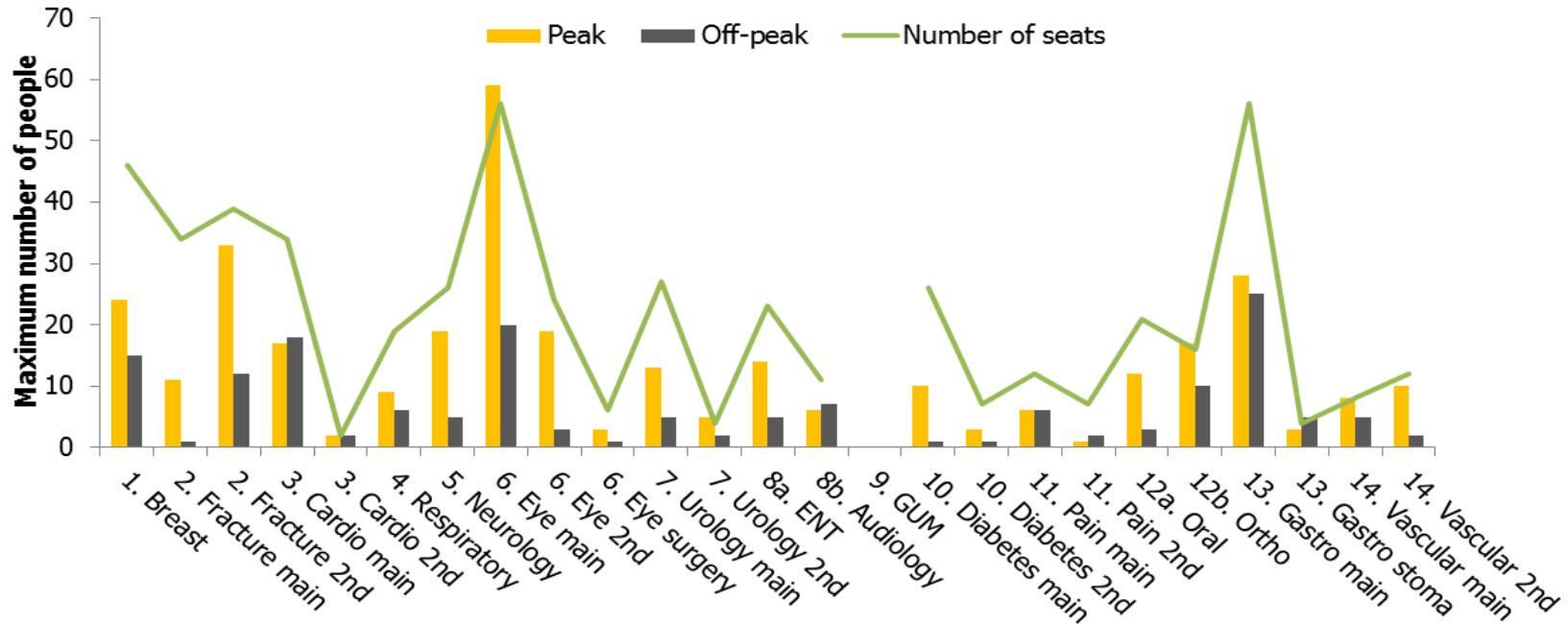
Ophthalmology



Diabetes

**We're too busy!
Need more space!!**

- Average **34%** observed utilisation during **peak**
- Average **16%** observed utilisation during **off peak**



HOW CAN WE CAPTURE THAT?

Traditional

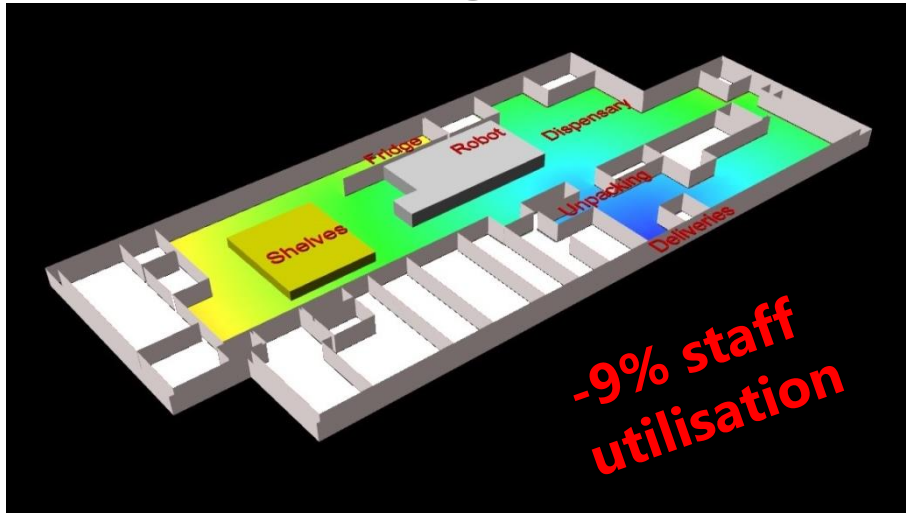


Innovative

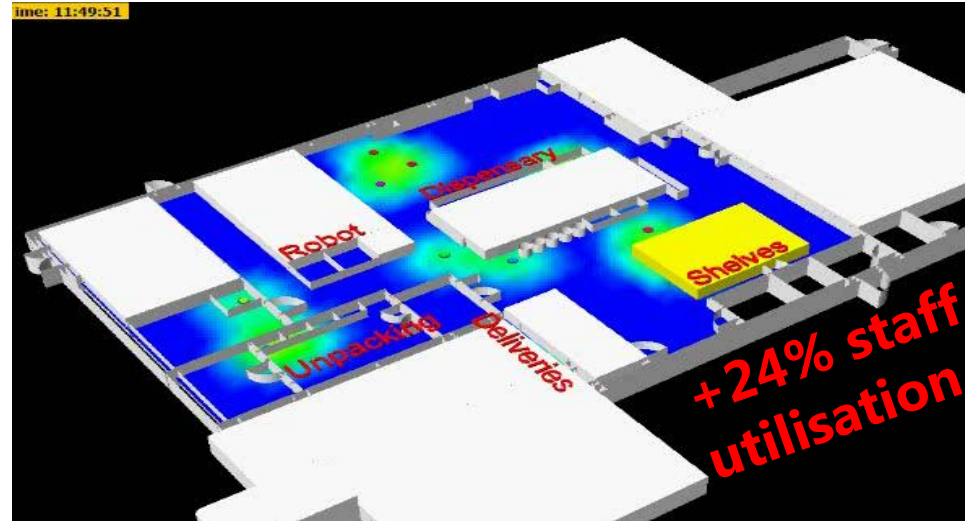
| Qualitative | Quantitative |
|------------------------|-----------------------------------|
| Interviews | Electronic record system analysis |
| Questionnaires/Surveys | Observations |
| Workshops | Sensing technology |
| Work diaries | Tracking technology |

IS ANECDOTAL EVIDENCE ENOUGH?

