THE DEVELOPMENT, CONNOTATIONS, AND INTERESTS OF RESEARCH ON LANDSCAPE PERFORMANCE EVALUATION FOR EVIDENCE-BASED DESIGN

ABSTRACT

Landscape performance evaluation plays an important role in Landscape Architecture's transformation to an evidence-based science. Most of existing relevant studies focus on the selection of evaluation indicators and methods, or description of the sustainability characteristics of completed projects, while in-depth theoretical discussion on its development processes and essential connotation is still in shortage. By tracing back and comparing the theoretical characteristics and development relationships of the three major systems — POE, SITES, and LPS, this paper clarifies the evolution of landscape performance evaluation towards serving evidence-based design, and further expounds its connotation of discovering the causality of design strategies and benefit results. Finally, two research interests, “feedback analysis of design efficiency” and “producing practical and operable knowledge” are proposed with significance as a key to support high-performance landscape design practices with reliable evidences.

KEYWORDS

Landscape Performance Evaluation; Post Occupancy Evaluation; Sustainable Sites Initiative; Evidence-Based Design; Design Efficiency; Research and Practice

1 引言

20世纪末以来，如何开展高品质或高绩效的设计实践成为人居环境科学探讨的重要议题之一[12]。特别是在风景园林学领域，为明确设计策略塑造高品质环境的有效性，“景观绩效评估”（landscape performance evaluation）已成为国内外学界的研究热点。其重要目的在于能够为项目管理者和客户提供关于方案实施效果的科学证据，这对
1 Introduction

Since the end of the 20th century, how to carry out high-quality/high-performance design practice has become one of the key research topics in the Science of Human Settlements. In Landscape Architecture, landscape performance evaluation witnesses a large amount of studies which have examined the effectiveness of design strategies in shaping high-quality environments. Relevant studies provide project managers and clients with scientific basis about the implementation effects of design strategies, greatly benefiting the development of evidence-based design. A number of current literatures explored the performing variety of sustainable landscape strategies and associated mechanisms, with rich research outcomes especially on ecosystem services and well-beings for human health. However, most of studies simply focus on the selection of evaluation indicators and methods, or qualitatively describe the sustainability of completed projects. Obviously, such descriptive evaluation is not enough to interpret what and how design strategies/elements may perform and benefit, seeing few solid evidences that can be widely and directly used to inform design practice. At present, although researchers have generally recognized the importance of landscape performance evaluation to promote the development of evidence-based design, the lack of research method leads to the failure to produce scientific evidence for design practice.

Before exploring this research method, deep insights on the evolution, connotations, and interests of landscape performance evaluation should be clarified at first. Through review and comparative analysis of the main research systems in the evolution of landscape performance evaluation, this paper reveals the development trajectory and fundamental purpose of related research, then inspects its research connotations and interests to concrete the theoretical basis for landscape performance evaluation to evidence-based design.

2 The Development Trajectory of Research on Landscape Performance Evaluation

2.1 Three Systems during the Evolution

Along with the social development and ideological evolution in related disciplines, there have been three important systems in the current research on landscape performance evaluation (Fig. 1): 1) Post Occupancy Evaluation (POE), originated in the field of Architecture under the humanism flourishing in the 1960s; 2) Sustainable Sites Initiative (SITES), proposed as an authoritative standard for sustainable landscape design,
建成项目的生态绩效受到普遍重视，‘场地可持续性设计行动计划’（SITES）被提出，旨在为推动可持续景观设计实践提供权威标准；3）21世纪，随着社会生态系统日益复杂，为了提高城市景观建设实践的品质并证明设计方案的可持续性功效，美国风景园林基金会（LAF）提出了‘景观绩效系列’（LPS）研究计划。

