RemoteHVAC

Deliverable: **Case Studies**

Subject: WP5 - Deliverable no.2: Case studies on findings from test buildings

Prepared by: Tony O'Keeffe

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RemoteHVAC

Fault Detection and Diagnosis

CASE STUDY

60% reduction in energy use

Automated Fault Detection and Diagnosis

This case study looks at how a **Temperature Set-point Hunting** fault caused a **60% increase** in an AHU's daily energy consumption.

Hunting faults are very difficult to find using traditional practices and can go undetected indefinitely, resulting in high costs throughout the equipment lifetime. Automated Fault Detection and Diagnosis (FDD) is a low cost and highly effective method of continuous performance monitoring in HVAC systems.

National Retailer

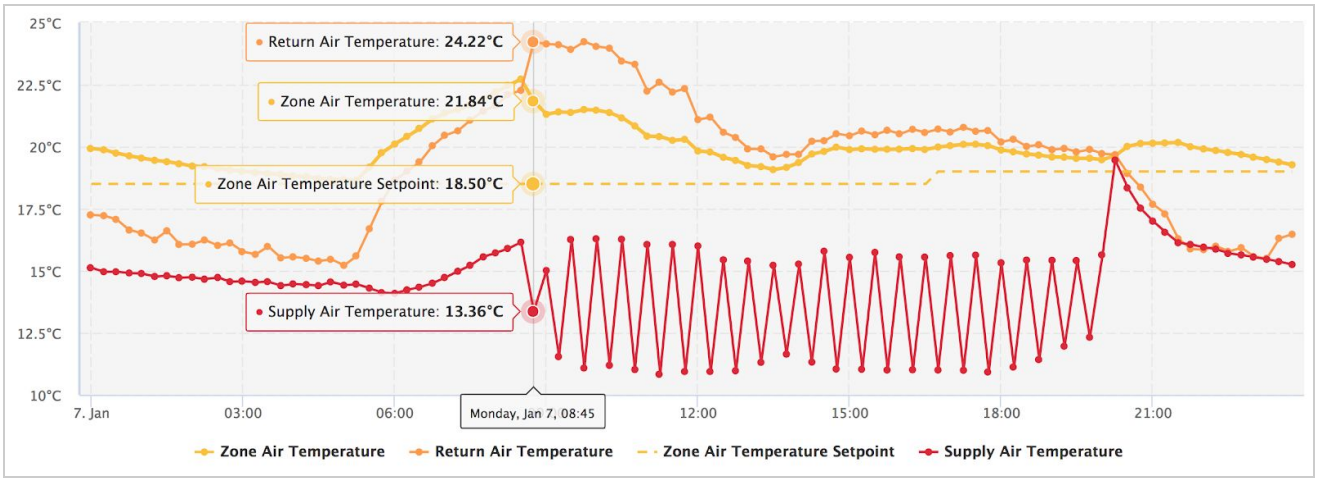
Our client is a large retailer providing fashion and grocery products to the Irish market. They operate an estate of over 100 stores throughout Ireland.

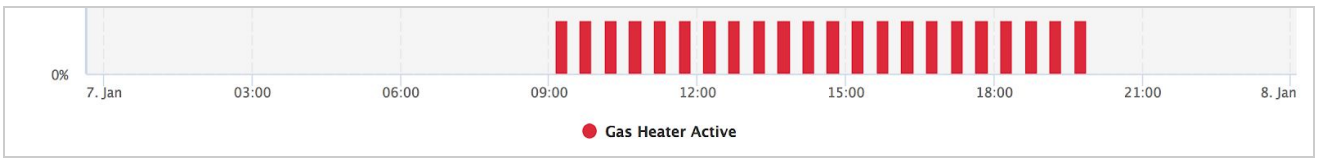
Facility Management Challenges

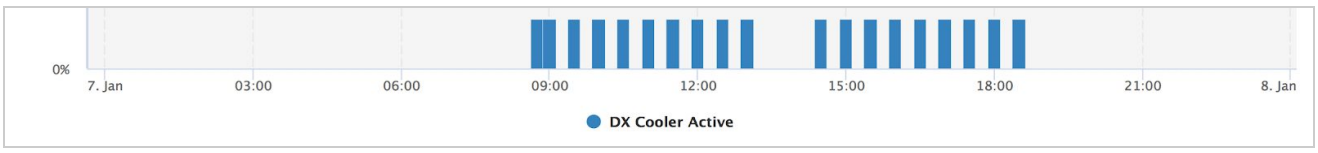
Management of large buildings or estates is challenging, especially when faced with growing demands for reduced energy consumption and carbon emissions. There is also an increasing awareness around the importance of comfortable and healthy indoor environments. Therefore the Heating, Ventilation and Air-conditioning (HVAC) equipment tasked with delivering these conditions must operate efficiently and effectively at all times. This is not easily achieved or even monitored when Facility Managers are relying on traditional methods and resources.