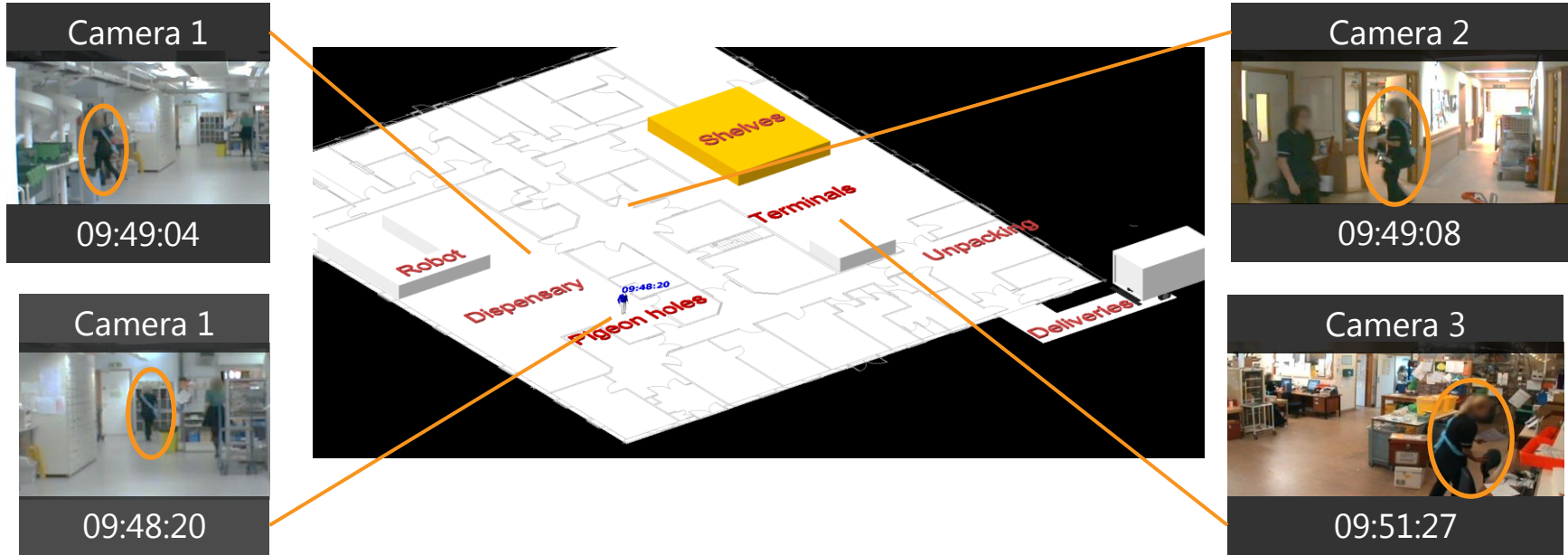
Anecdotal design



Evidence based



EVIDENCE NOT GUESSWORK

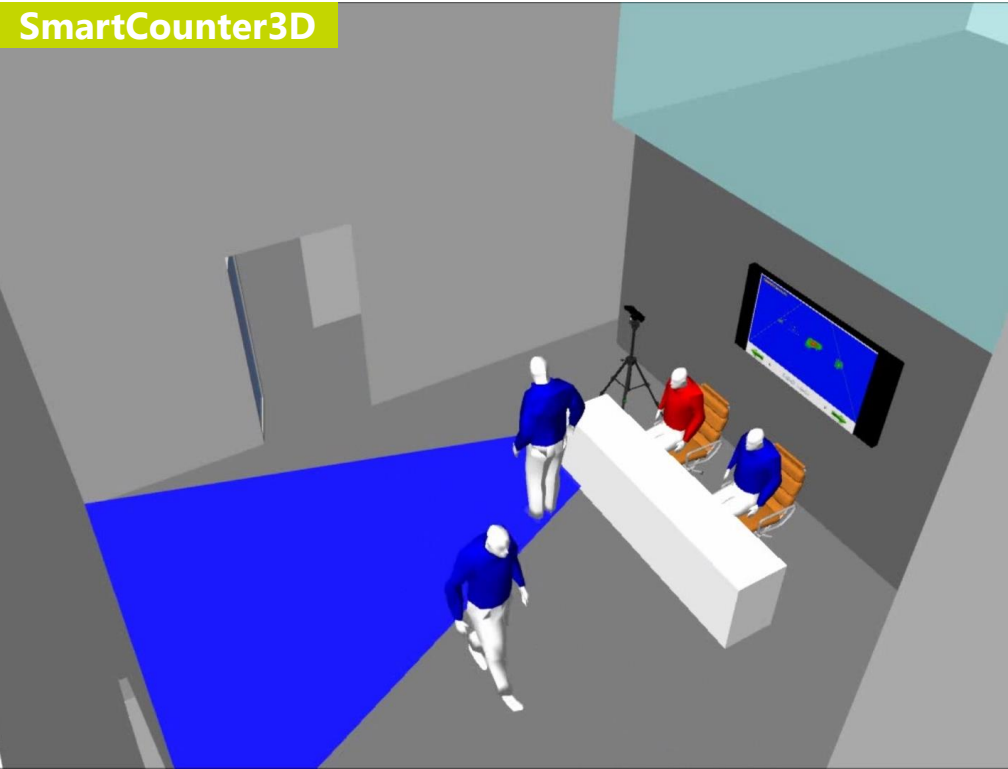


But we don't have forever...

SO HOW CAN WE AID EVIDENCE GATHERING?

SMART COUNTER 3D

SmartCounter3D



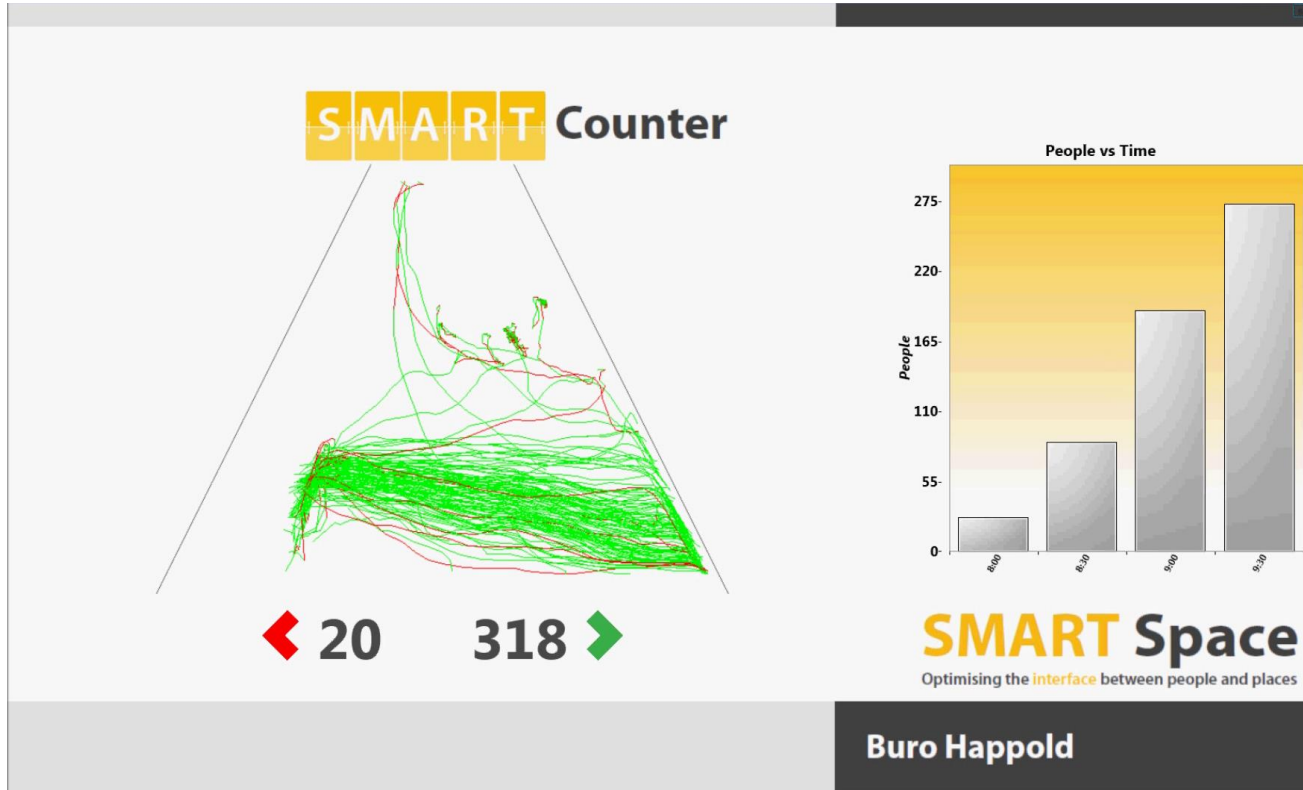
SmartCounter3D

High-level automated video analytics for:

- Department **Occupancy**
- **Flows**

SO HOW CAN WE AID EVIDENCE GATHERING?