### 2.1.1 景观绩效评估研究的雏形：POE

POE研究从建筑领域至公园、广场等多尺度的城市开放空间，为景观绩效评估研究提供理论基础。

| POE | BPE | LEED | LEED-ND | SITES | LPS |
|-----|-----|------|---------|-------|-----|
| 20世纪60年代末 | Late 1960s | 1997 | LEED released by USGBC | 2006 | 2010 |
| 美国建筑师对学生宿舍、医院、住宅、办公建筑等展开使用后评估研究 | 沃尔夫冈等人定义了POE的研究方法，出版著作《使用后评估》 | 沃尔夫冈等人在著作《建筑绩效评估》中进一步发展了POE理论，提出提出BPE的评价框架 | 美国绿色建筑协会发布LEED | 美国相关组织联合启动SITES | 美国风景园林基金会发起LPS，正式提出景观绩效评估概念和研究框架 |
| 1988 | 1998 | 1999 | 2009 | 2018 |
| 沃尔夫冈等人在著作《建筑绩效评估》中进一步发展了POE理论，并提出了BPE的评价框架 | 在工作Building Performance Evaluation, Wolfgang et al. further developed the POE theory and proposed the evaluation framework of BPE | 许多国家推出了绿色建筑评价系统，以促进绿色建筑发展 | 美国绿色建筑协会发布LEED | SITES v1, as the first sustainable rating system for landscape projects, was released |
| POE研究从建筑领域至公园、广场等多尺度的城市开放空间，为景观绩效评估研究提供理论基础 | LEED-ND正式发布实施 | SITES为风景园林可持续设计实践提供了理论体系和评价标准 | LPS在吸收BPE和SITES先行研究经验基础上，提出景观绩效评估概念和研究框架 |

POE研究从建筑领域至公园、广场等多尺度的城市开放空间，为景观绩效评估研究提供理论基础。

#### 1. 景观绩效评估主要研究体系的发展脉络

1. Development of major research systems for landscape performance evaluation

#### 2.1.1 POE: Early Research on Landscape Performance Evaluation

Commonly used in most early studies on urban built public spaces, POE research emerged in Architecture in the 1960s when the prevailing humanistic thoughts and systematic theories initiated an architectural interest shift from aesthetics towards rationality, highlighting user needs and humane care and users’ satisfaction feedback to design strategies. Wolfgang F. E. Preiser,
2.1.2 SITES: Progression of Research on Landscape Performance Evaluation

In the 1980s, pushed by the growing global energy crisis and environmental issues, the concept of “sustainable development” was developed and considered a guideline and objective to the practice in the Science of Human Settlements, paralleled by the increasing application of green building in sustainable urban development, including the associated green rating systems. For example, proposed by the U.S. Green Building Council (USGBC), the Leadership in Energy and Environmental Design (LEED) provides standards and guidelines for sustainable design practices. In 2006, inspired by LEED, the SITES was jointly initiated by Lady Bird Johnson Wildflower Center of the University of Texas at Austin, the American Society of Landscape Architects (ASLA), and the American Botanical Garden. In 2009, the SITES v1, the sustainable rating and certification system was released. Compared with POE, this system extents its focus onto the evaluation of multiple sustainable benefits, particularly on environmental benefits (such as resource intensive utilization, ecological restoration, stormwater management, and climate regulation). Social and economic benefits are also taken into consideration to improve the overall evaluation of design proposals, providing standards and guiding practice during the entire process of landscape design.

2.1.3 LPS: Refinement of Research on Landscape Performance Evaluation

The global urbanization in the 21st century has seen a wide transition from extensive urban sprawl to smart city growth through spatial quality improvement. This trend echoes the increasing demands for higher-quality landscape projects, which requires landscape architects to improve design strategies with scientific, reliable and effective evidences to enhance the sustainability of design practice. In 2010, LAF launched LPS and formally defined “landscape performance” as the “a measure of the effectiveness with which landscape solutions fulfill their intended purpose and contribute to sustainability”.
2.2 Comparative Analysis of the Three Research Systems

1) Evaluation attributes: Both POE and LPS are after-completion evaluation tools which allow for multiple-time evaluation; SITES is before-occupancy evaluation that can be done from the completion of scheme to that of construction, and its evaluation criteria, standard requirements, and reliability are dynamically improved with the constant updates of empirical case studies.

