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景观绩效：过去、现状及未来
Landscape Performance: Past, Present, and Future

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摘要：简述和讨论以美国为主的景观绩效研究与实践，并探讨以景观绩效为工具来创造可持续性、高效益以及具有弹性景观的未来展望。自 20 世纪 40 年代以来，绩效评价（Performance evaluation）就被运用于诸多领域。在风景园林与景观规划学科中，“ 景观绩效 ” 一词被定义为 “ 景观解决方案在实现其预设目标的同时满足可持续性方面的效率的度量 ”。定义中，可持续性是设计和规划的主要目标之一。景观绩效基于可测量结果，对景观的环境、社会与经济效益进行评价。

阐述了绩效评价系统的必要性及其形成。绩效评价系统力求提供可信的证据（数据及信息）支持，并指导和评价设计的决策。文章特别介绍了美国风景园林基金会（LAF）的景观绩效系列（Landscape Performance Series）。就景观绩效未来的发展而言，一是要将景观绩效理论应用于创造可持续性、高绩效的景观，二是要规定和规范能提升景观绩效研究与实践品质的景观特征。审视了这 2 个层面上的机遇与挑战。最后总结当对于有关景观绩效的生态会计学了解越多，将可以精准设定对于设计与规划干预的期望，包括制定有效的公共政策，降低投资风险，提高投资回馈，通过实现可持续性与弹性来扩大影响。

关键词：景观；绩效测量；生态会计学；评价体系；指标；可持续性景观解决方案；弹性

Abstract: This paper provides a synopsis and discussion of landscape performance research and practice, especially in the United States and explores its future as a vehicle for creating sustainable, high-performing, and resilient landscapes. Performance evaluation has been employed in many disciplines for a variety of purposes since the early 1940s. In landscape architecture and planning, landscape performance has been defined as “a measure of the efficiency with which landscape solutions fulfill their intended purpose and contribute toward achieving sustainability.” In this definition, sustainability is one of the major goals of a design and planning intervention. Performance assesses progress toward achieving the environmental, social, and economic goals based on measurable outcomes.

This paper reviews the growing need for and the emergence of performance systems that strive to provide credible evidence (data and information) to support, guide and evaluate the outcomes of design decisions, with special emphasis on Landscape Architecture Foundation’s (LAF) Landscape Performance Series initiatives. It examines the challenges and opportunities in implementing landscape performance to create sustainable and high-performance landscapes and proposes advances that will elevate the quality of landscape performance research and practice. The paper concludes by postulating that as more is known about ecological accounting involving landscape performance, it may be feasible to set concise expectations for design and planning interventions that will inform effective public policy, reduce investor risk and improve return on investment, and thereby scale up impact toward achieving sustainability and resiliency.

Key words: Landscape; Performance Measures; Ecological Accounting; Rating Systems; Metrics; Sustainable Landscape Solutions; Resiliency

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1 引言

本文综述了景观绩效的研究与实践，并重点探究了美国景观绩效的发展趋势，亦探讨以景观绩效为工具来创造可持续、高效益以及具有弹性景观的未来展望。绩效评价力求理解、管理并提高一个系统的绩效表现，即它的输入、处理和输出过程。设计与规划领域的绩效评价可追溯至 1943 年《度量城市活动：针对建议的评价管理标准之调查》（*Measuring Municipal Activities: A Survey of Suggested Criteria for Appraising Administration*）的发表 [1]。自此之后，绩效评价在多个领域的使用开始成长。

所有的绩效评价定义都有以下几个关键的主题，如根据预定目标，在特定的时间范围内评价项目的结果；将产出与投入（如资金，时间，专业技能等）或明确地定义的标准进行对比 [2]；在特定的目标和标准下，及时监测项目的完成进度。评价标准主要针对几个方面，包括有效性、效率、品质、及时性、生产力和安全性等 [3]。而在景观领域，景观绩效被定义为“景观解决方案在实现其预设目标的同时满足可持续性方面的效率的度量”[4]，其中“可持续性”是设计与规划介入的主要目标之一。景观绩效基于可测量结果，对景观的环境、社会与经济效益进行评价。表 1 对比了 4 个学科（建筑、交通、城市规划和风景园林）的绩效评价，说明了各自的评价原理、评价框架、评价指标和预期结果 [5]。

2 景观绩效的必要性

景观绩效这一观念并不新颖，几十年来，科学家（卡普兰斯、罗杰·乌立奇、弗朗西斯·郭等）、城市规划师（威廉·怀特等）以及政府部门（美国农业部森林服务）已对景观元素在环境、经济和社会方面的效益做了度量 [6]。随着人们对公众问责制以及环境品质的期望不断提升，为支持、指导和评价设计提供可靠的证据（数据和信息）成了景观、建筑等循证学科越来越不可忽视的责任。作为实践者，风景园林师可以利用景观绩效清晰地表达其设计作品的价值，也可以有效且可靠地评估项目的设计决策，这对实现可持续目标颇有助益。因为无论采取何种方式度量可持续发展的相关内容（如零碳、净零水、生物多样性和生活质量等），如果忽略了景观设计方法的考虑，那么可持续性的目标也无从实现。因此风景园林师以能度量的效益来描述其设计是至关重要的。这样做可以构建景观绩效的知识体系，并使风景园林师能为项目甲方、相关设计人员、政策制定者以及其他倡议人士提供更多可持续景观方案，如绿色基础设施、公共空间、宜居社区、弹性建设和自然环境建设等。与表 1 中的其他学科不同，景观绩效的定义明确地将“可持续性”作为设计与规划介入的目标。