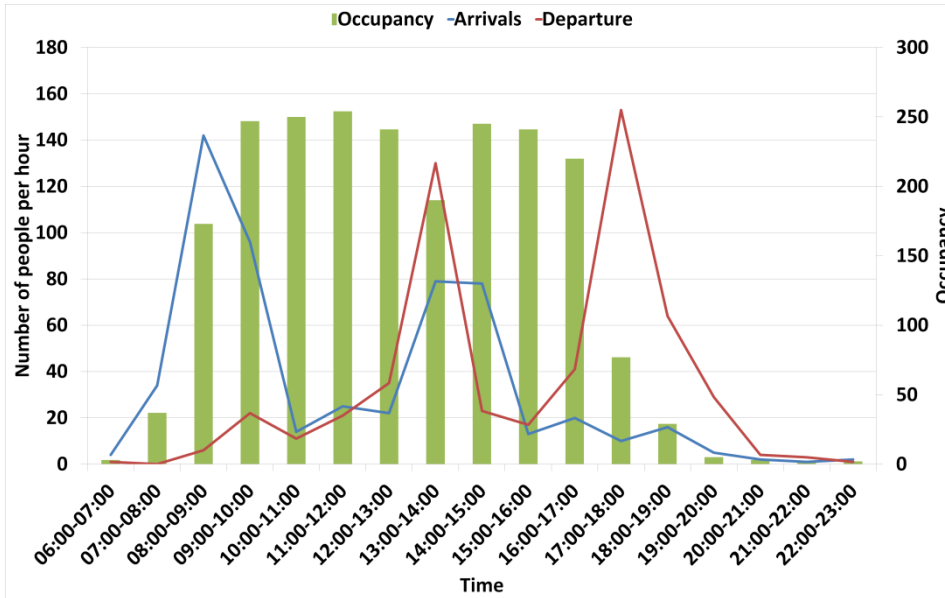
SMART COUNTER 3D



SO HOW CAN WE AID EVIDENCE GATHERING?

SMART COUNTER 3D

SmartCounter3D



SmartCounter3D

High-level automated video analytics for:

- Department **Occupancy**
- **Flows**

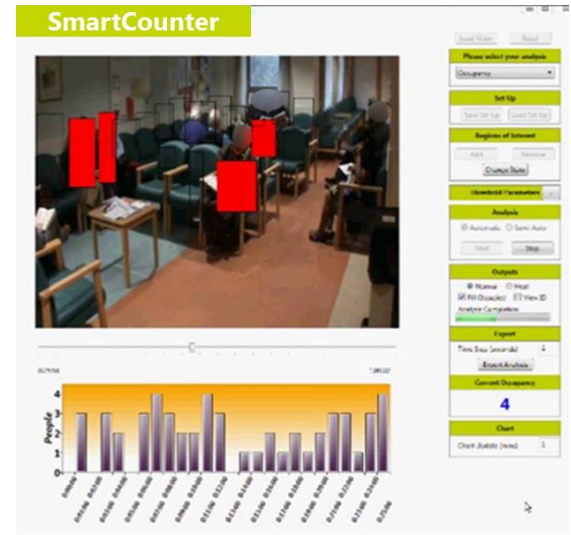
SO HOW CAN WE AID EVIDENCE GATHERING?

SMART COUNTER

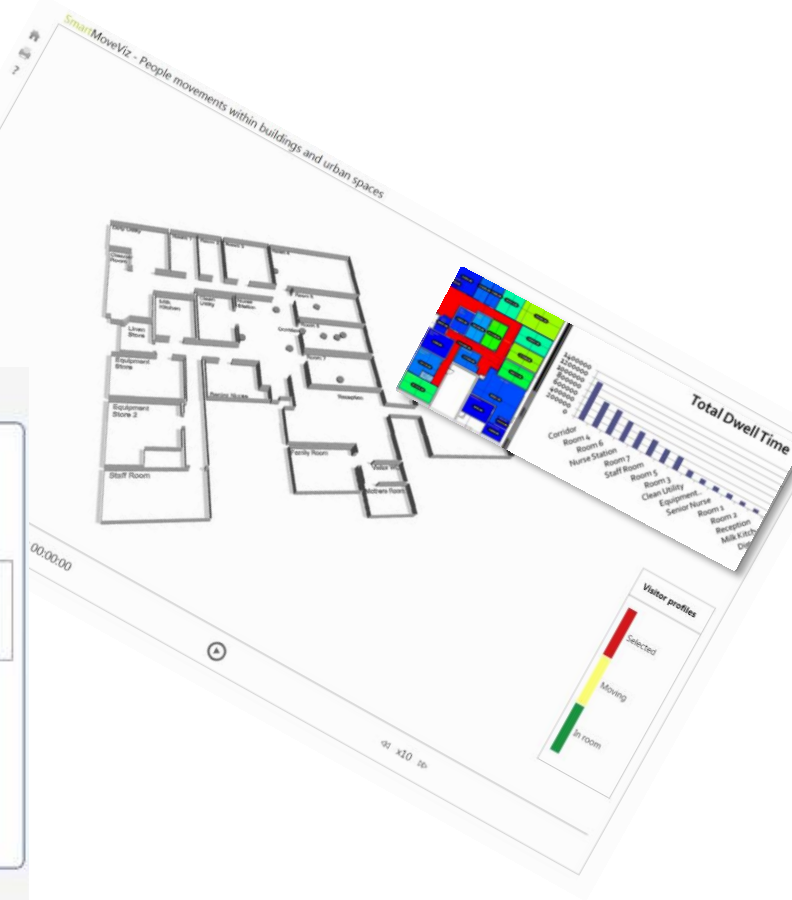
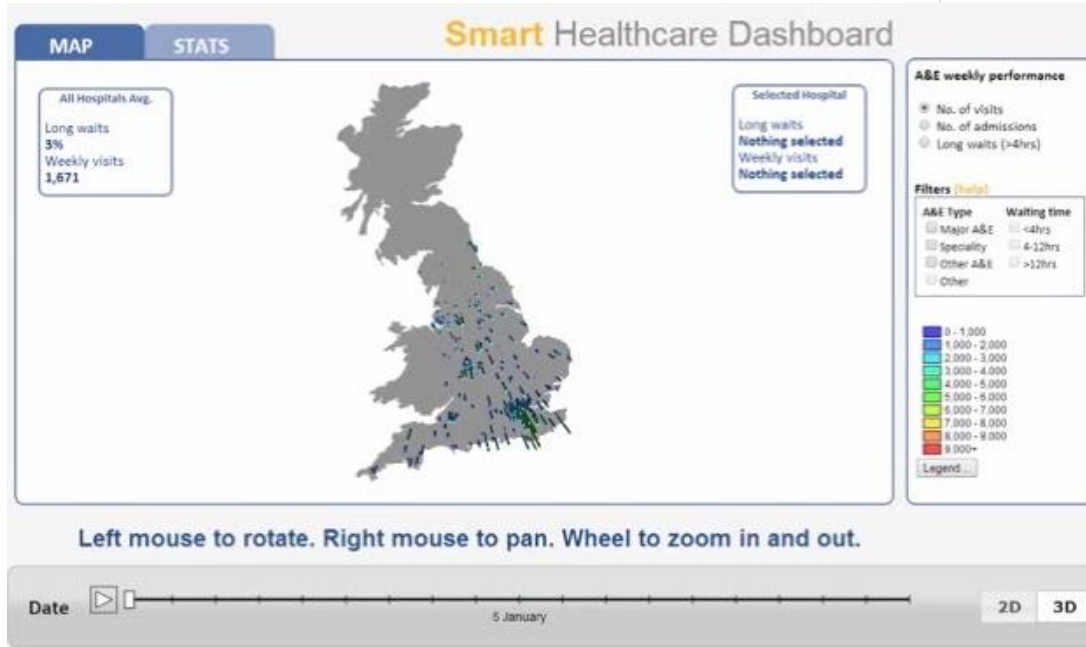
SmartCounter

