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Delivering and Managing Sustainable Tall Buildings
实现及管理可持续高层建筑


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Abstract

This paper examines best practices to develop a framework for the effective management of high-performance sustainable tall building

- Utilizes relevant case studies and workshop participation
- Discusses the current and future trends in building construction and design, and their effect on the management of high-performance, sustainable buildings (post-practical completion) and on the delivery of LEED accreditations for such assets
- Tackles other relevant topics, such as: metering and control strategies; Building Information Modelling (BIM); and tenant impacts and controls, including relevant implications on fit-out design and building use

Keywords: Sustainable Building Management, Green Building, Operations

摘要

本论文分析了制定高性能、可持续高层建筑有效管理框架的最佳实践

- 利用相关案例研究和参与研讨会的方式
- 探讨了建筑施工和设计的现状及其未来发展趋势，及其对高性能、可持续建筑 (实际竣工后) 管理以及对此类资产开展LEED认证的影响
- 同时探讨了其它相关话题，如: 计量和控制策略、建筑信息模型 (BIM) 、租户影响和控制，包括对内部装修设计和建筑使用的相关影响

关键词: 建筑可持续管理，绿色建筑，运营

Best Practice in Sustainable Building Management

Introduction

This paper, written from a building management perspective, is derived from JLL's experience across more than 1.4 billion sq. ft. of space across Asia Pacific.

The growing prevalence of green building design and construction has brought a substantially greater focus not only on the reduction of the long-term environmental impacts and the energy and emissions intensity of high-performance tall buildings, but also on the additional value of sustainable building practices for tenants and owners. However, trends in green building often rely on increasingly complex technologies or management techniques to ensure that the design promise is translated into sustainable operations.

High-performance, tall buildings are designed and delivered at a size and with a complexity that redefine the word "sustainable". Given the investment level, materials consumed, and embedded energy on such properties, it follows

建筑可持续管理的最佳实践

引言

本论文从建筑管理的角度进行撰写，其素材来自于仲量联行在整个亚太地区超过1.3亿平方米物业空间的丰富的建筑管理经验。

目前，随着绿色建筑设计和施工的日益普及，各个企业和组织机构提高了对以下两个问题的重视程度: 一是降低建筑对环境的长期影响以及高性能高层建筑的能源使用和排放强度，二是可持续建筑实践对租户和业主带来的附加值。不过，绿色建筑的发展趋势往往取决于日益复杂的技术或管理方法，才能确保兑现设计中的承诺，实现建筑的可持续运营。

在设计和建造高性能的高层建筑时，其规模和复杂程度重新界定了"可持续性" (sustainable) 这个词汇的定义。鉴于此类建筑的投资水平、所消耗的原材料及其使用的能源均非常巨大，因此常规的建筑生命周期思维方式应体现这一事实，即这些高层建筑的主体结构和幕墙系统如要被称为真正具有可持续性，其有效的生命周期必须达到40到60年。

that the conventional life-cycle thinking should reflect the fact that these buildings' primary structure and façade systems would need an active life span of 40-60 years if they were to be classified as truly sustainable.

Learning from Experience

To achieve a sustainable outcome, the initial phases of the building's construction should consider the projected design criteria, the likely operational needs of future tenants, the technologies being deployed and the prioritization of these technologies, the long-term building refurbishment or 'churn' plans, the intellectual property retention and development, and the adherence to green building standards, which may evolve over time.

Outlined below are several key issues that can provide a framework for a sustainable tall building management. Central to these issues is the need for a holistic approach, which moves beyond good design to include a long-term, multi-faceted management style.

Designing Buildings Effectively

A sustainable building operation is clearly connected to building design and construction, with good practice adopted early, having a lasting impact over the life of the asset. While detailed discussion on building design is outside the scope of this paper, it merits mentioning several basic principles that should be adopted during the design/construction phase to provide building operators with the greatest chance of success. These principles include:

Carefully Considering Long-Term Asset Usage Plans

Ensuring the building is setup to perform effectively under target operating conditions. For example, buildings with high energy use tenants, such as banks with trading floors or 24/7 operations, warrant special consideration compared to the "typical" 9-5 tenants. Flexible building designs, or those that allow the building to change the way it operates in response to different usage patterns over time, also provide a great benefit.