景观意味着人类活动发生所在的地域模板，它存在于自然过程与文化过程之间，是发生在土地上的全部自然与文化事件特征的表述 [7]。不同于建筑施工绩效，景观是互动、开放的复杂生态系统，物质、能量与物种可以跨越生态系统的边界自由流动。这种流动是动态的，并与时间相关。因此，准确有效的绩效度量需要在一个时间跨度内进行，比项目设计和规划的时间长得多。

此外，基线数据的不完整、不可靠甚至是不存在会增加景观绩效评价的难度。遗憾的是，对大部分项目来说，监测和反馈并不包含在预算中，再加上设计师、工程师与规划师的经验以及量化景观绩效的方法有限，景观绩效的量化在实践上很具挑战性。美国风景园林基金会（LAF）的一项非正式调查显示，设计师往往缺少资源，也缺乏评价其项目的环境、社会和经济效益的能力。尽管如此，成功案例也逐渐开始涌现。[8]

3 绩效评价系统

规划师与设计师正逐步采用一些基准建立对设计与规划项目的绩效预期。美国绿色建筑协会（The U.S. Green Building Council，简称 USGBC）创建了一套自发的、以绩效为基准的绿色评价系统，即能源与环境先锋认证（Leadership in Energy and Environmental Design，简称 LEED），主要针对建筑与场地的设计、施工、养护与使用。LEED 于 1988 年为建筑评价而建立，为了帮助建筑使用者、所有者、产权管理者更明智地运用资源，减少建筑中的浪费。如今，更加专门化的 LEED 系统出现了。2009 年，自然资源保护委员会（the Natural Resources Defense Council，简称 NRDC）、USGBC 与新城主义委员会（Congress for New Urbanism）合作创建的社区开发 LEED 认证（LEED for Neighborhood Development）将精明增长、城市化和绿色建筑的相关原则综合到评价体系中。该认证系统将评价范围扩展到建筑场地之外，延伸至整个社区乃至多个社区，“强调了建筑与基础设施、社区与区域景观的融合。”[9]

可持续场地倡议（Sustainable Sites Initiative，简称 SITES）在 LEED 的背景上创建。SITES 是一与生态会计学和度量系统相关的景观绩效认证系统，由德克萨斯大学奥斯丁分校的伯德·约翰逊夫人野花中心、美国风景园林协会和美国植物园联合创建，旨在为景观设计、施工、养护实践提供指导与绩效标准。SITES 的部分内容也被纳入 LEED 评价系统中，特别是加强场地规划与节水这 2 部分，它们可以依赖景观系统获得更高的效益。

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表 1 建筑、交通、城市规划和景观的绩效对比总结
Table 1 Summary Of Performance Comparison in Architecture, Transportation, Urban Planning and Landscape Architecture

	定义 Definition	测算原因 Reason for measuring	绩效对比基础 Performance comparison Base	起始时间 Year started	框架 Framework	相关群体 Involved parties
建筑 Architecture	将建筑或场地的实际绩效与明确记录的绩效标准进行系统性比较 “ the process of systematically comparing the actual performance of buildings, places, and systems to explicitly documented criteria for their expected performance ”	提供成功经验的反馈并揭示问题 Providefeedback regarding successful Experience and reveal problems 提高设计质量 Improvedesign quality	绩效标准（标杆） Performance criteria (benchmarks)	1960s	按建筑生命周期 6 阶段 Step-by-step along six phases of the life cycle of a building 规划 Planning 立项 Programming 设计 Design 施工 Construction 使用 Occupancy 拆除与回收 Adaptive reuse/recycle	客户 Client 设计师 Designer 项目参与者 Programmer 使用者代表 User representative 委员会 Commission agencies 使用者 Users
交通 Transportation	对项目成果，尤其是对是否达到设计目标的持续监测 “ the ongoing monitoring and reporting of program accomplishments, particularly progress toward pre-established goals ”	提高项目绩效，完善知识体系、激励正面行为、确保可控性 Improve performance, contribute to knowledge, motivate behavior and ensure control 强化责任 Improve accountability 对需求进行评估，促进与资源分配相关的交流和决策制定 Evaluate needs and facilitate communication and decision making regarding resource allocation	成本 Costs	1980s	成本与效益对比 Comparison of costs and benefits. 成本 Costs： 时间 Time 金钱 Money 财产损失和人身伤害 Property loss and injury 不适感 Discomfort 环境退化 Environmental degradation 效益 Benefits： 开展各种活动与娱乐项目 Access to activities and entertainment 促进市场形成 Enabled markets 经济和社会发展 Economic and social development	社区 Community 游客 Traveler 交通机构 Transportation agency
城市规划 Urban Planning	结果、服务或项目效益的定期度量 “ measurement ona regular basis of the results (outcomes) and efficiency of service or programs ”	强化责任 Improve accountability 根据预算制定决策 Inform decision regarding Budgeting	成本与标杆 Costs & Benchmarks	1940s	成本 - 效益评估 Cost-effectiveness evaluation. 项目和服务的效率和其生产率 Focus on efficiency and productivity of programs and services. 输入与输出的对比 Inputs vs. Outputs (outcomes)	项目代理商 Program agency 客户 Customer 专业测评员 Trained observer
风景园林 Landscape Architecture	景观解决方案在实现其预设目标的同时满足可持续性方面的效率的度量 “ the measure of efficiency, with which landscape solutions fulfill their intended purpose and contribute toward achieving sustainability ”	为景观的可持续性提供证据，减少设计中的不确定性 Collect evidence for sustainable solutions and reduce uncertainties during design 促进生态、文化、可持续性设计实践 Promote ecologically and culturally sustainable design practice	设计师的预设目标 Intended purpose of designers	2010	评估项目可持续性的三方面： 环境 - 经济 - 社会 Assess projects in the three aspects of sustainability: Environmental – Economic – Social	N/A