Automated video analytics for:

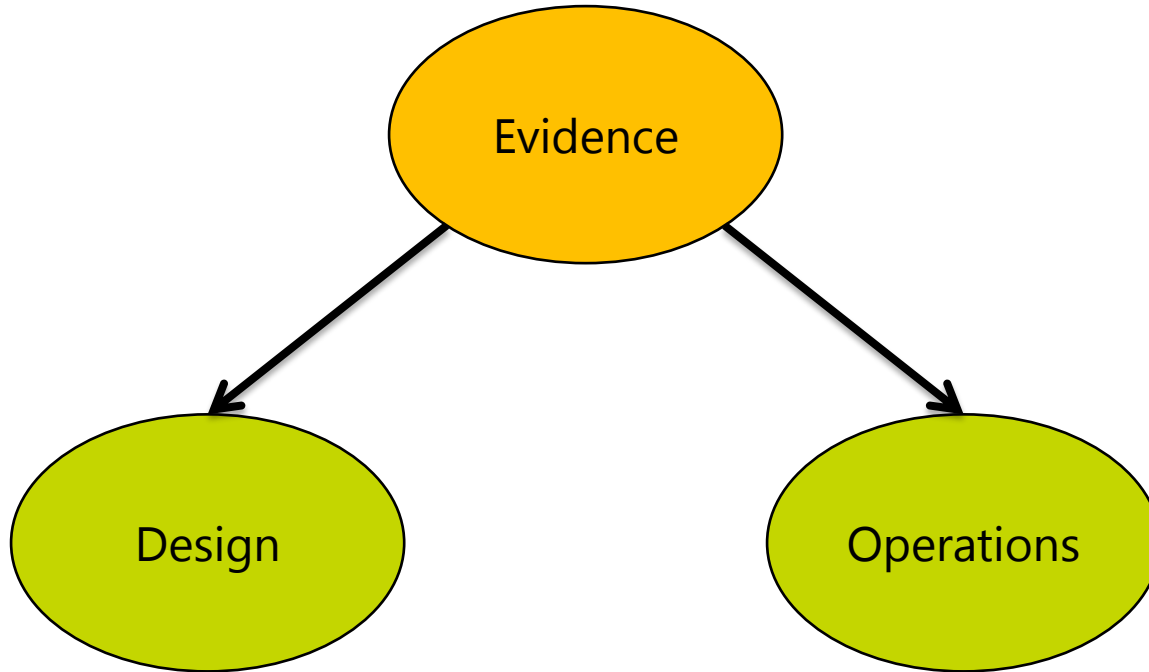
- **Occupancy**
- **Waiting times**
- **Utilisation**
- **Dwelling times**



HOW CAN WE VISUALISE IT?



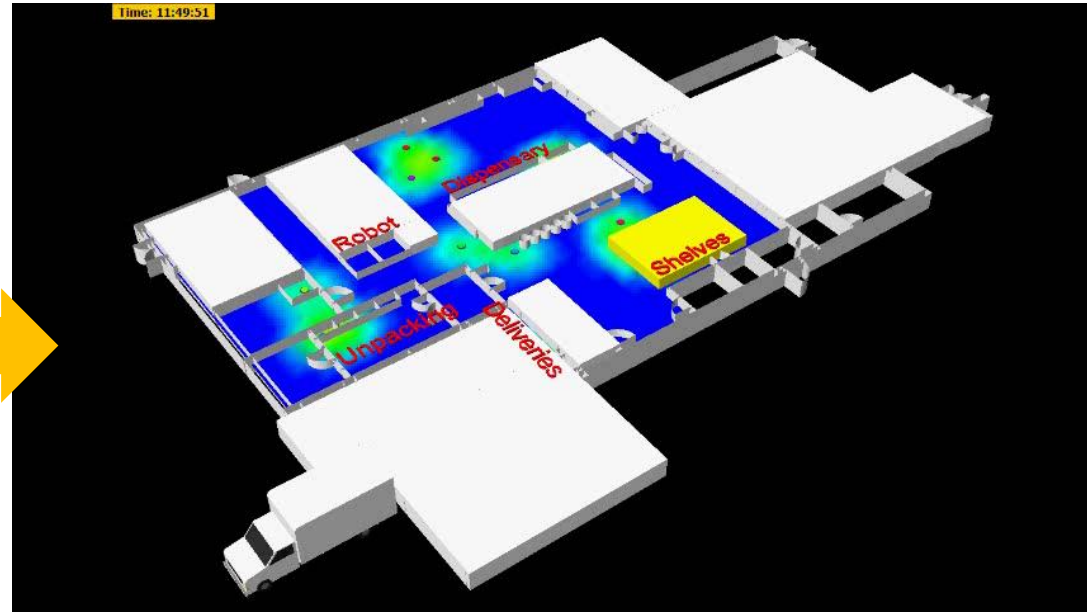
SO WE HAVE THE DATA...



HOW CAN WE USE IT?

