

Case Study //

222 Exhibition Street, Melbourne

An industry-first predictive maintenance (PdM) regime has reduced asset failure, improved tenant comfort and delivered significant energy savings within a 28-year old commercial office building in the heart of Melbourne's theatre district.

Project Summary

Reduction in Energy Consumption:	11.5%
Improvement in NABERS Rating:	4 stars
Reduction in Temperature Complaints:	68%

Predictive maintenance improves the effectiveness of maintenance by evaluating the condition of the HVAC plant through periodic and continuous condition monitoring in order to direct maintenance activities, ensuring the building's HVAC achieves peak performance on a continual basis.

Built in the late 1980s, the 29-storey post-modern tower at 222 Exhibition Street in Melbourne's CBD was designed by architects Denton Corker Marshall who won the Royal Australian Institute of Architects (RAIA) Merit Award following its completion in 1989.

Offering over 30,000m² NLA (net lettable area) and basement car park accommodating more than 500 vehicles, the majority of the building is tenanted by WorkSafe Victoria.

After being purchased by LaSalle Investment Management in 2015, Knight Frank was appointed as facility manager and given the task of improving the building's systems and performance.

Knight Frank awarded Airmaster and partner analytics provider BUENO the opportunity to implement an industry-first predictive maintenance program across the building in mid-2016.

Although analytics, condition monitoring, controls and mechanical services have been utilised in commercial buildings before, until now they had never been operationally integrated in a commercial office building prior to the implementation at 222 Exhibition Street.

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The challenge was to make mechanical services and controls maintenance more effective in order to reduce asset failure, increase tenant comfort, increase equipment uptime and provide energy savings ”

- **Matthew Graham**, Senior Facilities Manager at Knight Frank.

By mid-2017, despite a 13% increase in occupancy rate, electrical energy consumption had fallen by 11.5% and tenant comfort complaints reduced by 68%.

This has been achieved solely through the predictive maintenance program – no upgrades, BMS strategy changes or capital works have been undertaken.

Predicting failures

In contrast to traditional maintenance
- where an asset and/or component is attended to on a scheduled-calendar basis
- predictive maintenance is designed to provide maintenance to assets and associated components at the most cost-effective point in time while maintaining reliability and ensuring peak performance.

This requires the ability to identify the potential of an asset or component to fail by using an analytics platform. By analysing the large amounts of data generated by the BMS, the platform continually identifies faults and inefficiencies in the operation and condition of the buildings HVAC.

Airmaster and BUENO are then able to direct technicians via Bonfire & Airmaster MobileTEC notifications to diagnose and manage repairs proactively. Facility Manager's are also notified of the event, but are not required to intervene.

Some of the issues identified by BUENO's analytics platform included faulty VAV

damper-actuators, AHU air volume damper/actuators, temperature sensors, differential pressure sensors and associated pitot tubes, and supply air static pressure anomalies.

“There has been fewer complaints from tenants, and any potential issues for tenants are intercepted and resolved proactively,” said Graham.

“Comparing the statistics on call rates to the Knight Frank facility response centre since the predictive regime was put in place to the same period the year before shows, that temperature and airflow related complaints have fallen by 68% – from 71 work orders to 23 - resulting in a cost avoidance of \$16,742.”

For the occupants of 222 Exhibition St, the implementation of predictive maintenance has ensured that comfortable conditions are continually achieved; making the building's leased space more attractive.

Vibration Analysis

The use of vibration analysis is vitally important to the predictive maintenance program. Vibration analysis continually measures the condition of various rotating equipment.

Airmaster and BUENO have used the results of vibration analysis data to create a workflow display that further streamlines and reports on issues and outcomes.



Figure 1: Vibration Analysis Data Platform

Among the problems identified through condition monitoring included motor bearing outer race fluting, pulley misalignment, a buildup of matter on fan impellers affecting balance and efficiency, low grease levels on bearings, and the condition level of pump impellers.

“Having vibration analysis data at our disposal in order to pin-point faults efficiently allows us to make precise decisions when recommending repairs and directing maintenance personal efficiently, often avoiding labour intensive disassembly and inspection,” said Sean O’Shaughnessy, Account Manager for Airmaster.