2) Evaluation mechanisms: By collecting users’ satisfaction feedback, POE evaluates the rationality of design strategies according to the theories of Social Behavior and Social Psychology. As a feed-forward grade rating tool, SITES follows the theories of sustainable development and ecosystem services to establish unified evaluation standards to score each sections in a project’s life-cycle (from site selection, design, construction, to operation and management) by reviewing related design proposals and construction and management schemes. LPS is a feedback evaluation tool sharing the same theoretical basis with SITES but focuses on evaluating a project’s overall benefits by quantifying its environmental, social, and economic performances after completion.

3) Evaluation contents: Focusing on user needs, POE mainly evaluates a project’s social benefits and the environmental ones associated with user needs, such as thermal comfort, humidity, air quality. SITES emphasizes on environmental benefits, complemented with social concerns, and economic benefits are considered the least; LPS is devised to evaluate a project’s environmental, social, and economic benefits in a holistic way.

As mentioned above, this paper considers LPS an integration of POE and SITES. First, LPS combines the feedback evaluation logic of POE (for quantify real performance) with the theoretical guidelines of SITES (as evaluation objectives and contents). Second, LPS quantifies the intangible social benefits by improving POE’s evaluation methods with specific indicators and multi-sourced data. LPS and SITES can be complementary for their feedback and feedforward logics respectively in the procedure of sustainable design. Drawing from the relatively comprehensive, specific,
and accurate outcomes by LPS, the evaluation indicators and methods of SITES can get improved[21] with less dependence on experts’ and public participants’ empirical knowledge. In this sense, the combination of LPS and SITES can work together to strengthen the sustainability of landscape practices (Fig. 2).

2.3 Summary on the Evolution of Research on Landscape Performance Evaluation

From POE to LPS, research on landscape performance evaluation has gradually formed a theoretical system beyond the forms of architectural performance evaluation to get in line with the disciplinary characteristics and demands of Landscape Architecture. Furthermore, the differences and interrelationships between the three systems indicate a shift of design ideology in Landscape Architecture — from design for user needs (POE) and design for sustainability (SITES) to demonstrate whether and what degree of a design’s sustainability (LPS). Specifically, although POE has recognized the necessity to evaluate the implementation effects of design strategies, most of POE case studies put more attention on user needs. SITES made a progress in pre-evaluating design strategies on multiple sustainable benefits, but adopts a rough rating system to evaluate the possible benefits with uniform criteria; comparatively, LPS equips with theoretical guidelines to assess the efficiency of design strategies, through which sustainable benefits can be measured qualitatively and quantitively.

Such shifts reveal the growing research interests of landscape performance evaluation on the relevance between design strategies and the implementation effects, corroborating the research aim that is to provide more targeted and reliable scientific evidences for enhancing design efficiency, and eventually informing the practice of evidence-based sustainable landscape design.

3 The Essence of Landscape Performance Evaluation: Discovering the Causality between Design Strategies and Benefit Results

Derived from architectural performance evaluation[22], landscape performance evaluation has drawn a broader discussion among the landscape academia given its significance to empirical landscape research[23]~[25], especially on ecology[26]~[28] and aesthetics[29]~[31]. However, among existing literature, the concept of “landscape performance evaluation” is often confused with “landscape benefit evaluation” but the differences are little studied. The paper holds a necessity to
这两个概念，且二者在评估对象和评估内容上都有着诸多相似甚至重合的部分。但是，已有文献中对“景观绩效评估”是否等同于“景观效益评估”这一问题却鲜有探讨，本文认为有必要厘清这两个概念间的内涵关系，以便更清晰地理解和开展景观绩效评估理论的相关研究。