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频率 Frequency	是否考虑成本 Consideration of costs	指标类型 Metric type	指标选择标准 Metric selection criteria	方法 Methods	是否有对标准化方法的需求 Demand for standard methods
POE：每 2-5 年监控 POE: on-going monitoring, every2-5 years	是 Yes	定量指标 Quantitative 定性指标 Qualitative	客户广泛接受 Appea lwidely to clients 适用于大部分建筑 Be applicable to arange of buildings 简单 Simple 详细 Comprehensive in detail 可操作性强 Practical 相对便宜 Relatively cheap 可快速获得结果 Speedy turn-round of results 有处理细微变化的能力 Capable of dealing with subtle changes 提供易于解读的明确数据 Provide unambiguous factual data which are easy to interpret 基于坚实的核心方法 Based on a robust core methodology 连续性 Continuity 尽可能实现国际通用 Where possible, have capability for international application	POE: TM22 能量调查 TM22 energy survey 针对建筑使用者的问卷 Building Use Studies’ occupant questionnaire 其他调研 Other review： 采访 Interview 核心群众 Focus group 研讨会 Workshop 问卷 Questionnaire 日志 Diaries 群体访问 Group walkabout	是 Yes
长期持续监控 On-going longterm Monitoring	是 Yes	输入 Input 输出 Output 成果 Outcome	相关目标和对象 Linked to goals and objectives 限制测量项的数量 Limit number of measures 易于理解 Make it understandable 反映客户意见 Reflect customer point of view 考虑时间框架 Consider time frame 设定绩效标准 Set performance standards 跟踪外部因素 Track external factors 根据绩效而非数据可得性选择合适策略 Select measures according to performance rather than availability of data		是 Yes
长期持续监控 On-going long term monitoring	是 Yes	输入 Input 输出 Output 结果 Outcome 效率 Efficiency 生产率 Productivity	与任务书、设计对象的相关度 Relevance to mission and objective 易于理解 Easy to understand 数据收集可行性 Feasibility of data collection 成本 Costs 独特性 Uniqueness 可控性 Manipulability 综合 Comprehensiveness	项目和代理商的记录 Program andagency records 顾客调查 Customer survey 专业测评员评价 Trained observer rating 专业设备 Special technical Equipment	
N/A	证据不足 Not Sufficient	定量指标 Quantitative	与可持续策略相关 Linked to applied sustainable solutions 与数据可得性相关 Linked to availability of data	不同项目之间差别极大 Vary greatly across projects	是 Yes

卡斯卡迪亚绿色建筑协会（从属于国际生态建筑协会，同时为美国与加拿大绿色建筑协会分会）于2006年创建了“生态建筑挑战”（The Living Building Challenge，LBC）评价体系，这是另一个互补的国际可持续性建筑认证计划[10]。它推进了建筑环境可持续性的测量，能够被应用到各种空间尺度的开发中，如建筑、新建与更新项目、基础设施、场地和社区等。该认证计划的拥护者声称它比LEED等绿色认证计划更为严格。

LBC的创建基于“一个地球社区计划”。“一个地球社区计划”作为一个国际认证的计划，旨在促成开发商与设计师的合作，创造和维持一个可供所有人公平享有地球资源、健康快乐生活的世界[11]。目前全世界共有7个获得该认证的项目[12]，这个由伦敦百瑞诺公司（BioRegional）创建并执行的项目将可持续性定义为“地球资源可以承载的生态足迹”。在零碳与零垃圾的强制要求下，开发团队和设计团队通过紧密地合作，以“一个地球计划”的10条原则为目标。最终，当该绩效的目标实现时，地球资源能够承载的生态足迹的目标就可以实现。

需要强调的一点是，若要加入“一个地球社区计划”或参加LBC及其他评价，就需要对设计方案进行效益的量化。由于景观系统受到空间、时间和非线性特点的约束，完全展现可持续景观的价值是很困难的。因此景观往往被边缘化，在最终的设计中，景观仅仅作为装饰而非优先考虑的因素。因此，在展现景观的价值时，把景观特征（如屋顶绿化、生物滞洪区、可回收材料、乡土植物）和改善作用（如减少雨水径流、改善空气质量）的表述转变为实际的绩效（如净零水）的表述是相当必要的，以便让景观在最终的设计中得到重视。正如其他设计一样，景观只有在量化后才能展现出最大的潜力。

尽管所有这些评价系统都是循证的，并且对可持续设计的进步贡献良多，但给分数的依据仍然以设计意图为主，而不是建设与使用过程中实际的绩效。为了填补这个空白，美国风景园林基金会（LAF，以改善环境为目的的非营利性组织）发起了以绩效为核心倡议作为补充。

4 美国风景园林基金会（LAF）景观绩效研究倡议

2009年，LAF在景观绩效系列（LPS）策略研究倡议的创建过程中提出了“景观绩效”这一术语。多亏了LEED项目，设计师、社区开发者、管理者、政策制定者和一般公众已经对建筑绩效有了广泛的认知，LPS的目标是使景观绩效与建筑营造绩效一样深入人心。

通过收集典型的可持续景观项目在环境、社会和经济方面的效益，LPS试图弥补在设计、开发和政策领域中这一知识的缺失，从而被以下重要决策者理解和运用：风景园林师、相关的设计及开发者、联邦与地方政府机构、倡导可持续发展的非盈利性组织、参与可持续性议程的企业。

