

# Building for Efficiency: Systems Approaches Boost Profitability

Owners and developers deploy building system solutions—including vertical transportation, HVAC and UPS—leveraging improvements in operations to gain efficiencies, savings and competitive advantages.



**WITH A TIGHTENING LABOR MARKET** and commercial vacancy rates at recent lows, building owners and developers are challenged to compete on across-the-board experiential improvements and incremental gains in efficiency, regardless of property or building type. In 2018, according to real estate service firm Jones Lang LaSalle, “Office market fundamentals continue to shift into more balanced, neutral territory. New deliveries are providing a wider range of options for tenants, and greater competition among landlords is pushing up concession packages, even as asking rents continue to climb.” For buildings and their infrastructure, this means innovation is essential. Matching new amenities with increased efficiencies and integrating new building systems with visible or otherwise noteworthy enhancements have become two of the most

pressing considerations for owners and managers of commercial developments.

Fortunately, a number of core building system advances—most having entered the commercial and institutional building markets in recent years—are now driving competitive advantages for sector-leading properties. Three of those are considered in this white paper, with a focus on the technical innovations and documented system benefits presented by the categories. A final consideration presented is the trend toward owners and developers partnering with system providers to gain such advantages as custom-built solutions and improved service and warranty coverage through single-source or sole-source arrangements, as reported in the *Houston Chronicle*. These collaborative partnerships are also seen in the three system categories, which are:

→ **Vertical transportation.** A wide range of newly integrated technologies is bringing advanced functionality to elevator and escalator systems. Improved machinery and automated operating methods have enhanced ride comfort by smoothing movements and reducing vibration. Perhaps more essential to building efficiencies and differentiation has been the adoption by leading owner-developers of novel destination control systems as well as integrated audio/visual equipment and elevator systems without machine rooms. Commercial destination-control suites reduce times for tenant waiting and traveling by up to 10-20% depending on peak, and they present developers and reconstruction teams with new options for organizing building cores, stacking elevators and improving overall building architecture.

→ **Uninterruptible power supply (UPS) equipment.** Meeting the need for more resilient buildings and commercial complexes that can ride out severe weather episodes and peak demand cycles, new UPS systems are now more highly reliable. Among the most valuable innovations are the so-called hyperscale UPS configurations with very small footprints and flat efficiency curves, meaning higher efficiencies in a range of loading conditions and therefore a lower total cost of ownership (TCO) and improved power usage effectiveness (PUE) over conventional UPS equipment.

→ **Heating, ventilation and air conditioning (HVAC) systems.** A broad range of advances related to energy efficiency, sustainable or green building, and occupant health and wellness over the last decades have opened doors for gaining competitive advantage and reducing operating costs. Among the most valuable advances are variable refrigerant flow, or VRF, systems. Invented in the mid-1980s,

these systems are similar to ductless minisplits and deliver conditioned refrigerant directly to a space instead of pushing air through ductwork. Like variable frequency drives and variable air volume systems, VRFs offer up to 25% energy savings when compared to a conventional HVAC system.

These three system areas are discussed in this white paper, with particular attention given to how recent advances improve reliability and efficiency, as well as, in some cases, the profitability of a building or property. In addition, the paper reviews best practices in collaboration with vendors and providers to optimize these gains, as well as service and support approaches that supplement the capabilities of property managers and facilities and maintenance personnel to administer the systems over the product lifespan. Among the important findings is the demonstration of value in building solutions developed by Mitsubishi Electric, in particular their contribution to industry-leading efficiencies and low maintenance needs for systems applied to both new and renovated buildings.

### TECHNICAL INNOVATION

Whether for new building construction or reconstruction and retrofit situations, leading building owners and developers address the judicious and most advantageous deployment of key technologies by evaluating critical product and building measures, which include operating variables and competitive factors. Examples of operating variables include historical callback rates, expected frequency of unplanned service calls and predicted efficiency gains, according to studies by Mitsubishi Electric. Competitive factors can range from comfort and aesthetics to net rentable area, operating



costs and service costs for outsourced maintenance, repair and operations (MRO). All of these measures tend to influence asking rents and profit margins.