本文从三个方面对这二者的内涵进行了详细剖析：1）从词义来看，效益（benefit）是指广义上可客观度量的具体益处，强调建成景观实体具有的某种效益特征，而绩效（performance）则特指某种设计策略促使建成景观产生的某些预期功能效果，强调两者的因果关系，效益即指其中的结果；2）评估对象上，景观效益评估的范围更广，涵盖地球上一切自然存在的或人工干预后的景观，景观绩效评估则主要针对人工干预为主的景观建成项目；3）评估目的上，景观效益评估用来揭示景观为人类提供的实际或潜在的好处，而景观绩效评估旨在验证某一设计策略促使建成景观产生目标效果的有效性。由此可知，从本质上讲，景观效益评估研究关注景观实体对人的帮助和益处，即效益结果；而景观绩效评估在此基础上需进一步明确设计策略起作用的程度，即突出建成项目的“效能”（图3）。

经比较，笔者认为景观绩效评估的概念内涵应该拆解为两层：一是效益测量，即对可持续景观项目所具有的多种效益进行量化，这与景观效益评估研究范畴重合；二是效能反馈，即在效益测量结果的基础上验证设计策略的有效性，将其作为对具体设计策略实施效果的反馈，以增强设计过程的科学性。即相较于景观效益评估，景观绩效评估的独特内涵是将设计策略和实际效益作为一个整体，以客观量化的方式分析前
者向后者转化的有效程度，既非对景观项目效益的单纯度量，也并非在度量效益结果之后仅仅进行经验性或主观性总结。然而，通过研究现有的相关文献，笔者发现多数景观绩效评估实际上仍停留于景观效益评估层面。只有将效益测量和效能反馈进行紧密结合的景观绩效评估研究才能真正为景观设计师提供“明确何种设计策略和方法将在什么程度上带来哪些正向效益”的可靠证据，从而有效支撑风景园林学的循证设计研究。

4 服务于循证设计的景观绩效评估研究重点

4.1 设计效能的反馈分析

反馈分析（feedback analysis）蕴含着项目前期设计方案的制定与项目实施后的效益之间的因果关联，旨在揭示影响景观系统绩效的设计知识，以供实践者进行及时、持续且高效的迭代应用。景观绩效评估是风景园林实践闭环式设计程序中的重要反馈环节。而设计效能反馈分析又是保障景观绩效评估研究高效发挥其反馈作用的重要内容，也是为多功能的可持续性设计寻求科学证据的有效途径。设计效能的反馈分析的研究成果，有助于增强风景园林设计实践的科学性，使景观绩效评估真正服务于循证设计。

设计效能反馈分析的重点在于明确指出效益结果与其所对应的策略之间的关联性。以实践项目的主要设计问题为导向，反馈分析的研究内容主要包括：1）解析具体的设计策略与效益结果的对应关系，即明确采用的何种设计方法带来了某种有利于环境质量、社会公平、经济发展的预期效益结果；2）进一步剖析影响各类效益结果的设计要素及其作用机制与影响程度；3）继而基于设计策略与效益结果的关联分析，更加精确地改善或优化相关设计策略，达到提升景观项目可持续性的目的。

当前，最常见的设计效能的反馈分析研究方法，是首先识别并选取影响效益的关键设计变量，然后通过项目前后的对比分析，或者通过不同建成项目的横向比较，分析某种设计策略在实现某种效益方面的能力大小或不同设计策略的效能差异。这类研究方法在环境效益研究方面运用得更加成熟，这与环境效益的关联因素较明确且影响量化有关。而社会效益和经济效益因其间接性和无形性，通常需要更多从实践性、系统性、长期性等方面来保障准确的评估结果。

4 Research Interests of Landscape Performance Evaluation for Evidence-Based Design

4.1 Feedback Analysis of Design Efficiency

By revealing the causality between design strategies and benefit results, feedback analysis explores the laws and principles of landscape performance to support dynamic and constant iteration of design strategies. Landscape performance evaluation is indispensable to the design processes of landscape projects with feedback analysis of design efficiency, which can substantially enhance the rationality of landscape design with reliable evidences.

To respond to the problems faced by a given landscape project, feedback analysis should: 1) measure whether the design strategies have brought any expected environmental, social or economic benefits or not; 2) identify the relations between specific design elements and actual benefits; and 3) improve the specific and accuracy of design strategies based on the analyses to boost the sustainability of landscape projects.