EXAMPLE 1 – PHARMACY DEPARTMENT

| | Back of Robot | Robot Terminal | Ward Boxes | Pull out shelves | Main Dispensary | Pigeon holes | Store shelves | Store terminals (1) | Fridge | Store terminals (2) | Unpacking area |
|---------------------|---------------------|----------------|------------|------------------|-----------------|--------------|---------------|---------------------|--------|---------------------|----------------|
| Back of Robot | | 5 | 7 | 13 | 14 | 22 | 26 | 28 | 33 | 34 | 37 |
| Robot Terminal | 5 | | 2 | 8 | 10 | 16 | 20 | 20 | 28 | 28 | 36 |
| Ward Boxes | | | | 6 | 6 | 13 | 18 | 18 | 26 | 25 | 31 |
| Pull out shelves | Back of Robot | Robot Terminal | Ward Boxes | Pull out shelves | Main Dispensary | Pigeon holes | Store shelves | Store terminals (1) | Fridge | Store terminals (2) | Unpacking area |
| Main Dispensary | 3 | | 3 | 11 | 17 | 14 | 21 | 21 | 34 | 23 | 27 |
| Pigeon holes | Ward Boxes | 11 | | 9 | 15 | 12 | 18 | 15 | 15 | 2 | 15 |
| Store shelves | Pull out shelves | 17 | 9 | | 17 | 15 | 12 | 13 | 5 | 13 | 14 |
| Store terminals (1) | Main Dispensary | 14 | 15 | 17 | | 16 | 4 | 4 | 13 | 13 | 13 |
| Store terminals (2) | Pigeon holes | 21 | 18 | 15 | 5 | 4 | 15 | 13 | 21 | 23 | 13 |
| Unpacking area | Store shelves | 14 | 12 | 4 | 8 | 7 | 18 | 17 | 17 | 21 | 20 |
| | Store terminals (1) | 15 | 13 | 4 | 15 | 13 | 11 | 11 | 25 | 28 | 27 |
| | Fridge | 2 | 5 | 13 | 17 | 11 | 4 | 4 | 16 | 14 | 14 |
| | Store terminals (2) | 15 | 13 | 12 | 21 | 17 | 25 | 18 | 18 | 16 | 16 |
| | Unpacking area | 14 | 13 | 12 | 23 | 21 | 28 | 14 | 16 | 17 | 18 |
| | | | | | 23 | 20 | 27 | 14 | 16 | 18 | 3 |
| | | | | | | | | | | | 3 |



HOW CAN WE USE IT?