Primary versus Secondary Design Attributes

In the quest for higher green ratings, many buildings place heavy emphasis on secondary design attributes, such as solar panels, tri-generation, and blackwater recycling. These technologies are certainly useful when applied correctly, and a discussion on how to manage them effectively is included below. However, it warrants mention that the main focus of an effective building design must remain on the primary design elements, which include façades, floor-to-floor heights, HVAC, building core and structural design, and vertical transport. Over the extended life of an asset, the primary design elements will create the foundation for a strong building performance far more significantly than any secondary green building technology.

Selecting Appropriate Technology

High-performance buildings should be underpinned by solid design and delivery, with top priority attached to primary design elements and their impact on the asset's life cycle. While rating systems can be used to assist in decision making, the setting of priorities should be a careful balance between design integrity and delivery in the light of innovation to achieve rating benchmarks.

Engaging Building Operators Early in the Design/Construction Phase

Facilitating a two-way discussion between the building designer and the operators ensures an effective knowledge transfer between the two teams, such that design decisions are not made in isolation of the

从经验中学习

为实现建筑的可持续发展，在建造的初期就必须考虑到以下问题，其中包括预期的设计标准，未来租户可能的运营需求，部署的技术以及这些技术的优先级，建筑的长期翻新或"改造"计划，知识产权保留和开发，以及遵循绿色建筑标准等，这些问题都有可能随着时间的推移而发生变化。

本文希望通过讨论以下几个关键问题，为高层建筑的可持续管理提供一个框架。这些问题的核心在于采用一个综合全面的方法，该方法不应该单单局限于良好的设计，还应包括长期、多层面的管理方式。

有效设计建筑

显而易见，建筑的可持续运营与建筑设计和施工密切相关，建设初期即采纳此方面的良好实践能对建筑的整个使用周期带来长期持久的积极影响。尽管本论文不对建筑设计展开详细探讨，但值得指出的是，部分在建筑设计/施工阶段采纳的基本原则，可以为建筑可持续运营带来最大程度的成功机会。这些基本原则包括:

仔细考虑长期资产利用计划

确保建筑在目标运营条件下有效运营。例如，与典型的"朝九晚五"的租户相比，如有能源使用密集型的租户 (如交易大厅或全天候运营的银行)，建筑必须针对他们给予特殊的考虑。此外，灵活的建筑设计，或者使建筑可以针对不同时期不同的使用方式改变其运营方式的建筑设计，也可让这些建筑在运营阶段受益匪浅。

在选择设计元素上要主次分明

在追求更高绿色评级的过程中，许多建筑过于重视次要的设计元素，如太阳能发电、冷热电三联产系统和黑水 (厕所污水) 的循环利用等。当然，这些技术如果应用得当可以非常有用，我们将在后续章节中进一步讨论如何有效地管理这些技术。不过值得指出的是，有效的建筑设计仍然必须将主要关注点放在主要设计元素上，包括幕墙、层高、暖通空调 (HVAC) 、建筑核心和结构设计以及垂直交通等。在建筑的长期使用中，上述主要设计元素将为建筑提供出色的性能奠定坚实的基础，其重要性将远远超过次要的绿色建筑技术。

选择适宜的技术

可靠的设计和建造是高性能建筑的基础，需要优先考虑的是那些主要设计元素及其对资产生命周期的影响。一方面，可以利用绿色建筑评价体系来协助建筑设计的决策; 另一方面，期冀通过创新达到绿色建筑评价体系所设的标准时，也必须注意设计意图和实际建造/运营能力的良好平衡，并在选择设计元素/技术和确定其优先级时充分考虑上述因素。