Problem: Hunting Fault

Hunting is described as...*"A control state where the system does not settle to a steady value but oscillates about the set point"* [1]. The charts below display the AHU data which is used to automatically detect a Hunting fault.







[1] CIBSE Guide H - Building Control Systems

Solution: RemoteHVAC Building and Asset Analysis

Automated Fault Detection and Diagnosis, along with other data analysis techniques, provide a low cost and technically feasible means of reducing building operation costs, such as HVAC energy consumption levels, maintenance costs and the life expectancy of equipment. These benefits are achieved while still maintaining indoor comfort conditions and air-quality.

Building data analysis is aimed at achieving early detection of problems and accurate diagnosis of where faults have occurred to support efficient repair, leading to reduced energy waste, less equipment downtime, less impact to occupants and lower maintenance costs.

Benefit: Operating Cost reduction and Increase in Occupant Comfort

The fault causes the Air Handling Unit to become ineffective and it results in unnecessary energy use and significant wear and tear to components as they cycle on and off.

- **Energy Impact:** The estimated daily energy waste in gas and electricity costs was €25. When extrapolating over the 10-year life of an AHU, the estimated excess cost of this fault would be €42,500.

- **Component Impact:** Intensive component wear and tear due to rapid cycling between heating and cooling modes of operation results in severely shortened lifespan for the DX Cooling Compressor and Gas Burner.

- **Comfort Impact:** A draughts effect can be created as the AHU supply air temperature rapidly moves from warm to cold, as it hunts for equilibrium.

Contact Us:

+353 (0)21 212 9993

info@remotehvac.com

www.remotehvac.com

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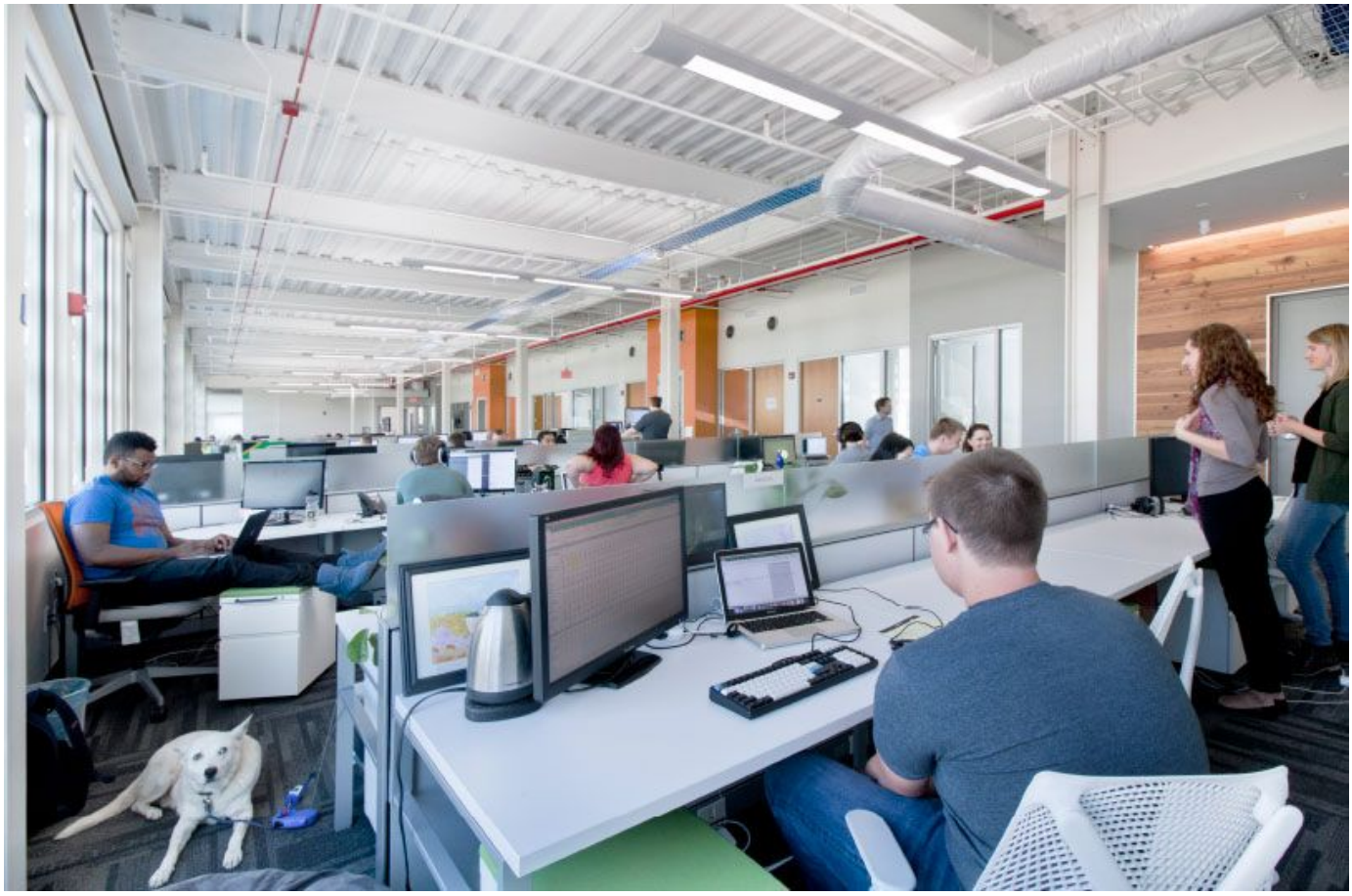
Comfort & Air-quality Monitoring