EXAMPLE 2 – OUTPATIENT DEPARTMENT

| J | A | B | C | D | E | F | G | H | I | J | K | L | M |
|----|-----------|------------------|------------------|------------------|------|-------------------------------------|------------------------|-------------|--------|---------|----------------------|---|---|
| 1 | 52371430 | 05/11/2015 09:30 | 05/11/2015 10:00 | 05/11/2015 09:26 | NULL | CheckIn/Reception DR S. Rudman | 37081.Medical Oncology | 1 Completed | 3103.9 | Consult | GST11GY/SIONCG/GBR10 | | |
| 2 | 53004844 | 05/11/2015 09:30 | 05/11/2015 10:00 | 05/11/2015 09:18 | NULL | CheckIn/Reception DR M. Sandri | 37081.Medical Oncology | 1 Completed | 5305.1 | Consult | GST11GY/SIONCG/GBR04 | | |
| 3 | 52234225 | 05/11/2015 09:30 | 05/11/2015 10:00 | 05/11/2015 09:23 | NULL | CheckIn/Reception DR E. Karapanagos | 37081.Medical Oncology | 1 Completed | 5324.0 | Consult | GST11GY/SIONCG/GBR07 | | |
| 4 | 52336915 | 05/11/2015 09:30 | 05/11/2015 09:40 | 05/11/2015 09:02 | NULL | CheckIn/Reception DR A. Mones | 37081.Medical Oncology | 1 Completed | 4841.3 | Consult | GST11GY/SIONCG/GBR16 | | |
| 5 | 52371233 | 05/11/2015 09:30 | 05/11/2015 09:40 | 05/11/2015 08:57 | NULL | CheckIn/Reception DR A. Mones | 37081.Medical Oncology | 1 Completed | 4638.4 | Consult | GST11GY/SIONCG/GBR18 | | |
| 6 | 52261578 | 05/11/2015 09:30 | 05/11/2015 09:40 | 05/11/2015 09:16 | NULL | CheckIn/Reception DR A. Mones | 37081.Medical Oncology | 1 Completed | 12.1 | Consult | GST11GY/SIONCG/GBR18 | | |
| 7 | 52306262 | 05/11/2015 09:30 | 05/11/2015 09:20 | 05/11/2015 08:14 | NULL | CheckIn/Reception DR A. Mones | 37081.Medical Oncology | 1 Completed | 38.47 | Consult | GST11GY/SIONCG/GBR14 | | |
| 8 | 52639817 | 05/11/2015 09:00 | 05/11/2015 09:20 | 05/11/2015 08:33 | NULL | CheckIn/Reception DR A. Mones | 37081.Medical Oncology | 1 Completed | 06.14 | Consult | GST11GY/SIONCG/GBR18 | | |
| 9 | 53019177 | 05/11/2015 09:00 | 05/11/2015 09:30 | 05/11/2015 08:40 | NULL | CheckIn/Reception DR S. Rudman | 37081.Medical Oncology | 1 Completed | 07.5 | Consult | GST11GY/SIONCG/GBR05 | | |
| 10 | 52370569 | 05/11/2015 09:00 | 05/11/2015 09:20 | 05/11/2015 09:05 | NULL | CheckIn/Reception DR A. Mones | 37081.Medical Oncology | 1 Completed | 09.40 | Consult | GST11GY/SIONCG/GBR14 | | |
| 11 | 52817580 | 05/11/2015 09:00 | 05/11/2015 09:30 | 05/11/2015 08:41 | NULL | CheckIn/Reception DR S. Rudman | 37081.Medical Oncology | 1 Completed | 26.30 | Consult | GST11GY/SIONCG/GBR09 | | |
| 12 | 52917263 | 05/11/2015 09:00 | 05/11/2015 09:30 | 05/11/2015 08:54 | NULL | CheckIn/Reception DR S. Rudman | 37081.Medical Oncology | 1 Completed | 28.04 | Consult | GST11GY/SIONCG/GBR11 | | |
| 13 | 53103665 | 04/11/2015 16:43 | 04/11/2015 16:43 | 04/11/2015 16:44 | NULL | CheckIn/Reception DR J. Spicer | 37081.Medical Oncology | 1 Completed | 52.52 | Consult | GST11GY/SIONCG/GBR18 | | |
| 14 | 52403966 | 04/11/2015 16:45 | 04/11/2015 16:45 | 04/11/2015 16:34 | NULL | CheckIn/Reception DR R. Lal | 37081.Medical Oncology | 1 Completed | 30.49 | Consult | GST11GY/SIONCG/GBR17 | | |
| 15 | 53053357 | 04/11/2015 16:45 | 04/11/2015 16:45 | 04/11/2015 15:57 | NULL | CheckIn/Reception DR R. Lal | 37081.Medical Oncology | 1 Completed | 02.03 | Consult | GST11GY/SIONCG/GBR13 | | |
| 16 | 53193367 | 04/11/2015 16:06 | 04/11/2015 16:06 | 04/11/2015 16:07 | NULL | CheckIn/Reception DR J. Spicer | 37081.Medical Oncology | 1 Completed | 25.22 | Consult | GST11GY/SIONCG/GBR09 | | |
| 17 | 52376517 | 04/11/2015 16:45 | 04/11/2015 16:45 | 04/11/2015 16:05 | NULL | CheckIn/Reception DR J. Spicer | 37081.Medical Oncology | 1 Completed | 48.55 | Consult | GST11GY/SIONCG/GBR10 | | |
| 18 | 53037784 | 04/11/2015 16:45 | 04/11/2015 16:45 | 04/11/2015 16:25 | NULL | CheckIn/Reception DR J. Spicer | 37081.Medical Oncology | 1 Completed | 52.59 | Consult | GST11GY/SIONCG/GBR18 | | |
| 19 | 53070456 | 04/11/2015 16:45 | 04/11/2015 16:45 | 04/11/2015 15:07 | NULL | CheckIn/Reception DR R. Lal | 37081.Medical Oncology | 1 Completed | 40.50 | Consult | GST11GY/SIONCG/GBR16 | | |
| 20 | 53068193 | 04/11/2015 16:45 | 04/11/2015 16:45 | 04/11/2015 15:55 | NULL | CheckIn/Reception DR J. Spicer | 37081.Medical Oncology | 0 Completed | 55.08 | Consult | GST11GY/SIONCG/GBR16 | | |
| 21 | 53037881 | 04/11/2015 16:45 | 04/11/2015 16:45 | 04/11/2015 15:50 | NULL | CheckIn/Reception DR J. Spicer | 37081.Medical Oncology | 1 Completed | 11.22 | Consult | GST11GY/SIONCG/GBR16 | | |
| 22 | 52934916 | 04/11/2015 16:45 | 04/11/2015 16:45 | 04/11/2015 15:05 | NULL | CheckIn/Reception DR R. Lal | 37081.Medical Oncology | 1 Completed | 44 | Consult | | | |
| 23 | 53020516 | 04/11/2015 16:45 | 04/11/2015 16:45 | 04/11/2015 15:09 | NULL | CheckIn/Reception DR R. Lal | 37081.Medical Oncology | 1 Completed | 56 | Consult | | | |
| 24 | 53007042 | 04/11/2015 16:45 | 04/11/2015 16:45 | 04/11/2015 14:47 | NULL | CheckIn/Reception DR J. Spicer | 37081.Medical Oncology | 1 Completed | 16 | Consult | | | |
| 25 | 53003495 | 04/11/2015 16:45 | 04/11/2015 16:45 | 04/11/2015 14:37 | NULL | CheckIn/Reception DR R. Lal | 37081.Medical Oncology | 1 Completed | 31 | Consult | | | |
| 26 | 53432261 | 04/11/2015 16:45 | 04/11/2015 16:45 | 04/11/2015 14:26 | NULL | CheckIn/Reception DR R. Lal | 37081.Medical Oncology | 1 Completed | 10 | Consult | | | |
| 27 | 53020017 | 04/11/2015 16:45 | 04/11/2015 16:45 | 04/11/2015 14:04 | NULL | CheckIn/Reception DR R. Lal | 37081.Medical Oncology | 2 Completed | 0841.9 | Consult | GST11GY/SIONCG/GBR16 | | |
| 28 | 52909370 | 04/11/2015 16:45 | 04/11/2015 16:45 | 04/11/2015 14:18 | NULL | CheckIn/Reception DR R. Lal | 37081.Medical Oncology | 3 Completed | 4748.9 | Consult | GST11GY/SIONCG/GBR16 | | |
| 29 | 52368759 | 04/11/2015 16:45 | 04/11/2015 16:45 | 04/11/2015 14:33 | NULL | CheckIn/Reception DR J. Spicer | 37081.Medical Oncology | 1 Completed | 54.17 | Consult | GST11GY/SIONCG/GBR13 | | |
| 30 | 528172943 | 04/11/2015 16:45 | 04/11/2015 16:45 | 04/11/2015 13:58 | NULL | CheckIn/Reception DR J. Spicer | 37081.Medical Oncology | 1 Completed | 04.11 | Consult | GST11GY/SIONCG/GBR17 | | |
| 31 | 52904496 | 04/11/2015 16:45 | 04/11/2015 16:45 | 04/11/2015 14:11 | NULL | CheckIn/Reception DR J. Spicer | 37081.Medical Oncology | 2 Completed | 40.15 | Consult | GST11GY/SIONCG/GBR12 | | |
| 32 | 52844024 | 04/11/2015 16:45 | 04/11/2015 16:45 | 04/11/2015 14:47 | NULL | CheckIn/Reception DR R. Lal | 37081.Medical Oncology | 1 Completed | 38.37 | Consult | GST11GY/SIONCG/GBR09 | | |
| 33 | 52837481 | 04/11/2015 16:45 | 04/11/2015 16:45 | 04/11/2015 14:15 | NULL | CheckIn/Reception DR J. Spicer | 37081.Medical Oncology | 1 Completed | 58.07 | Consult | GST11GY/SIONCG/GBR10 | | |
| 34 | 53067873 | 04/11/2015 16:45 | 04/11/2015 16:45 | 04/11/2015 14:03 | NULL | CheckIn/Reception DR R. Lal | 37081.Medical Oncology | 1 Completed | 05.16 | Consult | GST11GY/SIONCG/GBR17 | | |
| 35 | 52727599 | 04/11/2015 16:45 | 04/11/2015 16:45 | 04/11/2015 13:57 | NULL | CheckIn/Reception DR R. Lal | 37081.Medical Oncology | 1 Completed | 05.35 | Consult | GST11GY/SIONCG/GBR17 | | |
| 36 | 52369101 | 04/11/2015 16:45 | 04/11/2015 16:45 | 04/11/2015 14:24 | NULL | CheckIn/Reception DR J. Spicer | 37081.Medical Oncology | 1 Completed | 22.02 | Consult | GST11GY/SIONCG/GBR11 | | |
| 37 | 52837140 | 04/11/2015 16:45 | 04/11/2015 16:45 | 04/11/2015 13:56 | NULL | CheckIn/Reception DR J. Spicer | 37081.Medical Oncology | 1 Completed | 42.45 | Consult | GST11GY/SIONCG/GBR18 | | |
| 38 | 53003994 | 04/11/2015 16:45 | 04/11/2015 16:45 | 04/11/2015 12:56 | NULL | CheckIn/Reception DR J. Spicer | 37081.Medical Oncology | 1 Completed | 10.57 | Consult | GST11GY/SIONCG/GBR12 | | |
| 39 | 52937799 | 04/11/2015 16:45 | 04/11/2015 16:45 | 04/11/2015 14:09 | NULL | CheckIn/Reception DR J. Spicer | 37081.Medical Oncology | 1 Completed | 59.65 | Consult | GST11GY/SIONCG/GBR18 | | |
| 40 | 52366660 | 04/11/2015 13:00 | 04/11/2015 13:00 | 04/11/2015 13:01 | NULL | CheckIn/Reception DR M. Sandri | 37081.Medical Oncology | 1 Completed | 094.1 | Consult | GST11GY/SIONCG/GBR11 | | |
| 41 | 52366253 | 04/11/2015 12:30 | 04/11/2015 13:00 | 04/11/2015 10:05 | NULL | CheckIn/Reception DR M. Sandri | 37081.Medical Oncology | 1 Completed | 4155.3 | Consult | GST11GY/SIONCG/GBR17 | | |
| 42 | 52688785 | 04/11/2015 12:00 | 04/11/2015 12:00 | 04/11/2015 12:05 | NULL | CheckIn/Reception DR J. Mani | 37081.Medical Oncology | 0 Completed | 03.93 | Consult | GST11GY/SIONCG/GBR18 | | |
| 43 | 53003998 | 04/11/2015 12:00 | 04/11/2015 13:00 | 04/11/2015 11:29 | NULL | CheckIn/Reception DR J. Mani | 37081.Medical Oncology | 1 Completed | 30.07 | Consult | GST11GY/SIONCG/GBR11 | | |
| 44 | 52398954 | 04/11/2015 12:00 | 04/11/2015 12:30 | 04/11/2015 12:16 | NULL | CheckIn/Reception DR M. Sandri | 37081.Medical Oncology | 2 Completed | 54.24 | Consult | GST11GY/SIONCG/GBR17 | | |
| 45 | 52396507 | 04/11/2015 12:00 | 04/11/2015 12:30 | 04/11/2015 11:35 | NULL | CheckIn/Reception DR M. Sandri | 37081.Medical Oncology | 1 Completed | 33.32 | Consult | GST11GY/SIONCG/GBR18 | | |
| 46 | 52353832 | 04/11/2015 11:30 | 04/11/2015 12:00 | 04/11/2015 11:37 | NULL | CheckIn/Reception DR M. Sandri | 37081.Medical Oncology | 1 Completed | 07.42 | Consult | GST11GY/SIONCG/GBR18 | | |
| 47 | 53064136 | 04/11/2015 11:30 | 04/11/2015 12:00 | 04/11/2015 11:31 | NULL | CheckIn/Reception DR J. Mani | 37081.Medical Oncology | 1 Completed | 25.91 | Consult | GST11GY/SIONCG/GBR17 | | |

SmartClinicPlanner | BUROHAPPOLD ENGINEERING
?