建筑运营管理人员在设计/施工阶段的早期介入

推动建筑设计人员和运营管理人员之间的双向交流，可以确保双方开展有效的知识分享，使得建筑设计的决定不会脱离运营环境。同时，运营管理人员能够在设计阶段就对设计意图有深入的了解。在调试阶段，由于要开展大量测试和培训工作，需要许多人同时参与，运营团队的主要成员必须全部到位。通常来讲，在建筑正式运营前9到12个月，运营团队的机电和IT工程师应该全部到位。

正确开展调试工作

由于现代建筑的各个系统和数据的集成程度更加深入，其中一个或几个系统的问题可能会波及其它系统，从而导致其运营和性能欠优。弥补这些不足可以带来以下诸多好处:

- 提高建筑住户的工作效率
- 通过节能降低公用事业费用

operating environment. Instead, operators are given early and deep insight into the design intent. During the commissioning phase, the lead operation team members should be on board, as a multitude of testing and training will be undertaken, and one person cannot be in all places at one time. Typically, the mechanical, electrical, and IT engineers should all be on board 9-12 months before the go live.

Commissioning Correctly
Because all building and data systems are now integrated at a far deeper level, a deficiency in one or more systems can result in suboptimal operation and performance in other components. Remedying these deficiencies can result in a variety of benefits, including:

- Improved building occupant productivity
- Lower utility bills through energy savings
- Increased occupant and owner satisfaction
- Enhanced environmental/health conditions and occupant comfort
- Improved system and equipment function
- Improved building operation and maintenance
- Increased occupant safety
- Better building documentation
- Shortened occupancy transition period
- Significant extension of equipment/systems life cycle

Building Commissioning: Management Impact
In contrast to the above discussion on the need for effective design and construction, the reality is that operators will not always inherit well-designed or properly commissioned buildings. When this is the case, building operators are faced with several challenges, not the least of which is determining why the gaps occurred and who should be contractually responsible for this aspect. Once an understanding is established, the next steps include:

Optimizing Performance Based on the Current Scenario
The techniques employed here are similar, regardless of whether or not the building is designed and commissioned well. However, the potential for high performance outcomes may be limited by the issues affecting the poor building performance.

Closing the Design/Commissioning Gap
Building design changes become more complex and costly after practical completion or when a building becomes tenanted. However, every effort should be made to resolve building design flaws, as their severity and long-term impact on operations may lead to a building performing sub-optimally over the course of its life.

Setting Up the Right Team
Identifying, hiring, and training the right team at the appropriate time will have a major impact on the success of a high-performance asset. Correspondingly, as building design and management have evolved over time to include a greater focus on sustainability and high-performance assets, the need to attract staff members who have more advanced skills and continue training them has become more pronounced now than ever before.

As training and experience become more significant, so do staff retention, career development and succession planning. These latter three factors ensure the continuity of service to clients, as well as improved career prospects for the building operations teams.

- 提高租户和业主满意度
- 改善环境/健康状况，提高租户舒适度
- 改善系统和设备功能
- 改善建筑的运营和维护
- 提高租户的安全性
- 更好的文件记录存档
- 缩短过渡期
- 显著延长设备/系统的寿命

建筑调试对建筑管理的影响
在上述讨论中，我们谈到需要有效的建筑设计和施工，然而在现实生活中，并非所有的建筑均有良好设计或经过正确的调试。在这种情况，建筑的运营管理人员将面临多重挑战，其中最大的一项挑战是确定出现这种差距的原因，以及按照合约规定应对此负责的相关方/人员。对以上两点有清晰的认识后，应采取的后续措施包括:

基于现有的设计优化建筑性能
无论一栋建筑是否有良好的设计和经过正确的调试，为其进行性能优化所使用的技术都很类似。区别在于某些由于设计和调试不当而造成建筑性能不良的问题可能会使建筑性能优化的潜力受到限制。