According to experts, it is valuable to use “reliable and verifiable metrics” to help guide the decision-making team. These include (a) third-party testing of building system properties; (b) manufacturer history and track record; (c) product benefits; (d) economics, including first cost and operating costs as well as TCO; and (e) references from “people and projects that have already used the product,” according to Alex Argento, a green building materials specialist and executive with supplier PuraTerra.

Another challenge to address is the prevalence of barriers to adopting valuable yet relatively new building systems. In a recent article by Hong Kong Polytechnic University’s real estate expert Albert P.C. Chan, et al., a global survey of building professionals on sustainability technologies helps to illustrate: “Resistance of stakeholders to change and higher cost are identified as the most critical barriers to implementing,” wrote the researchers, who note that the adoption barriers fall into “five main interrelated components, which suggests the need for holistic and integrated strategies to overcome the barriers.”

With these challenges in mind, a review of critical factors for three technology areas follows, with attention to the operating variables and competitive factors most frequently considered by building owner-developers.

### **VERTICAL TRANSPORTATION**

First, consider the example of escalators and elevators, which serve as one of the most visible and prominent tenant/visitor touch points. Issues of system speed, proper functionality, brand image and even end-user frustration and impatience make it essential to have elevators that work well and respond quickly. For building owners, one of the most critical operating issues is the reliability of elevators and escalators. For this reason, an essential operating variable is the service callback rate, which can be compared to an industry average of about six callbacks per year per elevator.

Leading manufacturers boast dramatically improved rates of about two callbacks per unit per year and ultra-reliable products that are properly maintained can even experience less than one callback per elevator per year, according to Mitsubishi Electric. Statistics show that more than two-thirds of elevator callbacks are a result of door issues or malfunctions. To avoid these costs and associated downtime, newer elevator system designs “structurally isolate the door operation mechanism and apply a robust door operating system, which helps dramatically reduce the number

of door-related callbacks,” says a manufacturer. Maximizing uptime leads to more satisfied tenants.

Other operating variables to study include modernization rates (or likelihood of necessary modernization). At least one manufacturer has reported that it has not required a modernization of even one of its elevator systems in the last 30 years, maximizing building owner’s return on investment, another key variable.

### **Advancing Functionality**

In addition to studying operating variables such as callback rates, commercial properties leading their markets or undergoing a repositioning campaign often consider highly differentiating features associated with best-in-class vertical transportation. These approaches now include spiral escalators, which are curved systems for indoor applications up to just over 21.5 feet of vertical rise. Such escalators create a dramatic visual impact and sensory experience while providing life-cycle performance comparable to linear (straight) escalators by the same manufacturer.

Other features of elevators are less noticeable but equally important. From the tolerance of guiderail alignment, to the isolation of moving elevator parts such as traction machines and door operators, building owners can ensure that elevator products are adding value to their tenant experience by providing the smoothest and most comfortable ride possible. Enhancements such as audiovisual (AV) systems in elevators also help to reduce boredom and other negative associations in their buildings. AV systems in the elevator allow for direct tenant communication, and in some cases advertising revenue depending upon the building type.

One product for vertical transportation developed to enhance functionality is destination dispatch control, such as the Destination Oriented Allocation System, or DOAS, which provides for highly efficient elevator operation and end-user convenience. The system and approach “optimizes multi-car elevator systems by allocating cars efficiently according to the floors that passengers input at the hall landing before they enter the elevator, helping to reduce both wait and travel times,” according to the maker. The systems also relieve users of pressing buttons upon entering the car, since the destination is already programmed into the arriving car. DOAS and destination-control technologies maximize car allocation efficiency, by directing passengers who are going to the same floor to use the same elevator, and grouping passengers according to optimal traffic patterns. As a result, cars do not stop needlessly on floors being served by other cars, and a multi-car systems algorithm reduces energy draw by creating the most efficient service schemes.