In one example, high levels of vibration were measured on the AHU 5 fan shaft bearing. By identifying that the vibration was a result of a build-up of matter on the fan impeller, the impeller was pressure cleaned and excessive vibration eliminated, avoiding labour-intensive disassembly & inspection along with the potential need to replace the bearings and perform a dynamic balance.

The reduction in vibration is displayed in Figure 2.

In another example, the program predicted the failure of a 75 kW supply air fan motor, in turn avoiding the large cost of repair.

“Using a real-world example from another building demonstrates that had predictive maintenance not been in operation, repair costs would have been up to \$32,000, with the works resulting in ten days of equipment downtime,” said Graham. “Instead, repairs were undertaken at a cost of just \$2,374. No downtime was encountered, and tenants were not affected by the maintenance activities.”

Pre Fan impeller cleaning overall velocity readings 10.5.17.	Post Fan Impeller Cleaning overall velocity readings 2.8.17.
Fan DE vertical: 3.3mm/s RMS	Fan DE vertical: 3.1mm/s RMS
Fan NDE vertical: 3.9mm/s RMS	Fan NDE vertical: 2.9mm/s RMS
Fault Condition Rating: *** Severe	Fault Condition Rating: OK ; no problems are indicated.
Potential cost of total failure \$ 8,000 and ten days downtime Without V.A insights the cost to replace bearings and dynamic balance \$ 4,500 and three days downtime would have been realised	With V.A data we could confidently undertake these repairs that cost \$ 1,100 and resulted in no equipment downtime.

Figure 2: Excerpt from May & August Vibration Analysis report

Streamlining Maintenance through Bonfire

The BUENO Bonfire platform facilitates the prompt and free-flowing resolution of issues by broadcasting and tracking progress of all issues from discovery through to resolution.

Bonfire allows multiple stakeholders to provide input into any issue and collaborate to solve problems. Any team member is able to log in and check the progress of an issue or communicate to resolve with others in the team.