LPS专门构建了一个研究景观绩效的网上搜索平台。快速检索库（The Fast Fact Library）收录了在同行评议与发表的研究中与景观绩效重要发现相关的信息的简述。效益工具包（The Benefits Toolkit）是用于景观绩效评价的免费在线工具集。案例研究简报（The Case Study Briefs）是一个高绩效景观项目的数据库，这些项目具有可量化的环境、社会或经济效益。每个案例研究均包括一个描述评价方法的文档，文档描述了每一项效益计算的数据收集、数据来源以及计算过程。设计师、代理商和景观绩效倡导者可以应用LPS的工

具和资源寻找案例和绩效评价方法，同时为各种决策者提供可持续景观设计的案例。

不论是对于学者还是从业者来说，量化景观绩效都并非易事。为此，LAF 开展了一个特殊的合作方案——案例研究调查计划（Case Study Investigation，简称 CSI），该计划有助于景观设计公司和研究者共同推进量化景观绩效的案例研究。CSI 作为由研究人员、从业人员与客户三方合作对绩效进行评价的途径，在以下 2 方面均有重大的变革意义：（1）量化景观策略在可持续性上的贡献将会提升人们对高效益景观的需求，同时，CSI 能够为不同客户提供有效的参照，大大降低投资者的风险，进而推动了人们对景观服务的需求；（2）理解建成的景观项目的绩效能够为未来优质的景观设计打下基础，同时全面推动景观设计行业向可持续性的景观设计方向迈进。LPS 的在线资源还包括了一系列的宣传、交流和教材，使风景园林师能够更佳地理解量化绩效的重要性。LAF 出版的《景观绩效：指标选择指南》（*Landscape Performance: A Guidebook for Metric Selection*）是一本景观绩效评价体系的入门工具书，适用于景观从业者、学院机构和相关专业学生。

LAF 也推动了景观绩效理念与设计教育的融合。如今，景观市场对于实证的需求越来越高，面对这一趋势，风景园林专业学生应当对景观绩效的基本内涵与案例资源有一定的了解，掌握一定的评价技能，并能运用景观绩效与他人沟通。然而，景观绩效尚未成为教育体系中的常规部分。为了将景观绩效融入标准化的风景园林教学课程体系，LAF 编写了一系列案例教学材料，囊括了研究与调研方法、场地设计与分析、设计 Studio、交流讨论和研讨课程等等，并对相关院校提供补助。由景观绩效教育基金资助，景观绩效的相关教材发布在 LAF 网站上的“教育资源”部分，包括教学大纲、阅读书目、学生作业范例和教师对于教学方法和教学经验的总结。LAF 同时也通过与风景园林学科认证委员会（Landscape Architectural Accreditation Board，简称 LAAB）的对话，（註：该委员会发展和推广了美国第一个学士和硕士风景园林专业学科的认证标准）讨论修改目前 LAAB 的认证标准以期将景观绩效列入标准之一。

同时，LAF 帮助建立与景观绩效相关的知识主体和前沿研究。通过 CSI 计划资助案例研究，LAF 为风景园林院校建立了景观绩效的科研实力。参与者们表示该计划是绝无仅有的，院校也自发地将景观绩效内容带入课堂。除了以传统的形象生动的描述方式，景观公司在营销方案、面试和设计中逐渐进一步采用景观绩效的量化方法，且更青睐掌握景观绩效相关技能的员工。

5 执行绩效的测量：挑战与机遇

尽管景观绩效的发展前景光明，但在执行景观绩效的度量、创建可持续和高绩效的景观时依然面临许多挑战，这些挑战在设计和评价过程中都存在。绩效评价需要绩效度量的目标。最有效的方法是在项目开展之初设定绩效目标。绩效目标由规定的要求和客户需求共同决定，就理想情况而言，在项目即将建造或运营之前，设计师将根据项目目标提前决定哪一种指标和方法对于评价这一项目的绩效是最有效的。而后，设计师将针对性地从场地建设的不同阶段收集基线数据，从而在项目建成和使用后有对比的基准。但是，由于景观绩效方法还不成熟，往往没有资金支持使用后评价；同时，设计师未必会设定景观绩效的测量目标或收集基线数据用于对比项目建成前后的状况。因此，绩效的量化结论并不能完全代表该项目在可持续性方面的全部价值，但这并不影响它成为一个重要的开始，有待于在未来加以完善。

另一个执行景观绩效的挑战在于，景观绩效是没有一定常规的。与 LEED，SITES 或其他的评价体系不同，每个景观项目都有与之息息相关又各不相同的限制因素，如客户目标、气候条件、规模和可用数据等等，规定统一标准或指标对它们进行测算得出的结论恐怕不能令人信服。由于能够参与 CSI 项目的人员数量有限，LAF 为广大设计师和学者出版了《景观绩效：指标选择指南》一书，这本工具书也可在 LAF 网站上免费阅览，从而鼓励从业者加入景观绩效的实践。网站还将提供相关研究和案例的资讯更新。

6 景观绩效：展望

将景观绩效应用于设计和教育中，将有机会创造更具可持续性、高绩效和富有弹性的景观。由于设计成果可以被衡量，设计师将学会如何提高设计，从而为将来更加完善的设计打下基础。通过绩效评价展现可持续景观策略的价值可以提升景观的影响力，降低投资风险，增加投资机会，因为已有先例记录在案。这些案例能促使学生更有效地学习，并在政策有效性、款项利用和项目发展上获得支持。

景观绩效旨在提供一个另外的方法试图让设计解决方案获得接受。要是能与令人信服的陈述及图示表达方法相结合，量化的效益为广大决策者提供了制定策略的基本原理，扭转了因缺乏衡量决策得失的理论依据而形成的被动局面。LAF 景观绩效首次提供了一个基于量化评价、有目的地创造可持续景观的工具。当设计和记录景观绩效成为一项标准化操作程序，可持续景观策略将在更加复杂、综合、全球化的环境、社会和经济问题中发