Commonly, the first step of feedback analysis of design efficiency is to identify the key design factors that impact the landscape benefits; then, through before-and-after studies on landscape performance of the sites or comparative studies among different built projects, the efficiency of a certain design strategy for specific benefits, or the efficiency variation among different strategies, can be discovered. This method has been applied more widely in assessing ecological benefits because they are easier to quantify. Since social and economic benefits are often indirectly-effected and intangible, more efforts are required to improve the development of evaluation criteria on design factors. Besides, research should also consider the uniqueness of authentic cases and enlarge the amount of case studies to increase the reliability of research results and offer guidelines for a broader design practice.
4.2 生产具有实践操作性的知识

经过实践验证和科学甄别、具有实践指导性和应用性的知识，是衔接科学研究和设计实践的重要媒介，也能够推动人类社会不断进步和发展。对服务于循证设计的景观绩效评估研究，其重要价值即在于通过科学论证手段提炼出有助于高绩效景观设计实践的知识。这些知识的质量（即其实践操作性）是将景观绩效评估研究有效转化为实践决策所需的最关键科学证据。因此，作为集合管理相关领域知识的知识库，其结构形态亦将影响知识传播和被应用的效果——即知识在实际应用中的可操作性。因此，为避免研究产出的知识难以被实践者理解或有效使用而沉寂于文献之中[36]，景观绩效评估研究应当面向实际需求，以设计实践问题为导向，以提高实践效用为目的，为实践者提供直接且实用的知识库。

4.2 Actionable Knowledge Production for Authentic Practice

Knowledge boosts the progress of human societies. In Landscape Architecture, knowledge tested by scientific application bridges academic research and design practice. To evidence-based design, landscape performance evaluation is expected to provide actionable knowledge to enhance landscape performance of authentic projects — in other words, the knowledge can be translated from research findings into effective design strategies. Moreover, since the structure and form of knowledge base would impact the spread, learning, and application of knowledge[16], research on landscape performance evaluation is encouraged to address actual demands and problems of given cases by establishing an easy and practical knowledge base. That is also vital to avoid that the knowledge produced by research is difficult to be understood or effectively used by practitioners[17,18].

Such knowledge production ought to deal with decision makers’ real concerns[20,46] and requires dynamic data updates. To be specific, knowledge production needs 1) to assist decision makers to evaluate and select design strategies and factors according to specific objectives, benefit types and efficiency, influencing mechanisms, etc.; and 2) to establish a dynamic knowledge base collecting the ever-growing research outcomes to meet practice demands and encourage knowledge sharing among as stakeholders.

At present, LAF has made a significant contribution to the knowledge production of research on landscape performance evaluation by devising the Case Study Briefs to LPS[5], a database of demonstrative sustainable projects that introduces quantified benefit data, sustainable features, challenges and solutions, and lessons learned. All the online information keeps updated. However, the knowledge produced from each case in this database is relatively isolated and scattered, failing to guide design practice by explicitly indicating the relation between strategies and landscape benefits results. The creation of such a database deserves an improvement in practical evidences.

5 结语

景观绩效评估研究有助于促进风景园林实践向循证设计方向发展，增强其科学性。基于文献分析，本文反思了当前景观绩效评估领域大量研究流于表面、成果实效应用性不强的现状，并厘清了景观绩效评估研究的发展过程、本质内涵和研究重点。笔者指出，关注设计策略和实际效益的因果关系是景观绩效评估概念的重要内涵，也是景观绩效评估研究发展的核心逻辑。该思想指导下的景观绩效评估研究
authors argue that related research should go beyond benefit measurement to invest efforts into two research interests: the feedback analysis of design efficiency based on measurement results, and the production of actionable and practical knowledge for evidence-based design. More in-depth research should be encouraged centering on these two interests to concretize the evidence foundation for sustainable design practice with higher performance and quality. LAF

ACKNOWLEDGMENTS

Many thanks to the peer reviewers and editors of this journal for their valuable comments on this paper.