弥补建筑设计/调试中的不足
在接近竣工或入住后，要改变建筑的设计将更加复杂，代价也更为昂贵。不过，必须尽一切可能解决建筑设计中的问题，否则这些问题的严重性及其对运营的长期影响可能导致建筑在其整个生命周期中都以欠佳的状态运营。

组建合适的团队
在合适的时候确定、聘请和培训合适的团队，将对高性能资产的成功具有重大影响。由于随着时间的推移，建筑设计和管理更加重视可持续发展和高性能资产，因此，吸引那些拥有更高技能的人才并继续为之提供培训机会，其必要性比以往任何时候都更加突出。

随着人员培训和经验重要性的提高，留住优秀人才、职业发展、以及继任计划的重要性也随之提高。最后这三个要素可确保向客户提供服务的连续性，同时提升建筑运营团队的职业发展前景。

不过，对那些在偏远地区或者相对不发达市场开发的绿色建筑，建筑管理方可能一时难以找到合适的资源。在此情况下，与第三方供应商和原始设备制造商保持密切的关系至关重要。同样，为零部件供应和维修能力等进行有效的规划也是重要的一环。不过，在相对不发达的市场中，要同时满足这两项要求比在发达市场中更加复杂，也更加费时费力。

合理的文件归档
正如我们此前所指出的，从一开始就让现场运营团队参与其中，对建筑移交后的有效管理有诸多益处。同时，文件的移交在确保建筑的有效移交方面也发挥着关键作用。文件清单包括: 授权证书、建筑设计标准、租户/装修规定、资产登记表、调试数据、设计和实际安装文件、建筑用户指南、消防和人身安全指南、能耗模型 (设计与实际调试模型) 、运营和维护手册、以及保修文件等。

在正确完成上述工作后，移交历史文件的工作便可结束。不过，近来出现了两个新的发展趋势:

However, in instances where green buildings are being developed remotely, or in less-developed markets, building managers may have difficulty identifying suitable resources. In such cases, maintaining strong relationships with third-party vendors and original equipment manufacturers is critical, as is the effective planning for the supply of spare parts, servicing capacity, and so forth—but fulfilling both requirements can be more complex and time consuming in less-developed markets than in more developed ones.

Having the Right Documentation

As noted earlier, engaging the site operations team at the onset has major positive benefits in terms of managing a building effectively after its handover. The handover of documents also plays a key role in ensuring the process is effective. The documentation list includes authority certificates, building design criteria, tenant/fit-out provisions, asset registers, commissioning data, design and as-installed documents, building user guides, fire and life safety guides, energy models (design and as-commissioned), operations and maintenance manuals, and warranty documentation.

When done correctly, the process of handing over historical documents is sufficient. Recently, however, two trends are emerging:

Document Handover is, Typically, Poorly Managed

A typical scenario involves disparate information being not up to date or may be missing information, meaning that the site operations team is starting off behind where they should be.

Buildings are Becoming Increasingly Sophisticated

As such, the industry should redefine the approach to building documentation, which includes IT infrastructure, to account for this increase in the scale and complexity of data. Potential improvements would include: a full working documentation that is constantly updated, maintenance management and asset tracking system that enables a cost-effective and code-compliant maintenance, and fully integrated data systems where intuitive service to tenants can be delivered.

Special Issues for Tall Buildings

The scale of these assets can result in substantially higher risk in terms of:

- Fire and life safety
- Security
- System pressures and maintenance techniques
- Plant failure and subsequent damage to multiple floors and finishes

These factors are common to all buildings, but are magnified many times in tall buildings, particular due to the sheer number of building visitors and occupants.