挥更加重要的作用。

针对未来景观绩效的研究和应用，为了提高评价质量，我们提出以下建议：

（1）扩大目标的范畴，除了可持续性，还要更具弹性。弹性是指“系统具有一定的抗干扰能力，能够保持自身功能与结构的稳定性”[13]，弹性理论将景观（包括城市）看作一个具有社会、经济和生态多维度的自我组织系统或复合实体。对弹性的重视为加入像阈值这样的指标创造了可能。（註：阈值是指景观即将失去弹性并变为一个新状态，例如从草原景观变为沙漠景观时的临界值）。这种指标的加入为保证可持续的系统（景观）在收到人为或自然干扰的情况下仍能保持可持续性提供了机制。

（2）扩展评价标准，除了效率（efficiency）之外，还要引入有效性（effectiveness）。在景观绩效中，效率意味着景观的运作或者说对可持续发展的贡献程度，而有效性表明了景观是否按照设计预期来发挥。对这两种评价标准的关注有助于设计师与研究者收集更深层的评价数据和信息。

（3）强化定量与定性并重的研究思路。确保在环境、经验和美学 3 方面的景观干预能够被充分显示，而不是当前的片面强调定量测量。

（4）加强严谨、技术上有效的研究过程、方法和技术，同时对于其优势、劣势和局限性有清晰的了解。

（5）绩效评价时要考虑成本（如景观生命周期的成本）。“因为效益并非凭空发挥的……将成本纳入评价体系，不仅可以将传统景观策略和可持续策略之间的成本进行对比，同时可以实现成本与效益的对比。”[14]

（6）在评价过程中，综合考虑长期与短期效益及成本。

我们假定对于涉及景观绩效的生态会计学了解越多，对规划、设计带来的干预会相应地有更加准确和有根据的预估。这些预估将推进政策制定、降低投资风险、提高投资回馈，从而提高可持续与弹性景观的影响力。之前的挑战与机遇显示，景观绩效作为综合了研究与实践的新领域，可以为创建和维持可持续景观、弹性景观提供理论和方法论的基础，为评价景观在社会、经济和环境各方面的绩效提供可靠的指标体系。同时也表明，将景观绩效融入风景园林与规划学科体系是一种必然的趋势和迫切的需求，必须使未来的设计师能够配备相关的知识、能力与技术，开展景观绩效的研究和实践。

1 Introduction

This paper provides a general overview and discussion of landscape performance research and practice, especially in the United States and explores its future as a vehicle for creating sustainable and high-performing landscapes. Performance evaluation seeks to understand, manage, and improve the performance of a system---the inputs, processes and outputs---within the context of specific desired characteristics of the system. The origins of performance evaluation in the design and planning fields can be traced back to the publication of “Measuring Municipal Activities: A Survey of Suggested Criteria for Appraising Administration” in 1943.[1] Since then, its use in many disciplines has grown.

All definitions of performance evaluation emphasize several related themes, including assessing project or program outcomes within a specific time frame in light of the intended goals and objectives; comparing outputs to explicitly defined criteria or to inputs (e.g. resources such as funds, time, expertise);[2] and monitoring the timely progression of program accomplishments in the context of specific goals and criteria. The evaluation criteria may focus on dimensions of the system or project under consideration such as its effectiveness, efficiency, quality, timeliness, productivity, or safety.[3] In landscape architecture for instance, landscape performance has been defined as “a measure of the efficiency with which landscape solutions fulfill their intended purpose and contribute toward achieving sustainability.”[4] In this definition, sustainability is one of the major goals of a design and planning intervention. Performance assesses progress toward achieving the environmental, social, and economic goals based on measurable outcomes. Table one is a comparison of performance evaluation in four disciplines (architecture, transportation, urban planning and policy, landscape architecture) to illustrate the diversity of rationale for evaluation, assessment frameworks, evaluation metrics, and expected outcomes.[5]

2 Need for Landscape Performance

The notion of landscape performance is not new. For decades, scientists like the Kaplans, Roger Ulrich, and Frances Kuo, urbanists like William H. Whyte, and government agencies such as the USDA Forest Service have measured and observed the environmental, social, and economic benefits of landscape elements[6]. With growing public expectations on accountability and increasing the design and environmental quality of the built and natural environments, there has been an

increased pressure on evidence-based disciplines such as landscape architecture and architecture to provide credible evidence (data and information) to support, guide and evaluate the outcomes of design decisions. Landscape performance is emerging as a way for landscape architects as practitioners to represent and articulate the value of their work, as well as to provide reliable and valid evidence to support and evaluate their design decisions. This is critical in order to successfully make a vital contribution to achieving sustainability because no matter how sustainability is measured---zero carbon, net zero water, biodiversity, quality of life ---it cannot be achieved without considering landscape solutions. Therefore, it is important that landscape architects represent their work in terms of the measurable benefits. This will build the body of knowledge on landscape performance and provide evidence for landscape architects and others to make the case for more sustainable landscape solutions to their clients, allied design professionals, policy-makers, and others advocating for green infrastructure, public parks, livable communities, or resilient built and natural environments. The definition of landscape performance as presented here differs from the others depicted in Table One in that it explicitly identifies sustainability as one of the intended outcomes of design and planning interventions.

The landscape, as used here, implies the geographical template in which human activities take place. It lies at the interface between natural and cultural processes. It is the totality of the natural and cultural features on, over, and in the land.[7] Unlike estimating performance in buildings that are closed systems, landscapes are interacting, open-ended, complex ecosystems across whose boundaries materials, energy, and species flow freely. These flows are dynamic and linked to time. As such, estimating accurate and valid performance measurements occurs over a longer time horizon than that required for designing and planning many projects.