REFERENCES

[1] Dai, D., Chen, Y., Cao, C., & Ren, X. (2018). Method and Practices of High-Performance-oriented Campus Landscape Design — Landscape Design of Jiading Sports Center of Tongji University. Landscape Architecture, 2(5), 92-97. doi:10.14085/j.fjyl.2018.01.0106

[2] Shen, D., C. H., & Wang, R. (2019). High Quality Ecological Praxis: Analysis of Core Characteristics and Discussion on Implementation Path. Urban Planning International, 34(3), 16-29. doi:10.22217/upi.2019.150

[3] Franco, M. (2005). A Case Study Method for Landscape Architecture. Landscape Journal, 31(1), 50-54.

[4] Li, P., Liu, B., & Gao, Y. (2018). An evidence-based methodology for landscape design. Landscape Architecture Frontiers, 6(1), 93-101.

[5] Yang, B., Li, S., & Zhu, C. (2014). Effects of the Forest Type with Higher Performance and Quality. Chinese Landscape Architecture, 31(7), 6-9. doi:10.3969/j.cnki.xdxbzr.2019-04-017

[6] Zhu, L., & Gao, C. (2016). From Landscape Criticism to Evidence-Based Design. Chinese Landscape Architecture, (1), 99-109. doi:10.14085/j.fjyl.2015.01.0099

[7] Gao, Y., Li, S., & Zhu, C. (2012). Method of landscape resource assessment. Chinese Journal of Applied Ecology, 17(11), 1733-1739.

[8] Yu, K. (1986). Assessment Method of natural scenic landscapes. Chinese Landscape Architecture, (3), 38-40.

[9] Luo, Y., & Li, M.-H. (2015). Landscape Performance of Built Projects: Comparing Landscape Architecture Foundation’s Published Metrics and Methods. Landscape Architecture, (1), 87-98. doi:10.14085/j.fjyl.2015.01.0087

[10] Dai, D., Li, M.-H., & Li, S. (2015). Research Development of Landscape Performance Assessment in America. Landscape Architecture, (1), 25-31. doi:10.14085/j.fjyl.2015.01.0028

[11] Yu, K. (1994). Greenroof of Performance Studies: Puget Sound Region. Landscape Research Record, (2), 148-156. Retrieved from https://thecela.org/wp-content/uploads/Chinese-Landscape-Architecture-2009-0222.pdf

[12] Haidich, A.-B. (2010). Meta-analysis in medical research. Hippokratia, 14(3 Suppl), 3-27. doi:10.1111/j.1165-2057.2011.tb01607.x

[13] Wang, J., Zhu, A., & Wang, M. (2016). Correlating Physical Forms of Riparian Zones in Urban Parks with Effective Ecosystem Services Provision of Water. Landscape Architecture Foundation. (n. d.). About Landscape Architecture Foundation. Landscape Architecture, 25(10), 92-97. doi:10.14085/j.fjyl.2015.01.0099

[14] Hu, R. (2015). The Objective Indicating of Landscape Performance Evaluation (Rev. ed.). Cham, Switzerland: Springer International Publishing AG.

[15] Pieranunzi, D., Steiner, F. R., & Rieff, S. (2017). Advancing Green Infrastructure and Ecosystem Services through the SITES Rating System. Landscape Architecture Frontiers, 5(1), 22-39.

[16] Preiser, W. F. E., Hardy, A. E., & Schramm, U. (2017). Building Performance Evaluation (Rev. ed.). Cham, Switzerland: Springer International Publishing AG.

[17] Preiser, W. F., E., Hardy, A., & Schramm, U. (2017). Building Performance Evaluation (Rev. ed.). Cham, Switzerland: Springer International Publishing AG.

[18] Preiser, W. F. E., Hardy, A. E., & Schramm, U. (2017). Building Performance Evaluation (Rev. ed.). Cham, Switzerland: Springer International Publishing AG.

[19] Preiser, W. F., E., Hardy, A., & Schramm, U. (2017). Building Performance Evaluation (Rev. ed.). Cham, Switzerland: Springer International Publishing AG.

