

# Modular buildings in the time of Covid-19

By Graham Martin

**T**he coronavirus crisis has brought profound change across the globe. The sheer scale of the pandemic puts enormous stress on healthcare systems everywhere. Medical facilities, from hospitals to care homes and housing for vulnerable people – all are focussed on limiting the spread and human impact of Covid-19.

This crisis has developed very quickly, and, for many the response has been fast. China built two new hospitals in a matter of days. India and other countries are converting private hospitals to coronavirus-only facilities. And in the UK, new “Nightingale” hospitals are set to add thousands of beds in former exhibition centres in London and other regional centres.

Alongside these major hospitals, many smaller facilities are joining the battle against Covid-19. Examples include pods being built for the new coronavirus ward at Wigan Infirmary, providing 52 new beds for patients, 28 of them dedicated to critical care beds. A 20-bed isolation ward for Royal Surrey County Hospital is planned to be fully completed and ready to accept patients within just eight weeks. Wards for more than 150 new beds are being built in Shropshire for delivery to three NHS trusts in England in the North West, Midlands and Home Counties. The whole process is expected to take around nine to 10 weeks. And temporary mortuaries, such as the one being built in the London Borough of Newham, will relieve the stress on hospitals by acting as a holding point before burial or cremation can take place. As well as these facilities, there are many more smaller requirements such as assessment, screening and outpatient test.



Modular construction.

## Factory-built to hospital requirements

Modular construction is the key to meeting health services' diverse needs. For example, factory-built techniques can deliver a single ward in 16 weeks, while an individual operating theatre can be supplied in just ten. These modular buildings are typically custom-made so that they meet the health authority's exact space and budget requirements. Off-site construction means individual modules come delivered ready to install. Disruption to everyday running of the hospital is kept to a minimum, keeping it more convenient for all involved.

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The bespoke design of modular buildings is perfect for hospitals looking to create new wards and theatres with a designated use. Electrical requirements, from power and lighting to secure networking communications, are typically installed off-site in the form of modular power cabling and wireless battery-free controls. Already proven in commercial electrical and industrial installations, structured cabling and modular wiring ensure that electrical installations are undertaken efficiently and in the least possible time. With the situation constantly changing, such ready-made installations are highly adaptable and offer a high degree of flexibility.



A hospital intensive care ward.

Experience from industrial and commercial building shows that traditional fixed installations are labour intensive, offer little in flexibility and remain costly. In contrast, modular wiring and flat-cable-connected systems, prefabricated off-site and coupled to wireless controllers and sensors, enable a complete installation to be implemented fast and at low cost.

These technologies and processes have been proven in commercial premises and homes. By using computer design and modelling, total modular wiring design can be provided, with all the power cabling pre-wired in the ceiling or wall space. The installation process for energy harvesting wireless devices makes it a simple process as switch drops and associated conduit drops are not required.

There is no need to coordinate the switch position with the studwork and less time is spent during electrical first fix feeding cables through a closed wall. Reducing the level of interfaces and task dependencies between trades on-site ensures lower disruption: less for disease transmission.

Energy harvesting wireless sensors, switches and controls can be placed anywhere in the building, even at places that are difficult to access. Installed once, there are no requirements for maintaining the devices, for example to change dead batteries. Thanks to the energy harvesting principle, the switches and sensors are powered solely by their surrounding environment. It also allows the system to be expanded any time.

## Automation built-in

The combination of innovative product technology and good design puts the focus back on safety, security, as well as the needs of patients, care-workers, clinicians and auxiliary staff.

A common requirement is to place lighting switches and dimmers where they are most convenient. Powered by the kinetic energy harvested from the switch operation itself, these can be placed anywhere. They don't need to be wired-in, instead sending a wireless signal to the receiver in or near the light or DIN rail fitting.



A wall-mount self-powered double switch.

Energy harvesting technology also enables other applications based on solar-powered sensors. For example, self-powered occupancy sensors can link wirelessly to intruder alarms; in addition, they can switch the lighting and heating off when nobody is around. Similar capabilities are available by equipping windows with contact sensors powered by light. Safety and security can also be extended, for example using light-powered CO<sub>2</sub> sensors or flood detection with solar-powered or kinetic sensors. Another energy source is temperature differences between heating radiators and their environment. This kind of energy harvesting for example enables self-powered heating valves to communicate wirelessly with a room thermostat or a smart home box for heating control according to the specific situation.