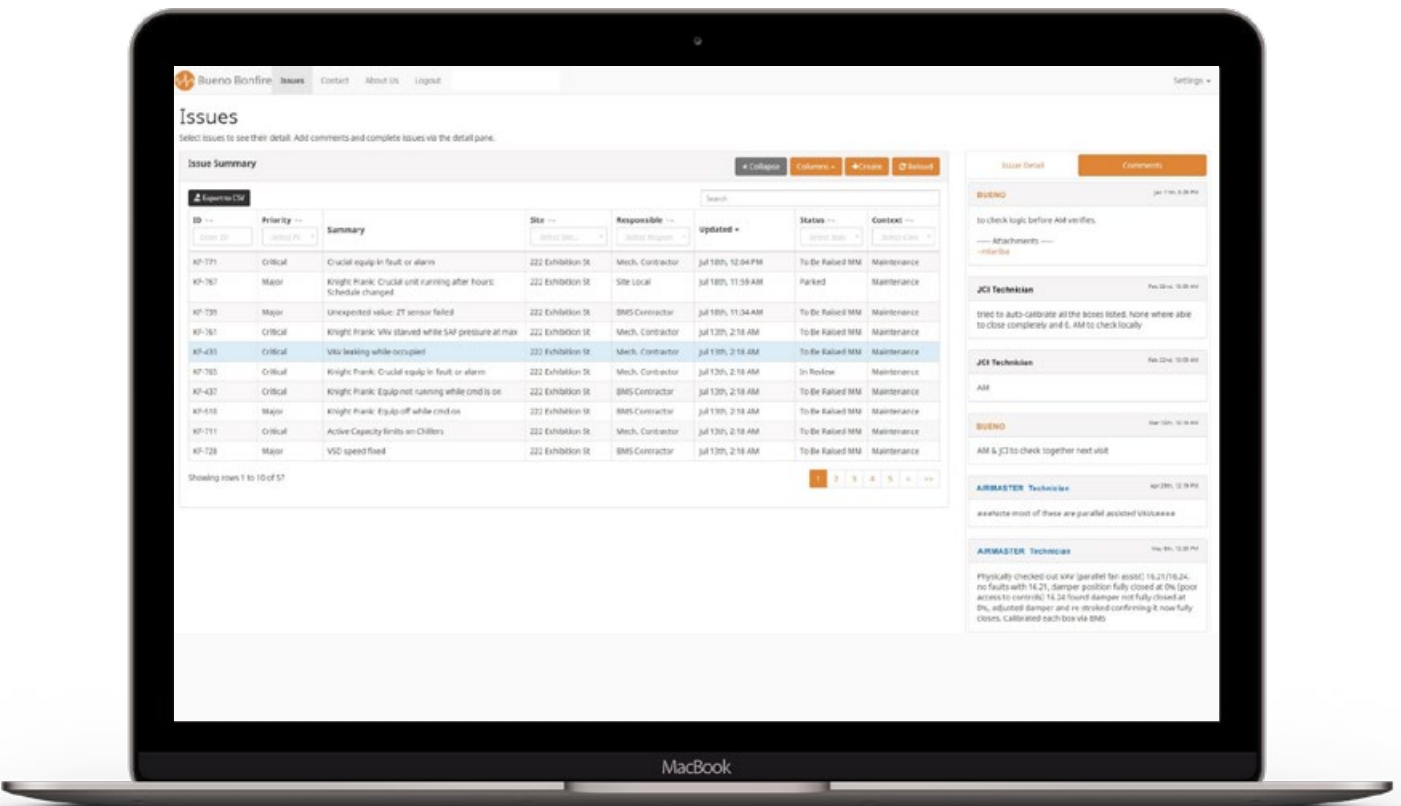


Figure 3: Bonfire Workflow Platform

To measure the effectiveness and in order to proactively adjust the maintenance program accordingly, tenant comfort, along with energy use, water use and condition monitoring data is displayed live using the BUENO dashboard.