SCENARIO

Save Load Reset

Clinic hours: 10 hours

Appointments per day: 150

Booking interval: 15 minutes

Arrival profile >

CLINICS

Low throughput High throughput

Appointment duration (mins): 24, 22, Avg. 22

% Clinic split: 50, 50

Clinic model: Hub and Spoke, Dedicated Clinic

No. clinic rooms: 7, 7

No. clinicians: 8, 7

Advanced parameters >

SIMULATE

ACCEPTANCE CRITERIA

Maximum waiting time: 30 mins

Waiting room capacity: 63 people

Staff hub capacity: 20 people

LEVEL: 5

Hub/Spoke rooms: 7

Dedicated rooms: 7

Waiting: 63

Hub: 20

OUTPUTS

- Patients waiting > 30 mins
- Clinic room utilisation
- Waiting room utilisation
- Hub utilisation
- Clinician utilisation
- Total patient facing time post clinic hours

Appointments per day

SUMMARY

Appointments per day: Min. 150 | 500 Max.

Average waiting time (mins): 0 | 129

Clinic room utilisation (Clinic hours, %): 25 | 59

Waiting room utilisation (Clinic hours, %): 0 | 107

Total patient facing time (Post clinic, mins): 10 | 3020

Clinic over-run (mins): 10 | 492

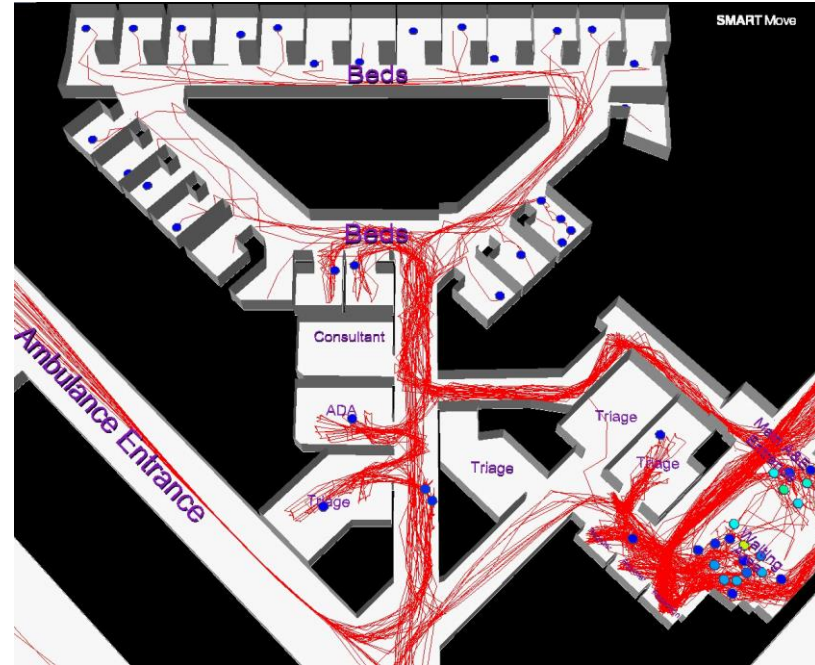
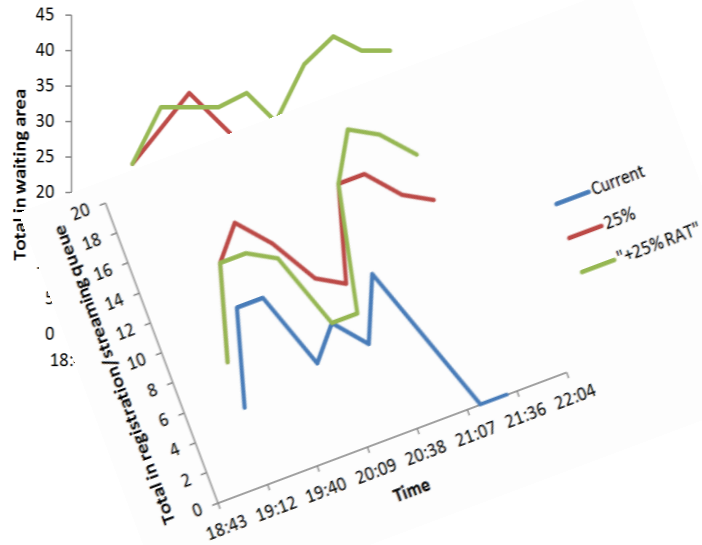
Patients remaining (Post clinic): 1 | 131

Export all graphs

EXPORT (png, pdf, xls)

HOW CAN WE USE IT?

EXAMPLE 3 – EMERGENCY DEPARTMENT

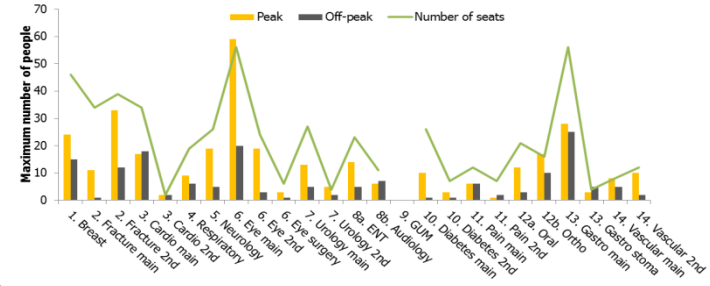


CONCLUSIONS

We need robust **data** to enhance...

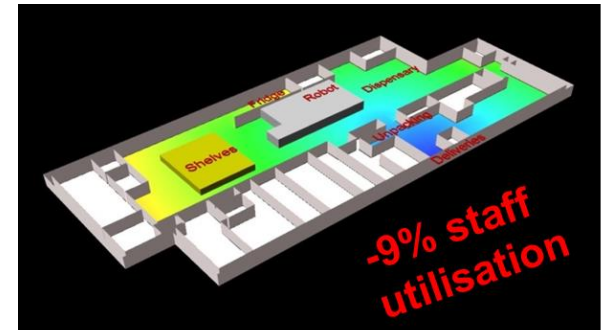


Patient experience & staff wellbeing



Space allocation & utilisation

Design efficiency



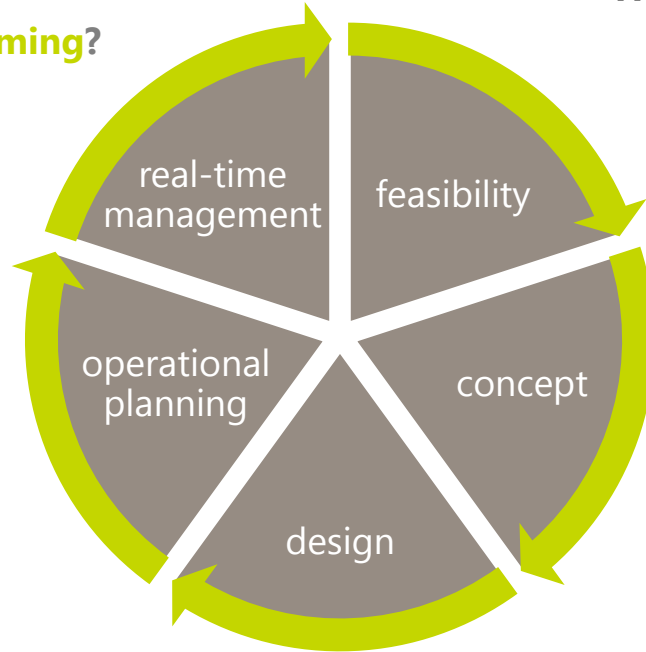
WHAT ARE THE QUESTIONS AND DATA REQUIRED?