CASE STUDY



50% decrease in building wide comfort complaints

Comfort and Air-quality Monitoring

This case study looks at how **performance tracking** of indoor environments can support management and maintenance of **comfort and air-quality** levels, supporting occupant satisfaction and productivity.

National Utility Provider

Our client manages a large estate of office buildings located in urban settings throughout Ireland.

Facility Management Challenges

The most fundamental purpose of a building is to provide comfort for occupants. Yet, comfort is rarely a metric by which building performance is measured, tracked and benchmarked. Instead, comfort levels are often gauged by the number and concentration of complaints. The traditional wait and react approach is costly, unnecessary and it frustrates occupants. It can also lead to inefficient, short-term fixes as the operations and maintenance teams scramble to resolve issues.

Indoor environmental conditions such as; comfort, air-quality, lighting and noise levels, are a keystone of building performance and they impact the health, well-being and productivity of building occupants. You no longer have to wait for issues to come to you.

Comfort Monitoring

Performance monitoring and analytics on your indoor environmental conditions can keep you and your team fully informed if issues arise. It can help you to proactively identify and address problems before occupants are even aware.

Client Problem

Our client organisation has a large open plan office on the ground floor of a multi-floor office block in Dublin City centre which was the focus of ongoing comfort investigations.

- The Facility Team was dealing with ongoing and long running issues regarding occupant comfort in the zone. Substantial time and resources were being consumed responding to and investigating issues, without finding a conclusive problem.
- Heating and Cooling was provided by a VRF Air-conditioning system and access to zone temperature data was limited through the system interface, which made investigation more challenging.

Client Requirement

The Facility Team needed reliable data and insight to support their investigations and track the comfort levels in the zone in order to find a long term solution to the problem.

RemoteHVAC Solution

RemoteHVAC tackled this problem in two ways:

- Firstly; they connected to the VRF Air-conditioning system, which was tasked with providing heating and cooling for each floor. The HVAC data was analysed to ensure that the equipment was operating correctly and as required.
- Secondly, RemoteHVAC installed multiple wireless Temperature and Humidity sensors throughout the zone to independently and accurately measure zone conditions. The zone data was analysed as a performance indicator to support the Facility Team to track zone conditions.

Benefits

1. Ruled Out Temperature:

   Analysis of the temperature data from the office demonstrated that thermal comfort was not a problem. The space temperature was within the desired band 21°C top 23°C at all times.
2. Ruled Out HVAC Equipment:

   Analysis of the Air-conditioning system demonstrated that they were operating and controlling correctly. Therefore the problem lay elsewhere.
3. Enabled Further Investigation:

Having ruled out temperature and faulty equipment as issues, the Facility Team discovered that the root problem was related to a draught effect caused by one of two access routes between the Ground Floor office and the main lobby. By closing off one access route they were able to resolve the draught effect.