Current and Future Trends

One key trend affecting the current design, construction and management of buildings is the role of technology. This technology trend includes cutting-edge technologies that do not have a long track record in buildings, as well as the combination of existing technologies deployed in unison to provide a sophisticated and comprehensive solution for building operations. Both scenarios raise the fundamental questions, "How do we ensure this is the right technology for my building?" and "How do we operate this technology effectively to achieve the desired outcomes?" A question that underpins many

文档移交工作往往管理不善

一个典型的情况是信息分散，要么不是最新的信息，要么可能遗漏部分信息，这样，现场运营团队从一开始就落后了。

建筑变得越来越复杂

因此，整个建筑行业必须考虑到数据量和数据复杂性增加的状况，重新确定建筑(包括IT基础设施)文档管理的方法。可能改进的方面包括: 动态更新的工作文档、建筑维护管理和资产追踪系统(使建筑维护实践符合规范且经济合理)，以及可以向租户提供直观贴心服务的全集成数据系统。

高层建筑面临的特殊问题

高层建筑的规模决定了它们在以下几个方面存在更高的风险:

- 消防和人身安全
- 保安
- 系统压力和维护技术
- 机房故障及其对多个楼层和装饰的破坏

尽管这些风险因素在所有建筑中都存在，但这些问题在高层建筑中的严重程度将增加数倍，其中一个主要的原因是高层建筑的访客和用户数量巨大。

当前和未来的发展趋势

技术是影响现有的建筑设计、施工和管理的一大趋势。这些技术包括在建筑中尚未得到长期验证的尖端前沿技术，以及为建筑运营提供全面、先进解决方案，统一部署的各种现有技术组合。在这两种情形下，我们都面临以下一些根本性的问题，比如: "我们如何才能确保这是适合我这个建筑的技术?"，"我们如何有效地利用这种技术才能达到理想的效果?"一个在许多技术决策中非常重要，但可能未被公开或经常讨论的一个问题则是: "我选择这项技术是因为它适合我的建筑，还是为了达到某个特定绿色建筑评价体系的要求?"主要设计元素和次要设计元素之间必须要达成合理的平衡，设计过程才能由技术得益，建筑的运营团队才能有效地开展运营工作。

要为以上的问题找出答案，最佳的方式是通过一系列的筛选，这些筛选因素包括: 考虑技术的生命周期; 确定是能效，还是温室气体排放，或者两者都是其主要驱动力; 了解资产维护和置换的成本。

以下，我们将通过若干例子来探讨技术对建筑运营的影响:

黑水处理

通常，黑水处理设备会在事先设定的容量参数条件下运行。也就是说，建筑使用情况的变化，可能会影响黑水处理机房/设备的有效运行。黑水处理机房/设备无法有效运行可能带来的影响包括: 恶臭，排放限制，污水处理费(如果必须排放至下水道时)的增加，以及饮用水量(用以替代再生水不足)的增加。鉴于这些潜在的影响，运营团队必须关注黑水处理对建筑性能的上下游影响。

太阳能电池板

除非是超大的太阳能电池板项目(如那些与建筑幕墙集成的光伏建筑一体化安装)，否则高层建筑中的太阳能发电在满足建筑总体能源需求中的贡献将会很小。但即使是规模不大的太阳能项目，也必须有合适的管控措施来确保建筑的安全运营和维护。如果太阳能电池板的所有权或维护归第三方，建筑运营团队还会受到其它方面的影响，包括承包商安全导入、屋顶出入许可等。如果不能有效地管理这些事项，太阳能电池板的发电量可能就会降低或者无法达到最佳效果，更为严重的甚至会造成安全隐患(如太阳能电池板在极端气候条件下脱落)。

technology decisions, but may not be openly or frequently discussed, is, "Am I selecting this technology because it is the right decision for my building, or am I doing this to achieve points under a particular rating scheme?" The correct balance between the primary and secondary design elements must be reached to benefit the design process and to help building operators do their jobs effectively.

The most appropriate way to deal with these decisions is through a series of filters, which would include: considering the technology life cycle; determining whether or not energy efficiency, or greenhouse gas emissions, or both, is/are the major driver(s); and understanding asset maintenance and replacement costs.

Several example technologies are discussed below in terms of their impact on building operations.