[20] Preiser, W. F., E., Hardy, A., & Schramm, U. (2017). Building Performance Evaluation (Rev. ed.). Cham, Switzerland: Springer International Publishing AG.

[21] Preiser, W. F., E., Hardy, A., & Schramm, U. (2017). Building Performance Evaluation (Rev. ed.). Cham, Switzerland: Springer International Publishing AG.

[22] Preiser, W. F., E., Hardy, A., & Schramm, U. (2017). Building Performance Evaluation (Rev. ed.). Cham, Switzerland: Springer International Publishing AG.

[23] Preiser, W. F., E., Hardy, A., & Schramm, U. (2017). Building Performance Evaluation (Rev. ed.). Cham, Switzerland: Springer International Publishing AG.

[24] Preiser, W. F., E., Hardy, A., & Schramm, U. (2017). Building Performance Evaluation (Rev. ed.). Cham, Switzerland: Springer International Publishing AG.

[25] Preiser, W. F., E., Hardy, A., & Schramm, U. (2017). Building Performance Evaluation (Rev. ed.). Cham, Switzerland: Springer International Publishing AG.

[26] Preiser, W. F., E., Hardy, A., & Schramm, U. (2017). Building Performance Evaluation (Rev. ed.). Cham, Switzerland: Springer International Publishing AG.

[27] Preiser, W. F., E., Hardy, A., & Schramm, U. (2017). Building Performance Evaluation (Rev. ed.). Cham, Switzerland: Springer International Publishing AG.

[28] Preiser, W. F., E., Hardy, A., & Schramm, U. (2017). Building Performance Evaluation (Rev. ed.). Cham, Switzerland: Springer International Publishing AG.

[29] Preiser, W. F., E., Hardy, A., & Schramm, U. (2017). Building Performance Evaluation (Rev. ed.). Cham, Switzerland: Springer International Publishing AG.

[30] Preiser, W. F., E., Hardy, A., & Schramm, U. (2017). Building Performance Evaluation (Rev. ed.). Cham, Switzerland: Springer International Publishing AG.

[31] Preiser, W. F., E., Hardy, A., & Schramm, U. (2017). Building Performance Evaluation (Rev. ed.). Cham, Switzerland: Springer International Publishing AG.

[32] Preiser, W. F., E., Hardy, A., & Schramm, U. (2017). Building Performance Evaluation (Rev. ed.). Cham, Switzerland: Springer International Publishing AG.

[33] Preiser, W. F., E., Hardy, A., & Schramm, U. (2017). Building Performance Evaluation (Rev. ed.). Cham, Switzerland: Springer International Publishing AG.

[34] Preiser, W. F., E., Hardy, A., & Schramm, U. (2017). Building Performance Evaluation (Rev. ed.). Cham, Switzerland: Springer International Publishing AG.

[35] Preiser, W. F., E., Hardy, A., & Schramm, U. (2017). Building Performance Evaluation (Rev. ed.). Cham, Switzerland: Springer International Publishing AG.

[36] Preiser, W. F., E., Hardy, A., & Schramm, U. (2017). Building Performance Evaluation (Rev. ed.). Cham, Switzerland: Springer International Publishing AG.

[37] Preiser, W. F., E., Hardy, A., & Schramm, U. (2017). Building Performance Evaluation (Rev. ed.). Cham, Switzerland: Springer International Publishing AG.

[38] Preiser, W. F., E., Hardy, A., & Schramm, U. (2017). Building Performance Evaluation (Rev. ed.). Cham, Switzerland: Springer International Publishing AG.

[39] Preiser, W. F., E., Hardy, A., & Schramm, U. (2017). Building Performance Evaluation (Rev. ed.). Cham, Switzerland: Springer International Publishing AG.

[40] Preiser, W. F., E., Hardy, A., & Schramm, U. (2017). Building Performance Evaluation (Rev. ed.). Cham, Switzerland: Springer International Publishing AG.

[41] Preiser, W. F., E., Hardy, A., & Schramm, U. (2017). Building Performance Evaluation (Rev. ed.). Cham, Switzerland: Springer International Publishing AG.