Based on simulations conducted by Mitsubishi Electric (using 16 floors, six cars and 20-person load capacities), when compared to conventional systems, the DOAS destination control methods for car allocation have cut average wait times by up to 30% during congested hours. The controls also reduced incidents of long waits (those lasting 60 seconds or more) by up to 60% during peak times.

### ***Aesthetics, Security and Safety***

With destination control systems, recently introduced hall panels and user control interfaces also provide upgraded designs and ease of use. Modern, sleek touch screens of 10 inches and larger are available, with high-brightness displays and options for audio guidance to improve accessibility and universal design. In addition, building security can be enhanced by combining destination dispatch systems with a separate access-control system that is integrated with the elevator control system. Building administrators can select a preferred registration method: either floor-access control or automatic call registration. Visitor management systems can be set up to allow tenants to authorize visitors independently, and without the need for additional building resources to manage the process – which reduces building manager’s overhead costs.

Investing in quality vertical transportation not only enhances the end user experience in buildings, but also has a dramatic impact on long-term profitability.

### ***UNINTERRUPTIBLE POWER SUPPLY (UPS) SYSTEMS***

A second area to consider in terms of building reliability and efficiency is the UPS setup. Uninterruptible operations and unlimited uptime are essential for certain building types, such as data centers, healthcare complexes, essential public agency facilities and many corporate office settings. The use of reliable, low-maintenance UPS systems also helps to maximize profitability—both by attracting and retaining tenants at market-leading lease valuations and by extending the investment horizon and ROI of the power solution, which reduces future customer capital expenditures and surprise costs.

In some markets, the use of resilient design principles is essential for Class A buildings. A confluence of factors has led to building with improved resiliency, including the vulnerabilities of regional power grids to seasonal outages or weather-related downtime. Another contributing challenge is the impact of severe weather on building services and systems, according to experts in facility operations.

“Build in redundancy for critical systems,” advises Jennifer L. Chiodo, P.E., of engineering



consulting firm CX Associates. “For the power supply, ideally serve these buildings from two separate utility substations or distribution nodes. Provide emergency generators with significant fuel storage and provide batteries with solar charging capability. Ensure that buildings can be islanded—separate from the power grid so that they can continue operation during outages.”

Achieving these levels of redundancy, isolation and backup can be more efficient and profitable than ever for building owners and developers. As the cost of downtime has skyrocketed for virtually all types of businesses, building owner-developers seek maximum reliability in their backup power electronic suppliers. In addition to maximizing uptime, the provider “needs to understand the distinct challenges within a variety of market segments and deliver critical power solutions that provide excellent value in the areas of high efficiency, rapid deployment, total cost of ownership, scalability, premier service and support,” according to a leading global supplier.

Examples are widespread of the innovative concepts now available in UPS solutions, most designed to make equipment smaller, lighter, more efficient and more reliable. To boost efficiency, three-level topology introduced in North America in 2008 ensures a UPS that provides >97% true online double-conversion efficiency. It is now included in many UPS systems. A second advance is the use of silicon carbide (SiC) for UPS systems, which reduces the size and weight of UPS modules while also boosting their efficiency. A third way to shrink UPS sizes while making them more efficient is by removing transformers from UPS modules, which is the key to achieving superior efficiencies. The resulting systems must compensate for a range of challenges that transformers traditionally handle. A last innovation is the development of double-conversion UPS modules, which create perfect AC output protected from damaging transients, harmonics and other voltage anomalies left unchecked in common “line interactive” UPS setups.

### ***Applied Technologies for Building Benefits***

With better efficiencies, smaller footprints and weights, as well as enhanced capabilities for protecting end-user operations, UPS systems have become a significant selling point for today’s building owners and developers. For example, in today’s environment of increasing demand for cloud and colocation services, hyperscale UPS systems are now promoted as a best-in-class facility feature to address the unique needs of data centers, public safety operations and corporate facilities with dense server usage and other critical systems. Medium-range UPSes, such as 750 kVA products

with SiC, apply to data centers and facilities with loading of 1–5 megawatts. To back up smaller enterprise operations or IT closets, three-phase UPSes for loads of 10–80 kVA extend system reliability beyond the facility’s utility power room to offer high-performance power protection for end-user-critical loads.