Blackwater Treatment
Typically, blackwater treatment units operate within set volume parameters, meaning that changes in building occupancy may affect the ability of the plant to function correctly. Impacts of poor operation may include unpleasant smells, licensing or discharge restrictions, an increase in sewerage charges (if discharge to the sewer is required), and an increase in potable water use (in lieu of recycled water use). Given these potential consequences, the operations team, therefore, must be mindful of the several upstream and downstream effects of blackwater treatment on building performance.

Solar Panels
Unless solar installations are particularly large, such as those cutting-edge technologies integrated into the building façade, it is likely that solar power generation on a tall building will contribute a small portion of the building's overall energy demand. Nevertheless, appropriate management controls must be implemented to ensure safe operations and maintenance. In scenarios where a third party owns or maintains the solar panels, additional impacts can be felt by the building operations teams with regard to contractor induction, roof access permits, and so on. Failure to appropriately manage such issues may lead to a reduced or sub-optimal power output, or worse, serious safety risks (such as solar panels demounting in extreme weather conditions).

River Water Cooling
Typically applied in geographies where rivers, harbors or large water bodies are available in lieu of alternative heat-rejection systems, the river water cooling technology can have a large, positive impact on water consumption. However, the technology will require careful management of increased energy costs (from pumps) along with an on-going dosing regimen to reduce build-up in the building's pipe work. Often, to minimize disruption on the marine environment, licensing is required to manage extraction and discharge flow rates and volumes.

Wind Turbines
As with solar panels, wind turbines typically contribute a small portion of the building's energy demand. However, wind turbines can stand as a very visible commitment toward sustainability; therefore, a number of green buildings have included this technology. Maintenance and operations issues are similar to solar panels, with the added potential factors of vibration, and (real or perceived) impact on human health, bird life and visual amenity. In the case of community objection (whether or not justified) to the installation of wind turbines, it is possible that building operators may be drawn into discussions well beyond the scope of a typical building operation contract.

江水源冷却技术
通常应用于有河流、港口或其它大型水体的地区，江水源冷却技术可以被用来替代传统的散热系统。江水源冷却技术通常对节水有显著积极的影响。不过，利用这种技术时必须对水泵能耗的增加进行精心管理，并且需要通过定期加药来消除/减少水管淤积的问题。通常来说，为减少对水文环境的破坏，必须通过特许准证的方式对该类系统的流速和流量进行管理和控制。

风轮机
与太阳能电池板一样，风轮机在满足建筑能源需求方面的贡献也很小。不过，由于其在建筑中的能见度，风轮机有时被作为可持续建筑的一个标志; 这也解释了为什么能源贡献虽小，但还是有不少建筑愿意使用该项技术。风轮机的维护和运行问题与太阳能电池板类似，此外还存在共振、对人类健康、鸟类生命和建筑外观影响 (实际或预计的) 等潜在因素。如果所在社区反对 (无论是否有正当理由) 安装风轮机，建筑运营团队很可能会陷入远远超出一般建筑运营合同范围的争端。

冷热电三联产
基于天然气定价和供应状况 (即气电价格比受商品市场的影响)，建筑运营团队不仅要考虑到运营冷热电三联产设备本身的情况，还必须考虑到整个商品市场的状况，确保运营和维护该设备的商业环境不会发生变化。

"二八法则"
经过以上讨论，我们很容易看出，如果选择不当，或者对其重视程度超过主要设计元素，以上这些技术就可能给现场运营团队带来很大的问题。在极端情况下，利用这些技术的成本可能超出其对建筑表现所带来的效益。"二八法则"可以在这方面提供一个很好的指导。如果建筑运营团队需要在次要设计元素上花费的时间超过20%，或者在主要设计元素上花费的时间不足80%，则主次设计元素之间的平衡肯定存在问题并需要改变。