4. Reduction in Comfort Complaints:

   There was a **100% reductio**n in comfort complaints on the Ground Floor Office and a **50% drop** in comfort complaints for the entire building.

The Benefits of Building Analysis

Automated building data analysis techniques, provide a low cost and technically feasible means of reducing building operation costs.

We provide the hard data and insightful analytics that supports critical business decisions. We help identify waste, such as underutilised space, faulty equipment, over conditioning and unnecessary heating and lighting . We tie occupancy levels to energy, comfort and equipment data to provide deep insights on whole building performance, that will drive new levels of efficiency and sustainability.

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info@remotehvac.com
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Energy & Equipment Monitoring

CASE STUDY

25MWh reduction in out-of-hours energy use

Energy and Equipment Monitoring

This case study looks at how **Fault Detection and Energy Monitoring** identified significant wasteful out-of-hours energy use, leading to reduced energy bills and carbon emissions.

City Centre Office

Our client manages a large high profile office building located in Dublin's IFSC.

Energy Management Challenges

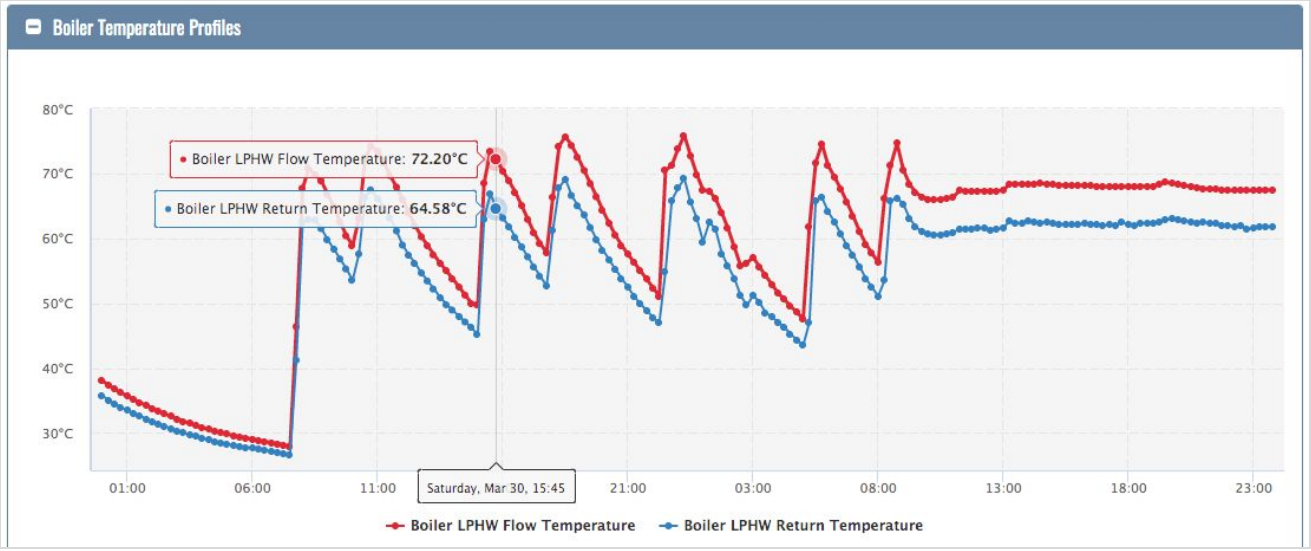
Energy Managers use a combination of threshold alarms from their Monitoring and Targeting software to alert them of excess energy consumption. However, these thresholds have to be set at a level that does not create false alarms, this is challenging. Even when you do find a problem, identifying the offending piece of equipment can be tricky if the energy meters monitors multiple loads. However, when equipment data is combined with energy data it becomes much easier to separate normal energy consumption with energy saving opportunities.