Moreover, it is difficult to estimate landscape performance when the baseline data are incomplete, unreliable, or in many cases, nonexistent. Regrettably, monitoring and feedback are rarely included in the budgets of most projects. Designers', engineers', and planners' experience and knowledge of the methods for quantifying landscape performance are limited. Quantifying landscape performance is challenging for practitioners. An informal survey by the Landscape Architecture Foundation (LAF) found that designers do not have the resources nor the perceived abilities to evaluate the performance of their projects to show the environmental, social, and economic benefits; however, success stories are emerging and growing.[8]

3 Performance Rating Systems

The good news is that planning and design professionals are gradually employing benchmarks to establish performance expectations for designed and planned landscapes. The U.S. Green Building Council (USGBC) developed a voluntary, performance-based, green rating system for design, construction, maintenance, and operation of buildings and sites know as Leadership in Energy and Environmental Design (LEED). The intent of LEED, established for the building level in 1988, is to help users, building owners, and property managers to use resources wisely and to minimize waste in buildings. Today, specialized LEED systems exist, such as LEED for Neighborhood Development. Developed in 2009 in partnership with the Congress for New Urbanism, the Natural Resources Defense Council (NRDC), and the USGBC, LEED for Neighborhood Development integrates the principles of smart growth, urbanism, and green building into a rating system that extends beyond the building to the site, whole neighborhoods, and multiple neighborhoods. According to USGBC, it "emphasizes elements that bring buildings and infrastructure together and relates the neighborhood to its local and regional landscape."[9]

LEED provided the context for the development of the Sustainable Sites Initiative (SITES), a related ecological accounting and measurement system for ascertaining landscape performance. SITES is a partnership of the Lady Bird Johnson Wildflower Center at the University of Texas at Austin, the American Society of Landscape Architects, and the U.S. Botanic Garden to create a voluntary set of national guidelines and performance benchmarks for landscape design, construction, and management practices. Portions of SITES have been incorporated into the LEED rating system. In particular, to enhance the site planning and water efficiency modules which are dependent on landscape systems to achieve greatest all around efficiencies.

The Living Building Challenge is another complementary international sustainable building certification program that promotes the measurement of sustainability in the built environment.[10] Developed by the Cascadia Green

Building Council (whose parent organization is the International Living Building Institute and is a chapter of both the United States and Canadian Green Building Councils) in 2006, the certification program can be applied to development at all spatial scales: buildings, new and revitalization projects, infrastructure, sites, and neighborhoods. The proponents of the program claim that it is more rigorous than green certification schemes such as LEED.

The Living Building Challenge in turn draws from the One Planet Communities Program. The One Planet Communities Program is an international certification program to lead collaboration among developers and designers to build and sustain a world in which it is easy, attractive and affordable for people everywhere to lead happy, healthy lives within their fair share of the earth's resources.[11] There are seven certified projects throughout the world. [12]Developed and implemented by BioRegional in London, the Program defines sustainability as an ecological footprint of one planet's worth of resources and then developed a process based on the 10 One Planet Principles to achieve it. The development and design teams work collaboratively to set stretch targets for the 10 One Planet Principles, with Zero Carbon and Zero Waste being non-negotiable, such that when the performance targets are achieved the project delivers an ecological footprint of one planet's worth of resources.

The key point to note that in order to participate in the One Planet Communities Program, and increasingly the Living Building Challenge and other rating systems, it is necessary to quantify the benefits of proposed design solutions. Because of the spatial, temporal, and non-linear characteristics of landscape systems, it is challenging to represent the value of sustainable landscape solutions to their greatest potential. As a result, landscape solutions are typically marginalized as decoration and not prioritized in the project's final design. Thus a shift in thinking beyond features (e.g. green roofs, bio-retention areas, recycled materials, native plants) and improvements (e.g. reduced storm water runoff, improved air quality) to actual performance (achieved net zero water) as representations of a landscape's value is necessary to have landscape solutions make their vital contribution to a project's final design. Like other project design solutions, the contribution of the landscape components must be quantified to fully participate to their greatest potential.

Importantly, while all of these rating systems are evidence-based and have done much to advance sustainable design, credits are awarded based on design intent, not how the projects actually perform over time once they are built and operating. To fill this gap in the marketplace, a complementary initiative that has ongoing performance as its centerpiece has been developed by the Landscape Architecture Foundation (LAF), a nonprofit organization devoted to the improvement and enhancement of the environment.

4 Landscape Architecture Foundation (LAF) Landscape Performance Research Initiative

LAF coined the term "landscape performance" in 2009, during the development of its Landscape Performance Series (LPS) strategic research initiative. The goal of the Landscape Performance Series(LandscapePerformance.org) was to make the concept and practice of "Landscape Performance" as well known and understood as "Building Performance", which is generally understood by the design and development community, regulators, policy makers, and the general public primarily thanks to the LEED program.

The LPS was intended to address this knowledge gap in the design, development, and policy realms by compiling the evidence-based environmental, social, and economic benefits of exemplary sustainable landscape solutions and making them understandable and accessible to key decision-makers, including: Landscape architects; Allied design and development professionals; Federal and municipal agencies; Nonprofits that advocate for sustainable development; Corporations with sustainability agendas.