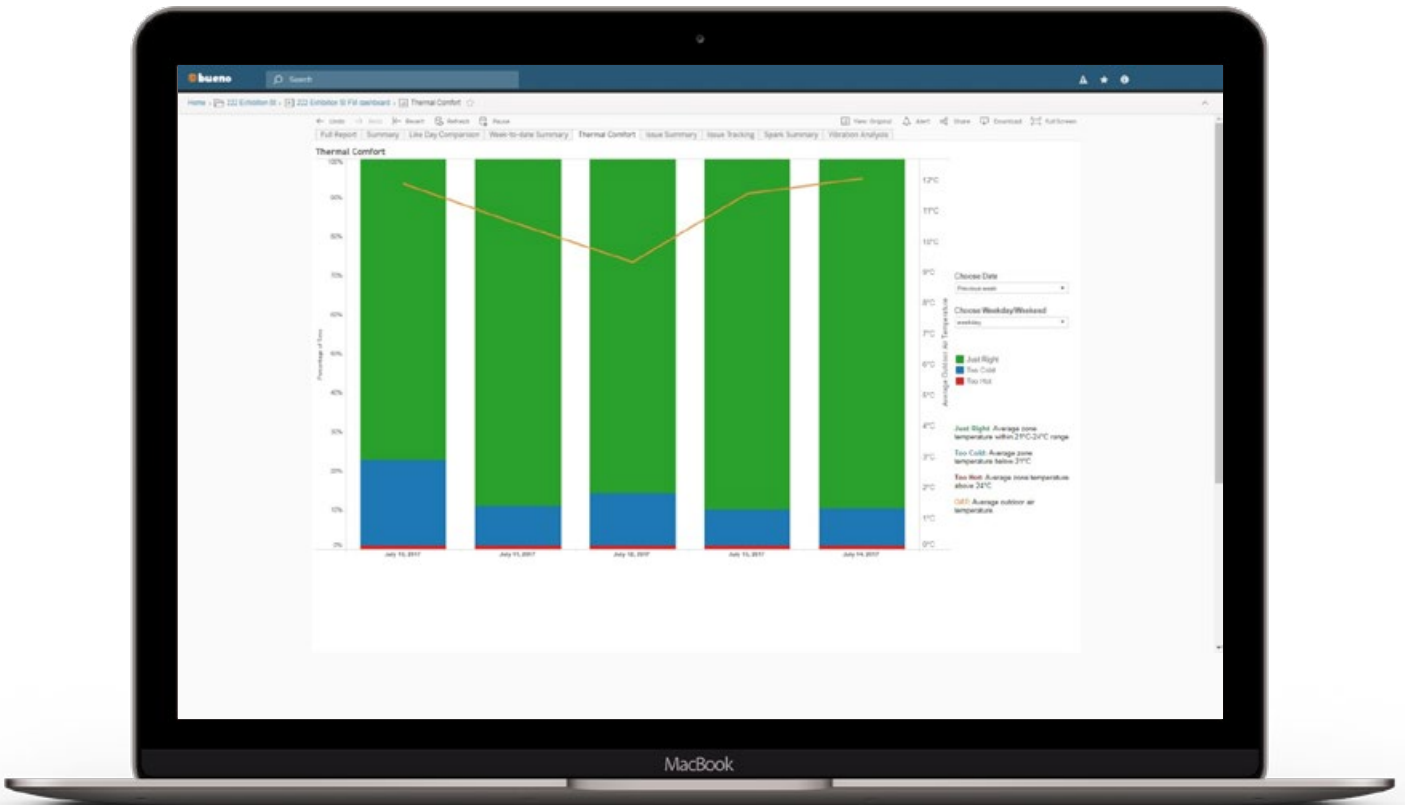


Figure 4: Thermal Comfort Tracking

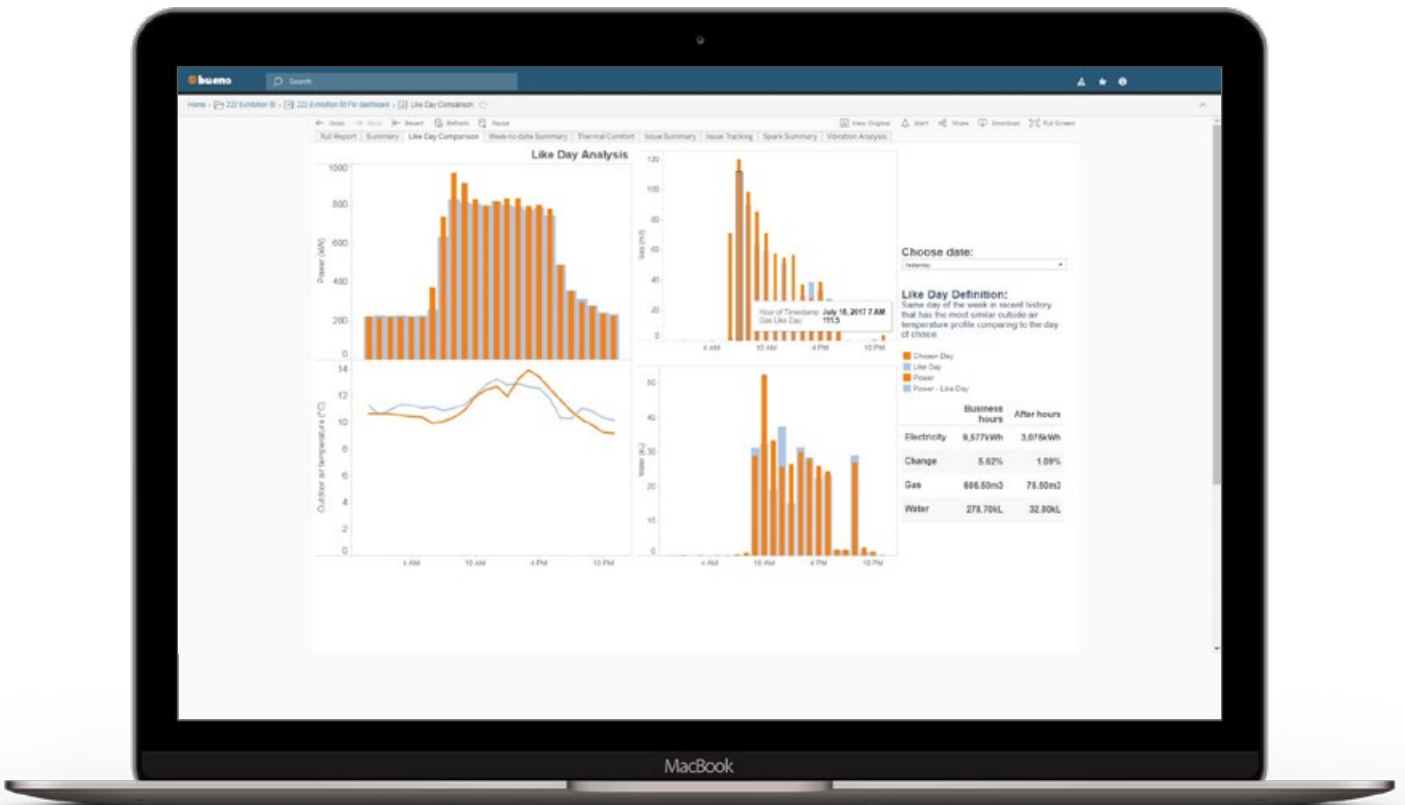


Figure 5: Energy like day analysis dashboard.

Tangible savings

Since the implementation of the predictive maintenance program in September 2016, electrical energy consumption has fallen by 15.5% on the previous year. This has been achieved despite a 13% increase in occupancy.

Even after regression modeling has been used to correct the figures for weather, the saving is still 11.5%, or 260,141kWh.

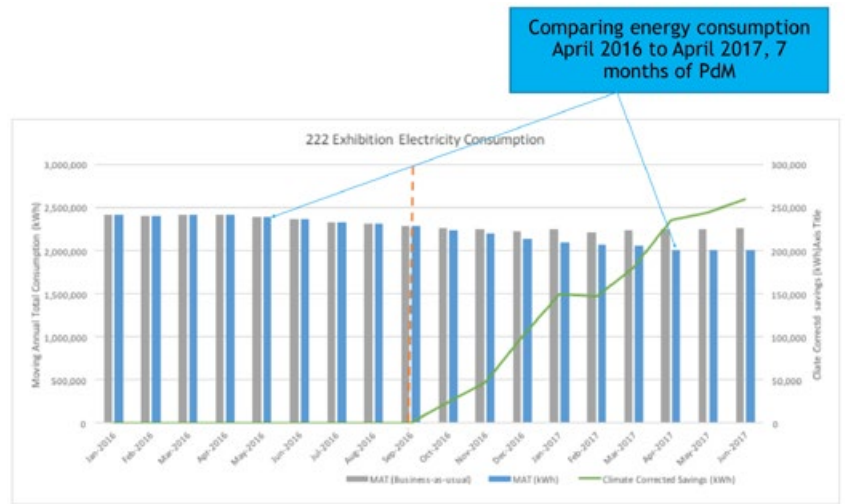


Figure 5: Energy like day analysis dashboard.

These savings can be attributed to a number of issues being identified and resolved including faulty temperature sensors generating false heating and cooling calls and broken or out of calibration Variable Air Volume dampers leading to excess or restricted flow causing upstream fans to ramp up. After-hours operation of AHUs was also addressed, which eliminated fan energy waste and reduced chiller, boilers, and associated pumps, being called on after-hours.

The property's NABERS Energy rating has also improved from 3.5 stars in 2015 to 4 stars.

Subsequent to the success achieved at 222 Exhibition Street, Airmaster will now look to offer predictive and data-driven maintenance as a highly recommended option to their clients.

"The use of data that is readily available within a building to develop entirely new ways of providing service and maintenance will disrupt the building services industry in unprecedented ways," said Noel Courtney, CEO of Airmaster Australia.

"With sophisticated data analytics and corresponding processes that streamline maintenance and reactive service calls, a new hybrid service option has been created. Optimisation techniques generated through the analytics process just add to the overall value proposition. This creates higher value services for our customers."

About Us //

Optimum Air is a technical solutions company, delivering end-to-end management of heating, ventilation, air conditioning, industrial and process cooling and building automation across New Zealand. Founded by Airmaster Australia, one of Australia's leading HVAC service solutions companies, Optimum Air draws upon the vast industry experience to deliver Airmaster's range of award-winning services and solutions to the New Zealand market.

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