The EnOcean energy harvesting wireless technology is already proven in around 1,000,000 buildings worldwide, from factories to offices and multi-occupancy buildings as well as healthcare facilities. The technology has been successfully installed in modular homes across Europe, North America and Asia for more than a decade. Across the board, it performs flawlessly and has demonstrated excellent reliability, resilience and security. As well as new builds, it is ideal for the retrofits required as medical facilities respond to the ever-changing coronavirus situation.

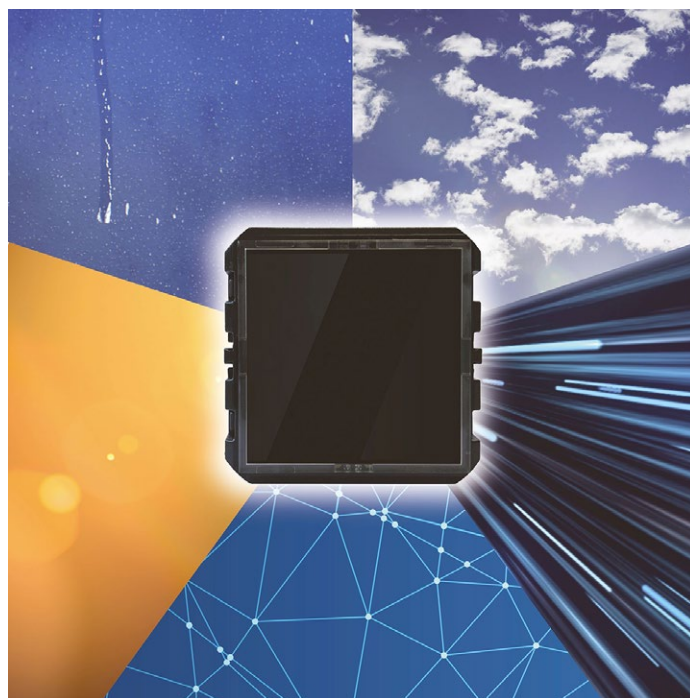
Most energy harvesting sensors, switches and other self-powered devices communicate over distances of up to 30 metres in buildings, with short encrypted messages sent via the international EnOcean wireless standard (ISO/IEC 14543-3-1X) in sub-1GHz. With a large variety of sensors and switches available, initiatives such as the EnOcean Alliance allows users to choose functions with style and certified interoperability. This makes it easy to choose a range of building automation options while the modular building is being fabricated; and it is simple to add new functions later.

There are also self-powered devices integrating EnOcean's energy harvesting technology which communicate directly with lights via secure wireless telegram signals. This enables green, battery-free switches and solar-powered sensors to be used to flexibly control additional applications such as LED lights or loudspeakers.

### Healthcare applications

Experience over many varied projects shows the possibilities of using smart modular technology in medical facilities to help meet the coronavirus challenge. The University Medical Center Utrecht is one such showcase.

This project started with tagging hospital equipment and connecting it to a mesh network, enabling nurses and technical staff to know in real-time where the equipment was located. Later, self-powered and battery-free switches are used as call buttons. The addition of connected proximity sensors allows staff to know which areas are in use, and to schedule cleaning in unoccupied areas, whilst identifying spaces that have not been used so do not require cleaning. Another possibility is to attach sensors to soap dispensers in restrooms, alerting maintenance staff to re-supply, ensuring that people can always wash their hands properly. The list of opportunities goes on: for example, adding a sensor network to monitor patients with specific risk or linking beacons to Google maps for navigation around the hospital.



Solar-powered multi-sensor units can be used flexibly to control various applications.

### As the pandemic subsides

Going forward, the combination of IoT and AI could bring in a huge array of data into the equation. This assists progress towards building cognitive homes.

Intelligent modular buildings will soon be able to integrate IoT devices on their own, generate vast amounts of data and use them to optimize the building. This gives an entirely new dimension to services and business models. It is particularly relevant to the coronavirus survivors in the ageing population. Private homes and care homes will include smart non-intrusive, secure connections with friends, family, GPs, nurses and carers, all involved in looking after the residents. Conditions such as dementia would be addressed through 'sensory-loss' technologies based on patterns of activity and behaviour. And technology based on IoT connected battery-free sensors will help prevent incidents in the home such as cookers left on, overflowing baths and people becoming confused about their whereabouts.