The LPS provides an online, searchable platform of curated content focused exclusively on the measurable benefits of landscapes. The Fast Fact Library compiles short statements of the key findings related to landscape performance from peer-reviewed, published research. The Benefits Toolkit is a collection of free online tools and calculators that can be used to estimate landscape performance. The Case Study Briefs are a database of exemplary high-performing landscape projects with quantified environmental, social, and economic benefits. Each case study includes a Methods document, which describes the data collection, sources, calculations, and assumptions involved in the calculation of each landscape performance benefit. The tools and resources in the LPS are used by designers, agencies and advocates to find

precedents, evaluate performance, and make the case for sustainable landscape solutions to a wide variety of decision-makers.

Quantifying benefits has proven challenging for practitioners and academics alike. LAF then developed a unique collaborative program called Case Study Investigation (CSI) to support design firms and academic researchers to work together and produce case studies with quantified environmental, social, and economic benefits of landscape solutions. This participatory and collaborative approach to evaluating performance partnering researchers, practitioners, and the client has been transformative with a two-pronged effect: (1) Quantifying the contribution that landscape solutions make toward sustainability will increase the demand for high-performing landscapes and for the services of landscape architects by reducing risk for investors and providing effective content for advocates to better make their case, and (2) Understanding the performance of built landscapes will lead to better future designs thus, increasing our collective capacity to achieve sustainability. The online LPS resources are accompanied by a suite of outreach, communication, and educational offerings designed to get landscape architects to understand the importance of quantifying benefits. LAF's "*Landscape Performance: A Guidebook for Metric Selection*", is a tool that practitioners, faculty, and students can use as a starting point to conduct a landscape performance evaluation.

LAF is also working to accelerate the adoption of landscape performance in design education. To prepare for the professional challenges and opportunities of an increasingly evidence-based marketplace, landscape architecture students need awareness, skills, and resources to be able to design for, evaluate, and communicate landscape performance. Yet landscape performance is not yet an established part of the educational curriculum. LAF has compiled a set of sample teaching materials and offers grants to select university faculty to develop and test models for integrating landscape performance into standard landscape architecture course offerings, such as research and methods, site planning and analysis, design studios, communications, and other lecture or seminar courses. Course materials developed through the Landscape Performance Education Grants form the basis of the "Resources for Educators" section on the LAF website, which includes syllabi, reading lists, and sample student assignments, as well as faculty reflections on their pedagogical approaches and experiences teaching landscape performance. LAF has also begun dialogue with the Landscape Architectural Accreditation Board (LAAB), which develops and promulgates the accreditation standards for first professional landscape architecture programs at the bachelor's or master's level in the United States, about changing accreditation standards to specifically include landscape performance.

LAF is also helping to build the body of knowledge and advance research related to landscape performance. By investing in the collaborative production of Case Study Briefs through CSI, LAF is building research capacity among landscape architecture faculty and students through a participatory approach. Participants report that they will never design the same way again after going through the program. Faculty are voluntarily integrating landscape performance into the classroom. In addition to the images and evocative descriptions that have been traditionally used to make the case, leading landscape architecture firms are increasingly representing their work in terms of quantified landscape performance benefits in marketing proposals, interviews, and design objectives and are looking for employees who have these skills.

5 Implementing Performance Measures: Challenges and Opportunities

Despite these successes and positive trends, there remain several challenges in implementing performance measures to create sustainable and high-performing landscapes. These challenges occur in both the design and evaluation processes. Evaluating performance by definition requires that there are performance objectives from which to measure performance. Setting performance objectives is most effective at the beginning of the project, and when included in the scope of work. Performance objectives are determined by both regulatory requirements and client objectives. In addition, and ideally, designers look ahead to when the project will be built and operating and determine which metrics and methods would be most effective in evaluating how the project was performing according to the project's objectives. The designer would then collect baseline data accordingly in the site analysis stage of the design process in order to have data to benchmark against once the project is built and operating. Since the landscape performance approach is new and funding is generally not appropriated for post occupancy evaluation, designers are retrofitting the process and may or may not have set performance

objectives from which to measure performance or have collected baseline data to benchmark against before the project was built for a comparative analysis of before and after conditions. Therefore, performance benefits determined at this point may not fully represent the entire value of the project's sustainable landscape solutions, but serve as a critical start for others to model and develop further.

Another challenge to implementing landscape performance is that it is performance-based and not prescriptive. Unlike LEED, SITES, or other rating systems, each project is context-sensitive by client objectives, climate, scale, and availability of data, such that it would not be useful or effective to have standard or prescribed metrics and methods for a project from which to evaluate its performance. This can be challenging for designers who are not trained or paid to determine metrics and methods for evaluation. In response the LAF has produced a handbook for designers and academics to get them started to scale up implementation as not everyone can participate in its CSI program. The "*Landscape Performance: A Guidebook for Metric Selection*" is available for free on LAF's website. Future plans are to offer the handbook in web form for additional search and reference capabilities.

6 Landscape Performance: Looking Forward

There are many opportunities to create more sustainable, high-performing, and resilient landscapes as a result of implementing landscape performance into the design and education process. By being able to evaluate work, designers can learn how to improve it and adapt it to other projects for greater success in the future. Demonstrating the value of sustainable landscape solutions as a result of evaluation will increase awareness of sustainable landscape solutions, and reduce an investor's risk and increase opportunities for investment because there will be documented precedent. Documented precedent facilitates students learning and supports effort to be more effective in policy, appropriations, and program development.