Problem: Out-of-Hours Boiler Operation Fault

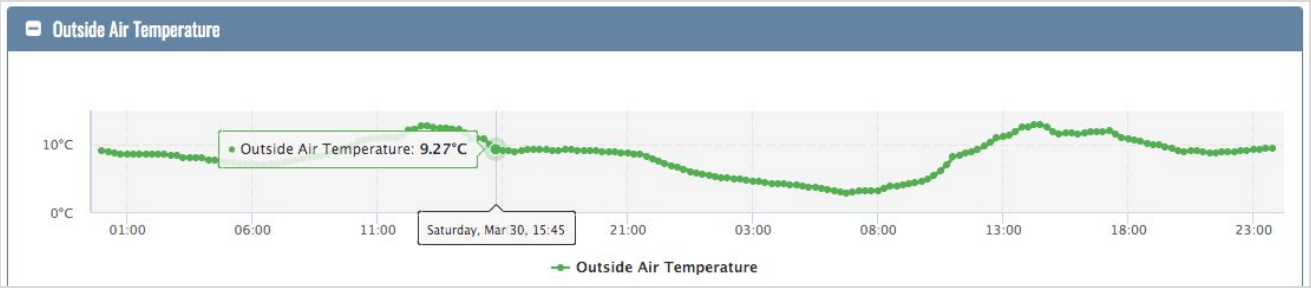
Unnecessary out-of-hours equipment operation is a 'low hanging fruit' opportunity, but finding it is the hard part. For example, Boiler plant can start at any time of day or night if frost protection is required, and alarm thresholds must cater for this. However, this threshold can also mask faults, as what happened with our client site and will be discussed here.

Solution:

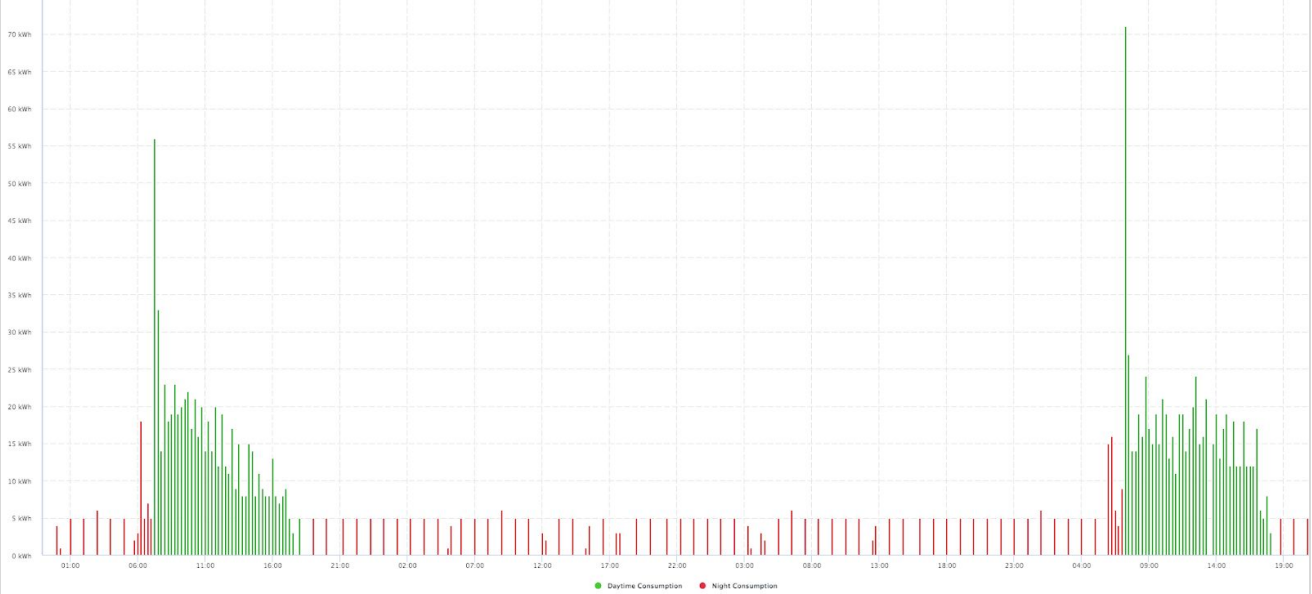
Automated fault analysis of the Boiler plant operation demonstrated activity at night and during weekends, when there was no demand for heat or risk of frost, see charts below.



Outside air temperatures were well above freezing, ruling out frost protection activity see below.



Despite gas consumption at night and weekends, no alarm was produced by the Energy Monitoring software as the level of consumption was below the alarm threshold, see below. The chart below shows gas use from Friday through to Monday. The red bars indicate out-of-hours gas consumption.