计量，控制策略，建筑信息模型 (BIM)，租户影响

从建筑运营的角度来看，有效控制建筑的整体性能以及保持租户对建筑整体性能的积极影响，是所有高性能、可持续建筑面临的主要挑战。建筑运营团队可以利用的主要工具包括: 建筑中已部署的系统，从这些系统获得所需信息，解析该类信息的界面，以及基于数据分析的结果来影响决策的能力。建筑控制系统和计量策略是物业管理团队可用来实现建筑最佳性能的关键架构。

租户装修手册和管控
完善的租户装修指南是既有和新建建筑运营中的一个重要考量因素。在编制租户装修指南时，必须参照建筑的长期策略，如绿色建筑认证或类似目标，并应基于不断进行完善和信息共享这一原则。此外，必须建立和实施适宜的管控机制，确保租户在装修及运营期间遵守这些标准的要求。这种管控机制还可进一步演变为"绿色租赁"，即在整个租赁期间，业主和租户在建筑的可持续发展领域持续开展合作，并各自履行约定的义务。

分项计量和指挥中心
针对建筑能源计量和自动化的技术和方法很多。不过，我们应当关注的根本性问题应该是提供一个有效的信息系统，能向运营团队提供简洁明了和切实可行的信息，以便他们能够快速做出反应，改善建筑的性能。重点必须放在"简洁明了和切实可行的信息"上，帮助建筑运营团队克服每天面临大量数据"轰炸"的现象，协助他们跟据轻重缓急合理安排各项活动。

建筑信息模型 (BIM) 及其使用方法的文档编制
鉴于建筑设计和文档编制过程中所包含的信息量巨大，目前较为先进的开发项目开始考虑或者采用建筑信息模型/模拟方法 (BIM)

Tri-Generation
Because of gas pricing and supply conditions—or the variable pricing equation between gas and electricity that is affected by commodity markets—operators need to look not only at the physical aspects of operating the tri-generation equipment, but also from a broader view of commodity markets to ensure that the commercial case for running and maintaining the equipment has not changed.

80/20 Rule
Upon review, it is easy to see how the technologies cited here, when poorly selected or when overemphasized as compared to the primary design elements, can create a burden for site operations teams. In an extreme case, the cost of use of these technologies may exceed the benefit to the building's performance. The 80/20 rule offers good guidance—if the building operations team spends more than 20% of its time on the secondary design elements, or far less than 80% on building fundamentals, something is wrong in the balance and a change may be required.

Metering, Control Strategies, BIM, Tenant Impacts

In an operational sense, having effective control over and maintaining positive tenant impacts on overall building performance are the main challenges facing high-performance sustainable buildings. The main staples in a building operator's toolbox are the systems in place, the information from these systems, the interface used to interpret the available information, and the capabilities to influence decisions based on the results of the data analysis. Building control systems and strategies with attendant metering are some of the key structures the management team will use to achieve optimum performance.

Tenant Fit-Out Manual and Controls
The availability and strength of a tenant fit-out guide is an important consideration in the operations of both new and existing buildings. In preparing these guides, it is important that they be based on long-term strategies for building certification and other goals, as well as on continuous improvement and information sharing. Furthermore, appropriate mechanisms should be implemented, ensuring that tenants comply with these standards during fit-outs and in the ongoing operation of the asset. Taken to an extended degree, a control mechanism could extend into a 'green lease' scenario with on-going collaboration and obligation of both the landlord and tenant in terms of sustainability over the course of the lease.

Sub-Metering and Command Centers
There are a range of technologies and approaches to building metering and automation. However, the fundamental focus should be on delivering a system that provides succinct and actionable information to operations such that they are well placed to quickly improve building performance. The emphasis must remain on "succinct and actionable information" to help overcome the volume of data building operators face on a daily basis and to assist them in prioritizing their activities.