Reliability is the most important qualification for UPS choices, yet most manufacturers only estimate their UPS reliability rather than using accelerated testing or installed track record and customer history. Some market leaders provide detailed reliability data, including the installed base of 9900 Series UPS systems (Mitsubishi Electric), which have been verified to provide uninterruptible power supply that has sustained load-carrying capability of more than 99.999% throughout the product line’s operational history.

Such unique products represent best-in-class building operations, thanks to their category-leading reliability, efficiencies and, ultimately, satisfaction of specific tenant requirements. The novel technologies boost ROI while reducing TCO.

### **HVAC SYSTEMS**

The third area to consider in terms of top-level building reliability, efficiency and profitability is the HVAC system, which is an ongoing cost center and a common source of operational challenges in terms of budget, effectiveness and MRO needs. Cast this against the backdrop of expectations for building sustainability, uptime and occupant wellness, and the HVAC infrastructure becomes an essential facet of leasing and resale.

On average, 39% of energy use in commercial buildings is by HVAC systems, according to Carl Ian Graham, P.E., of Viridian Energy & Environmental, Inc. High-performance HVAC systems can save 10% to 40% of energy, emissions and costs, and even greater savings up to 70% are possible through whole building design, Graham concludes in a WBDG report. Improved comfort and thermal control are essential to indoor environmental quality (IEQ) and positive tenant experience. Examples include humidity control in warm climates, which addresses excessive humid air and moisture accumulation in materials, which in turn can lead to upper respiratory infections and asthma, according to Kimberly Llewellyn, performance construction manager with Mitsubishi Electric.

Among the advances addressing these HVAC challenges in commercial applications are innovative, zone-based Variable Refrigerant Flow (VRF) cooling and heating systems. First, two-pipe VRF systems have been shown to speed installations as well as reduce piping and space requirements

for the HVAC system, while delivering effective operations for commercial building cooling and heating. The systems allow independent control of conditions within each zone of multitenant or single-tenant spaces, boosting personal satisfaction and comfort for building occupants while minimizing costs to building owners. Novel platforms are emerging that allow integration with Google Assistant, for example, providing for web-based controls that appeal to multi-family residents.

Second, boosting the efficiency of commercial VRF systems are advanced INVERTER-driven compressors: By varying the compressor speed to precisely meet each zone’s conditioning requirements, the resulting increases in efficiency provide substantial cost savings and increased profitability to the building owner.

While VRF equipment already offers up to 25% energy savings when compared to a conventional HVAC system, the technology continues to advance. New products entering the market include air-source outdoor units of 6 to 30 tons in size with zinc-aluminum flat-tube heat exchangers that significantly improve efficiency ratings. Not only that, the product has an up to 30% smaller footprint, saving rentable square footage, and significantly reduces the amount of refrigerant require for operation. Summarizing the recent growth in VRF systems, this year *Buildings* magazine reported, “With its improved flexibility making it viable for most types, sizes and locations of facilities, VRF systems have outpaced the growth of other types of HVAC technologies over the last decade, making up roughly 6–8% of all HVAC systems in the U.S. Its use in commercial facilities is expected to continue growing, fulfilling its status as the HVAC system of the future.”

On the installation and maintenance side for VRF systems, the use of certified and preferred contractor networks can be essential to translating the manufacturer’s strong record of reliability and collaboration into better product performance and building operations.