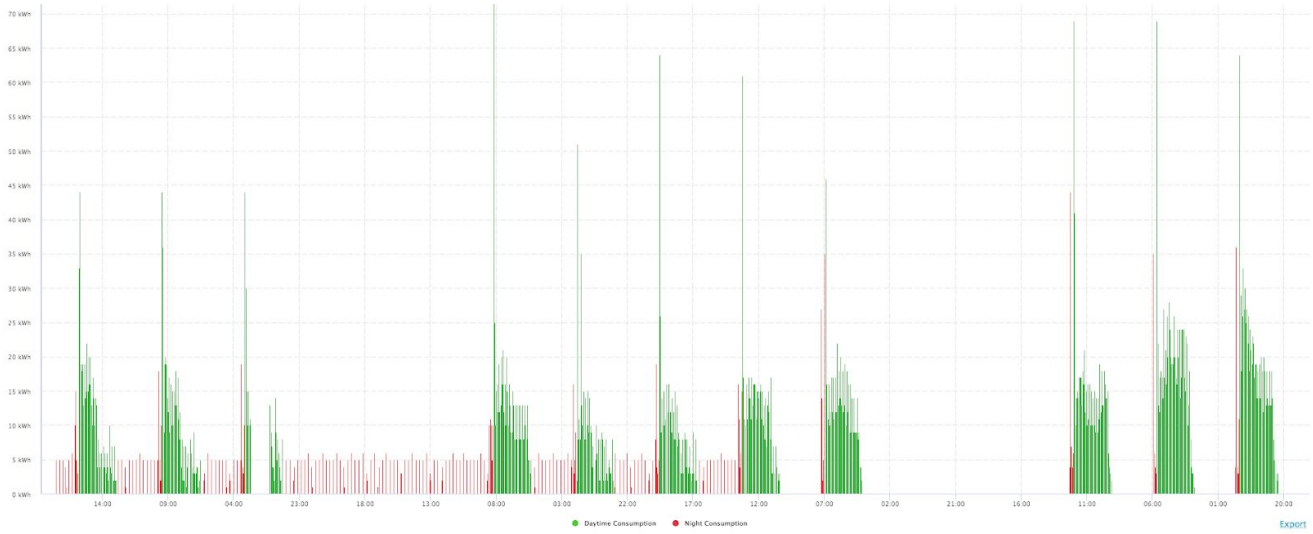
Diagnosing the Fault

Automated data analysis can combine boiler data, weather data and gas consumption data to produce a very clear diagnosis of the fault. It identifies that the activiry is in approporaite as well as accuratelky measuring the energy cost using gas meter data.

Energy Savings

Energy data is very often used as the red flag alert to indicate a problem exists within a building or facility. However, when energy data is coupled with other data sources the level of analysis and insight can be dramatically increased.

- **Energy Impact:** The estimated energy waste in gas consumption was approximately **25 MWh per year**. When extrapolating over the 15-year lease period for the building, the estimated excess cost of this fault would be **€18,750**.
- The chart below demonstrates the immediate drop off in out-of-hours gas consumption when the boiler fault is resolved.



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Space & Occupancy Monitoring

CASE STUDY

20 Desk increase, no additional rent & rates!

Space and Occupancy Monitoring

This case study looks at how **occupancy data and space utilisation data** can help organisations to increase their productive space without increasing their rent and rates.

National Utility Provider

Our client manages a large estate of office buildings located in urban settings throughout Ireland.