BIM and Documentation on How to Use It
Given the scale and volume of information contained in building design and documentation, more advanced developments are now considering or using Building Information Models/Modelling (BIM), which can effectively document the full working asset before its construction. The use of BIM and associated processes infers that beyond construction, the maximum power of available information

，在其开始施工前就可以有效地为所有的流动资产记录和归档。使用建筑信息模型及其相关流程意味着，除了其在施工阶段的作用以外，如果管理团队能够正确维护和更新信息知识库，可以最大限度实现信息的价值。对于更为复杂的大型建筑，由于获取的最新信息来源于一个单一的可信渠道，使用建筑信息模型可以显著提高管理的有效性，带来诸多潜在的好处，如加快决策进程、改善维护过程、降低成本和改善建筑的性能等。

确立相应的流程，使物业管理团队能够在运营中使用建筑信息模拟，这将使反馈回路能够尽快闭合，从而为相关各方带来颇多好处。

既有建筑认证
整个绿色建筑设计过程的最终目标，是更好的建筑总体性能表现。LEED或"能源及环境设计先锋"认证等绿色建筑评价体系已开发了相关工具来评估建筑在运营阶段的性能，这实质上闭合了性能反馈回路，并且确保将建筑设计中的各项"承诺"转化为有效的运营实践。

尽管为既有建筑获取认证并非建筑有效运营的必要条件 (实际上，运营团队可以通过能源、水、废弃物等关键指标来确认其建筑运营的可持续性)，但LEED和其它类似的认证体系确实可以带来明显的好处。尤其是，此类认证体系可以利用各种业内普遍认可的评级工具，以具有可比性的建筑为基准，独立评估建筑的总体性能。无论是否寻求外部认证，为取得"LEED既有建筑"认证的许多技术和流程与良好的建筑运营实践是一致的。因此，上述两种方法在推动绿色建筑运营的实践上殊途同归。

结论

建筑资产的所有者必须仔细斟酌各种决定，确保其投资在建筑的整个使用周期内得到保护。高性能建筑资产的卓越运营，不仅是为了取得评级或认证，同时还必须打破旧有的建筑孤岛式知识管理体系 (knowledge silo)。尽早将管理反馈系统纳入建筑的设计、施工和调试过程中是地标性项目开发的关键。因此，必须精心选择一个技术过硬并且对上述各种系统和流程都知之甚详的团队。此外，如要广泛深入地了解不同建筑系统，以及这些系统之间如何互动才能为租户和业主带来卓越的成效，就必须从根本上转变对管理方法以及其在建筑开发过程中作用的认识。

would be realized where management teams maintain and grow the knowledge base. For larger, more complex assets, BIM use will enable far more time effective and efficient management, as sourcing current information will stem from a single source of truth. The potential benefits in expediting decision making, improving maintenance processes, reducing costs, and improving building performance are immense.

Setting up the processes for the use of BIM by the proposed management team can lead to a significant benefit for all parties, as the feedback loops can be closed more rapidly.

Existing Building Certification

An improved overall performance is the obvious end-goal of the entire process of green building design. Green building rating schemes, such as Leadership in Energy and Environmental Design (LEED), have tools that assess the performance of buildings in their operational phase, essentially closing the loop on, and ensuring the translation into effective operations of, the design "promise."

Although obtaining an existing building certification is not a prerequisite to operating effectively—and operators can confirm this via key metrics of energy, water, waste, and so forth—LEED and similar schemes do have substantial benefits. Particularly, such schemes provide an independent review of overall performance benchmarked against comparable buildings using rating tools with wide industry acceptance. Whether or not external accreditation is sought, many of the techniques and processes involved in gaining a "LEED Existing Building" certification align with good building operations techniques. As such, the drive for green buildings is assisted either way.

Conclusions

Asset owners must consider their decisions carefully to ensure their investment is protected over the life of the building. Operational excellence for high-performance assets transcends rating system and older style knowledge silos, under which buildings were delivered in the past. The key to landmark developments is the earliest possible integration of the management feedback system into the design, construction and commissioning process. The careful selection of skilled and knowledgeable teams with proven systems and processes is a given. Still, the need to gain a wider understanding of the building systems—and how these systems interact in the delivery of superior outcomes for tenants and owners—demands a paradigm shift in the perception of management practices and their role in the delivery process.