### **COLLABORATION, SERVICE AND TRACK RECORD**

HVAC is only one area where building owners and developers are finding enhanced product and service delivery through collaborative supplier partnerships. For a range of key commercial building systems, savvy building owners and developers seek custom and often exclusive agreements with suppliers to boost creativity and service as well as reduce MRO and downtime. “Work with a partner that will focus on your unique needs to supply the right design and product solutions—before, during and after you build,” says Kevin Miskewicz, director of commercial marketing for the Cooling & Heating



Division of Mitsubishi Electric. Describing the elements of such alliances, he points to:

→ **Collaborative solutions.** The primary goal is that major building systems perform consistently. Starting with a reliable product and exacting installation methods contributes to this end, but the provider must also emphasize the use of adaptive, custom solutions because they clearly meet the operational needs envisioned by the building owner-developer.

→ **Responsive service.** The manufacturer's or supplier's team of employees must share a basic commitment to serving the building owner-developer all the way from purchase through the life of the products and systems.

→ **Partner relationships.** The study of partner relationship management (PRM) and partner-to-partner relationships by organizational experts has been applied to commercial building development and operations. Evidence shows that stronger relationships with partners tend to accelerate innovation and increase profitability or create new revenues, or both, for the building portfolio. According to IDC, entities that associated 30% or more of their revenue with partner-to-partner collaboration were the fastest-growing organizations, achieving 19% growth vs. about 10–12% for others.

The partner model also supplies design and product solutions associated with innovative buildings and renovation approaches. For example, installations exemplifying the versatility and flexibility of VRF technology often result from partner-based project teams.

### REDUCING TCO AND BOOSTING ROI

The supplier partner is also essential to reduced TCO, or total cost of ownership and operations. In some cases, the building owner-developer may benefit from single-source or sole-source contracting agreements. Single-source approaches allow the owner-developer to move from vendor to vendor or, in some cases, to renegotiate with the originally selected supplier, providing alternatives if the initially selected supplier or distributor proves inadequate. Sole-source contracting can reduce time needed for the owner/manager organizations to contact various vendors, solicit pricing and negotiate operating agreements. In sole-sourcing, administrative costs are often reduced.

According to leading commercial owners and developers, the basis for either type of partnership agreement must focus on (a) installed system lifetime horizon; (b) equipment reliability and maintenance track record; (c) system design impact on operating expenditures such as energy use, replacement parts and disposal costs; and (d) likelihood of unplanned expenditures—"surprise costs" that reflect poor system predictability.



Speaking to these specific factors for supplier alliances and exclusive contracts, studies by one global manufacturer demonstrate the specific variables most likely to affect TCO and therefore system ROI and overall building profitability. According to the studies, these factors have a similar influence on profitability for vertical transport, UPS and HVAC systems, the three building systems considered in this white paper:

1. Equipment should be durable and competitive in terms of operations. Consider products designed with **testing and track records** indicating an advantage over competition offerings. This is a key path to reducing future and overall capital expenditures.
2. Study manufacturer and product claims for overall callback rates. The lowest overall **callback rates** ensure reductions in monthly and overall maintenance costs. Some leading suppliers can assure low or zero unplanned costs, increasing reliability and reducing uncertainty in building operations. (Examples include the elevator example cited above, with callback rates averaging less than one per year per elevator, compared to two callbacks per year claimed by competitive systems and up to five callbacks per year as documented by field studies and interviews by elevator consultants.)
3. Review manufacturer history for the **operating lifetime** of specific equipment and products. Some building products and systems for vertical transport, for example, provide functionality for 30 years or more, which compares favorably to industry averages of 15–20 years for the same systems by others.
4. Analyze **MRO needs** and quantify the costs of downtime. Investing in robust system design structures may be essential to ensuring that key parts/components will not fail during building operations, which is a source of unplanned costs and tenant disagreements. In addition, teams need to reduce overall maintenance expenditures and avoid surprise costs.

Today's owners and developers continue to face challenges regarding cost and efficiencies, with the ultimate aim of attracting and retaining star tenants to occupy their buildings. Technological innovations in the marketplace have emerged to offer owners and developers more benefits and improvements across its vertical transportation, uninterruptible power supply, and HVAC systems. As seen in various case studies and in studies cited in this white paper, a number of core building system advances are now driving competitive advantages for sector-leading commercial properties.