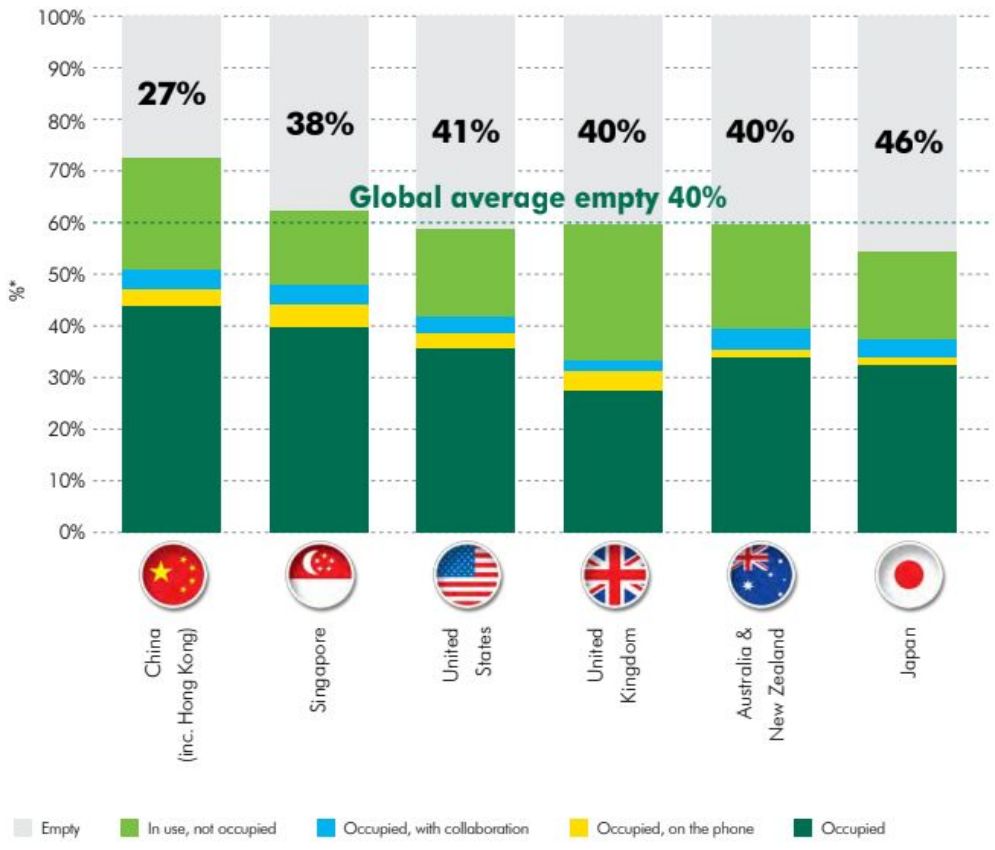
Space Management Challenges

High quality, efficient and well located commercial buildings are in short supply, expensive to acquire and expensive to operate. Hand in hand with this, the way we work has fundamentally changed. Flexibility and mobility of staff has become crucial to business success as well as being an expected benefit for employees.

As organisations introduce agile practices and remote working, it becomes extremely difficult to identify the current and future requirements for space and how to organise these spaces to adequately support the flexibility, collaboration and productivity that is needed for business success. Without reliable data you have no insight, decisions become best guesstimates and in general people will overcompensate to manage risk...resulting in waste!

A recent CBRE suggests that globally office buildings are on average **40% empty**, see below.

Figure 3: Space Utilisation by Country



Space Monitoring

Space and occupancy offers two major areas of efficiency improvement; future capacity planning and optimising the layout of existing space. Both require reliable data about the movement of people in and out and throughout a building.

Occupancy counting and utilisation levels provide the critical information needed to support planning and decision making. This case study demonstrates how we helped a client to increase their productive spaces (desk space) better matching the number and size of meeting rooms to their needs.

A recent CBRE report showed that most organisations build larger meeting rooms than is required. Most meetings are small in size, 2 to 3 people. Changing meeting room size to best suit your needs creates a huge efficiency opportunity.

We can capture the data and provide the analysis to achieve space efficiency improvements.

Problem

- The client suspected that many of their meeting rooms were being left idle, due to 'no show' bookings.
- Large meeting rooms were being used for micro-meetings (2 people or less), when more appropriate sized spaces could suffice.
- Hand in hand with this, they had a shortage of desk space to accommodate their growing workforce.
- They needed a way to correlate meeting room use with booking information and they needed to capture how many people were attending meetings so that they could better utilise all floor space available to them.

Solution

- RemoteHVAC installed people counting sensors on all meeting room. This data was able to identify when meetings occurred and how many were in attendance.
- The results showed that meeting room use correlated very closely to the CBRE Report findings in relation to waste (missed bookings and over-sized meeting rooms).
- The organisation was able to reconfigure the layout of their floor space; they reduced the size and number of meeting rooms to match their needs, they increased the space available for desks and they provided breakout space for micro-meetings.

Cost Savings

Rent and rates are an unavoidable cost, however if you can increase your occupancy capacity without increasing these rates...you are achieving a measurable financial gain.

Avoided costs:

- Rent and rates in Dublin City are estimated at **€50 per square foot per year**.
- Average space density (Europe / United States) is 150 to 200 square foot per desk.
- Therefore 20 desks require approximately 3,000 square foot of building space.
- Annual cost to acquire this amount of space equates to **€150,000 per year**.

The Benefits of Building Analysis

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