Landscape performance is meant to serve as additional way to make the case for design solutions. In combination with a compelling narrative and visual communications, the quantified benefits from evaluating landscape performance provide the rationale for a variety of decision-makers which has here-to-for been insufficient or generally lacking to scale up efforts to achieve sustainability through landscape solutions. We contend that the primary rationale for embracing performance measures in creating sustainable and resilient landscapes is that it promises to elevate the quality of designed and planned landscapes, including the health, well-being, and preservation of people and ecosystem services. The LAF Landscape Performance initiative provides one effective vehicle to operationalize aspirations to create sustainable landscapes as a result of evaluation. When designing and documenting for landscape performance becomes standard operating procedure, sustainable landscape solutions will better make their vital contribution to the complex, interdisciplinary environmental, social, and economic issues faced world-wide today.

As we look into the future of landscape performance research and use, we suggest that the following will help to elevate the quality of the outcomes:

(1)Expanding the goals and objectives of the design intervention to embrace resilience, in addition to sustainability. Resilience is the "capacity of a system to absorb disturbance and reorganize so as to retain essentially the same function, structure, and feedbacks---to have the same identity"[13] Resilience theory views landscapes [including cities] as self-organizing systems or entities that have linked social, economic, and biophysical dimensions. Emphasis on resiliency provides an opportunity to integrate metrics such as thresholds (critical points at which sustainably designed landscapes begin to lose their elasticity and move to a different state such as from a grassland to a desert landscape). As a result, the integration provides a mechanism to ensure that sustainable systems [landscapes] continue to be sustainable in response to human-induced and natural disturbances;

(2)Expanding the evaluation criteria to include effectiveness, in addition to efficiency. In the context of landscape performance, efficiency deals with how well the designed landscape is performing and contributing toward sustainability. Effectiveness, on the other hand, addresses whether or not the designed landscape is performing the way it ought to. Focusing on both criteria enables the designer/researcher to gather a more in-depth evaluative data and information.

(3)Reinforcing current efforts in embracing both quantitative and qualitative benefits to ensure that the contextual, experiential, and aesthetic aspects of a design intervention are revealed and accounted for, unlike the current predominant emphasis on employing only quantitative measures;

(4)Strengthening current efforts in designing and implementing rigorous, technically valid research design, methods, and techniques that are also transparent in terms of their strength, weaknesses, and limitations;

(5)Integrating costs (e.g. life cycle costs) in estimating performance benefits---"since benefits are not generated for free … Costs not only allow cost comparison between conventional and sustainable solutions, but also facilitate cost-benefit study of sustainable solutions, and; "[14]

(6)Accounting for both short term and long-term performance benefits and costs in the evaluative process.

We posit that as more is known about ecological accounting involving landscape performance, it will be feasible to set concise expectations for design and planning interventions that will inform effective public policy, reduce investor risk and improve return on investment, and thereby scale up impact toward achieving sustainability and resiliency. Moreover, the aforementioned challenges and opportunities suggest exciting areas of research, scholarship, and reflective practice directed at solidifying the theoretical and methodological foundation of creating and maintaining sustainable and resilient landscapes and in developing reliable metrics for measuring the social, economic, and environmental phenomena needed for estimating the performance of these landscapes. They also illuminate the urgent need to integrate landscape performance into the landscape architecture and planning curricula, thereby increasing the likelihood that future designers have the relevant knowledge, competences, and skills to effectively engage in landscape performance research and practice.

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[2][7]Ibid, in Hatry and Worley (1999). Hatry H and J. Worley. Performance Measurement: Getting Results[M]. Washington, D.C: Urban Institute Press, 1999:4.

[3]Performance management[Z/OL]. accessed March 22, 2014, http://www.wikipedia.org; www.performancemanagement.org

[4]Landscape Architecture Foundation[Z/OL]. http://lafoundation.org, accessed September 10, 2011, December 4, 2013. The words in brackets are mine. LAF, a non-profit organization devoted to the improvement and enhancement of the environment, established a Landscape Performance Seriesin 2010 composed of an online set of resources to display, demonstrate, and provide tools for designers, allied landscape architecture professionals, agencies, and advocates to evaluate performance and establish a case for sustainable landscape solutions.

[5]Yi Luo, 2014, 47-48. In environmental planning for instance, metrics have been used to assist in policy formulation by providing benchmarks for environmental conditions, establishing environmental thresholds, evaluating the effectiveness of programs, ascertaining changes in environmental quality, and communicating to the public the well-being of ecological systems. These metrics are employed based on the assumption that the structural and functional characteristics of an ecosystem vary predictably with their location in their landscape; and that the well-being and functioning of the landscape can be inferred from the metrics. In architecture, building performance is well known and employed by builders, property owners, and the public to evaluate specific features of a building such as energy, structural properties, and thermal comfort, and productivity of its users.

[6]https://lafoundation.org/research/landscape-performance-series/fast-facts/

[8]Ming-Han Li, Bruce Dvorak, Yi Luo, and M. Baumgarten, "Landscape Performance: Quantified Benefits and Lessons Learned from a Treatment Wetland System and Naturalized Landscapes"[J]. Landscape Architecture Frontiers 1 (4), (2013):56-68.

[9]Leadership in Energy and Environmental Design[Z/OL]. accessed January 24, 2014, http:\\www.usgbc.org. According to the USGBC, over 57,000 commercial and institutional projects comprising 10.5 billion square feet of construction space are currently participating in LEED. These projects span over 147 countries which is an indication of the popularity of the rating system.

[10]Living Building Challenge[Z/OL].http://living-future.org/lbc, accessed November 13, 2014. The certification program has seven performance areas, namely site, water, energy, health, materials, equity, and beauty. In turn, these are subdivided into a total of twenty imperatives, with each focusing on a specific domain of influence.

[11]One Planet Communities Program[Z/OL].http://www.oneplanetcommunities.org/about-2/vision-and-aims/

[12]One Planet Communities Program[Z/OL]. http://www.oneplanetcommunities.org/communities/endorsed-communities/

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