How is my hospital **performing**?

- Occupancy vs. capacity
- Waiting times
- Space & resource utilisation

How many **patients** can I see in a day?

- Patient processes
- Booking intervals
- Variation in appointments



How much **site space** is required?

- Attendance statistics
- Population data

How many clinic **rooms** do we need?

- Appointment durations
- Anticipated demand

How **wide** do my corridors need to be?

- Flow rates
- Walking speeds

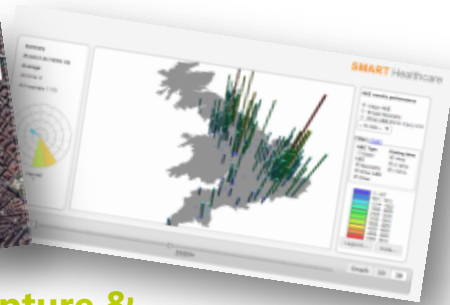
SMART TECHNOLOGIES



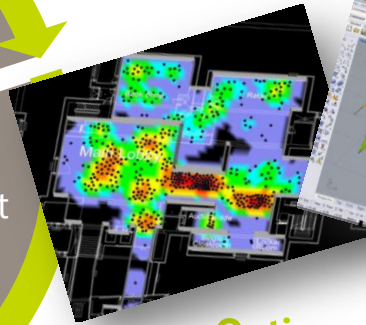
Live Dashboards



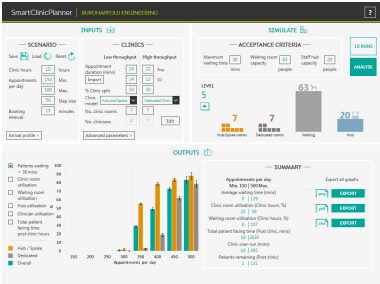
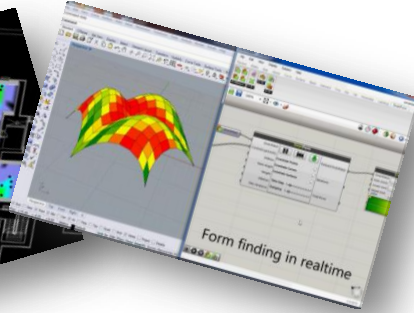
Data capture & visualisation tools



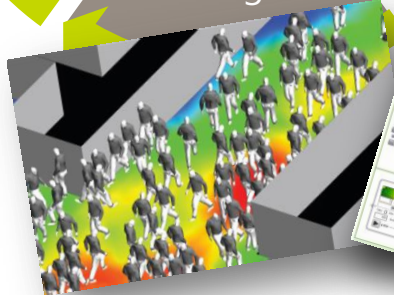
Sensing / tracking tools



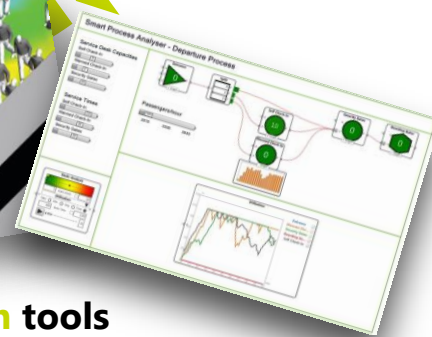
Optioneering tools



Planning tools

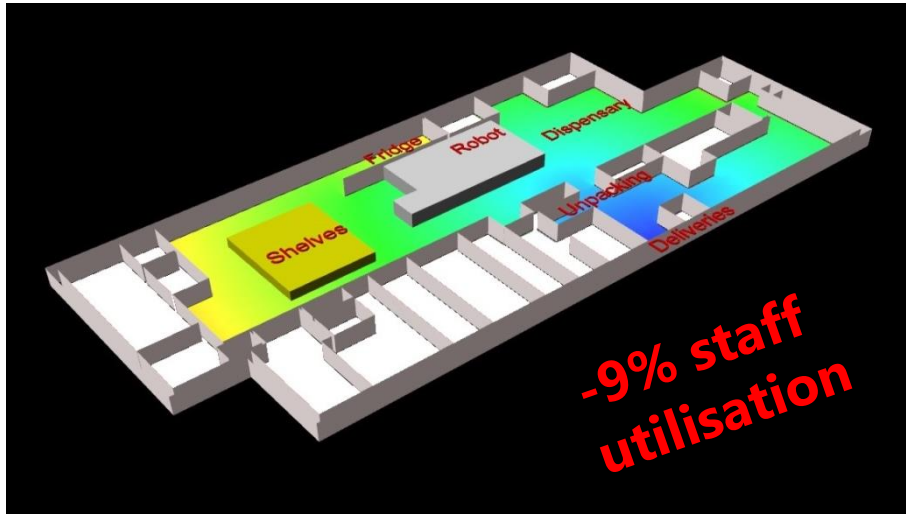


Simulation tools

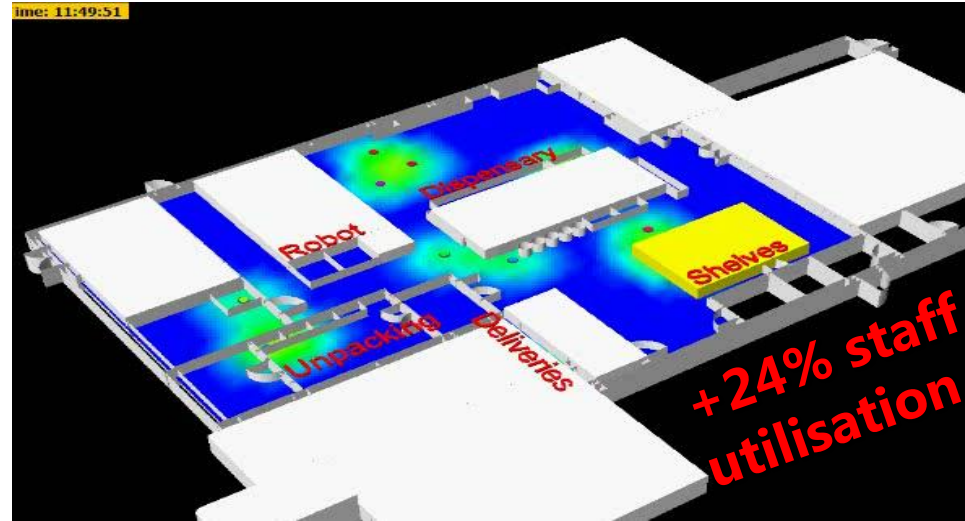


CONCLUSIONS

Avoid this...



Attain this...



Gather the **evidence**

Use the **data**

Perform better

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