

ASCE

美国土木工程师学会

2025 年的土木工程

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土木工程未来峰会报告

土木工程未来峰会工作委员会

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摘要

It is a great profession.

*There is the fascination of watching a figment of the imagination
emerge through the aide of science to a plan on paper.*

*Then it brings jobs and homes...it elevates the standards of living
and adds to the comforts of life.*

That is the engineer's high privilege.

土木工程是一个崇高的行业。它的魅力在于把人类想象借助科技力量加以实现，同时为人们提供住房，创造就业机会，提高生活质量。这就是土木工程师的职责。

（赫伯特·胡佛，工程师，人道主义者）

A diverse group of civil engineering and other leaders, including international guests, gathered in June 2006 to actively participate in the Summit on the Future of Civil Engineering. Their purpose: articulate an aspirational global vision for the future of civil engineering addressing all levels and facets of the civil engineering community.

2006年6月，来自世界各地的土木工程及其他行业领导人和代表齐聚一堂，参加土木工程未来发展研讨峰会。其目的在于为土木工程界的不同层面勾画出土木工程行业未来发展的前景。

Today's status of civil engineering served as the Summit's benchmark. Examples of current issues and trends noted at the Summit include the poor condition of the infrastructure in many nations, occurrence of corruption in the global engineering and construction industry, minimal involvement of civil engineers in the political process, the need to more fully embrace sustainability, the globalization of engineering practice, and the desire to attract the best and brightest to the profession.

根据土木工程的现状，峰会提出了当前存在的问题与发展趋势，如：许多国家基础设施建设不完善、全球建筑工程中存在的腐败现象、土木工程师缺乏对公共决策的参与；应加快持续性发展及工程实践的全球化进程、吸引更多优秀人才加入本行业等。

Summit participants see a very different world for civil engineers in 2025. An ever-increasing global population that continues to shift to urban areas will require widespread adoption of sustainability. Demands for energy, drinking water, clean air, safe waste disposal, and transportation will drive environmental protection and infrastructure development. Society will face increased threats from natural events, accidents, and perhaps other causes such as terrorism.

与会代表预见，对于土木工程师来说，2025年与现在相比将会是完全不同的世界。全球性的人口增长并向城市迁移的进程要求广泛采取可持续发展战略。能源、洁净水、清洁空气、废物安全处理以及交通方面的需求将进一步促进环境保护及基础设施建设的发展。社会仍将继续面临自然灾害、突发事件以及其他威胁，如恐怖主义等。

Dealing with the preceding problems and opportunities will require intra-disciplinary, cross-disciplinary, and multi-disciplinary collaboration on projects and in research and development. More advances in areas such as information technology, intelligent infrastructure, and digital simulation will be needed.

上述问题与机遇要求在工程实践、科研开发等领域开展学科内、跨学科以及多学科的交流合作，同时也将促进信息技术、智能设备和数字模拟等方面的进步。

Informed by the preceding status of civil engineering and the challenges and opportunities facing it, the aspirational global vision developed as a result of the Summit is:

在这样的背景下，峰会达成共识，提出了土木工程业的发展趋势：

**Entrusted by society to
create a sustainable world and enhance the global quality of life,
civil engineers
serve competently, collaboratively, and ethically as master:**

- **planners, designers, constructors, and operators of society's economic and social engine, the built environment;**
- **stewards of the natural environment and its resources;**
- **innovators and integrators of ideas and technology across the public, private, and academic sectors;**
- **managers of risk and uncertainty caused by natural events, accidents, and other threats; and**
- **leaders in discussions and decisions shaping public environmental and infrastructure policy.**

土木工程师肩负着创造可持续发展世界与提高全球生活质量的神圣使命。为此，他们应具备团队合作精神与职业道德观念，成为称职的、专业的：

- 社会、经济与环境发展的规划者、设计者、建造者和运营者；

- 自然环境及其资源的管理者；
- 公共、私人、学术领域思想与技术的创新者与整合者；
- 自然灾害、突发事件与其他风险的管理者；
- 讨论和制定公共环境与基础设施建设决策的引导者。

Summit organizers and participants want the preceding vision to guide policies, plans, processes, and progress within the civil engineering community and beyond – and around the globe. The engineering community, especially the civil engineering community, is global and, as such, should share a common vision and work together to achieve it.

峰会组织者和参与者希望本报告能指导土木工程业内外以及全球的政策、计划、进程和发展工作。工程业，特别是土木工程业，是全球性的，应分享本展望并为此共同努力。

Now that the Summit is complete, the vision articulated, and the report completed, leaders of civil engineering organizations around the globe should move the civil engineering community toward the vision. Active engagement on a variety of fronts related to the environment and infrastructure are required in response to the challenge laid before the profession.

峰会结束后提出了本展望报告。世界各国土木工程组织的领导者应推动整个行业向该展望方向努力，并为应对行业所面临的挑战，积极投身于环境和基础设施建设相关的各个前沿领域。

2006: Status, Concerns, and Opportunities in the Civil Engineering Profession

土木工程业的现状、问题与机遇

除非加倍努力，否则就会落后。

（卢修斯·安纳尔斯·塞涅卡，罗马哲学家）

Civil engineers are rightfully proud of their legacy. Over the past century, clean water supplies have extended general life expectancies. Transportation systems serve as an economic and social engine. New bridges, blending strength and beauty, speed transport and bring communities closer together. Public and private construction, for which engineers provide the essential underpinnings of design and project oversight produces hundreds of thousands of jobs and drives community development. From the functional and beautiful Golden Gate Bridge in the U.S., Petronas Towers in Malaysia, and Pont du Gard in France to the largely hidden water supply and sanitary sewer systems, civil engineers have made their mark, day in and day out, in many aspects of the daily life of essentially everyone around the globe.

土木工程师应对前辈们所取得的成就感到由衷的自豪。上世纪，洁净水的供应大大延长了人类的寿命。交通系统成为推动经济与社会发展的引擎。作为力与美的结合，新的桥梁改善了交通运输并使社会联系更加紧密。工程师设计建造的公共与私有建筑为人们提供了成千上万的就业机会并促进了社会的发展。从美观实用的美国金门大桥到马来西亚的双

子星大厦，从法国加尔桥到大规模隐蔽供水系统和生活污水处理系统，土木工程师在每个人的日常生活中都留下了辛勤的印记。

问题与趋势

Civil engineers know they cannot rest on their laurels. Current trends pose questions about the future of the profession. These questions address the role that civil engineers play, and could play, in society, in the ultimate integrity of the world's infrastructure, and in the health of the natural environment.

土木工程师认识到他们不能安于成就。当前的趋势给本行业的未来发展提出了更高要求，涉及到土木工程师在全球社会基础设施建设的最终完善和环境良性发展方面所起到和能够起到的作用。

For many years, civil engineering leaders sounded the alarm about the lack of investment in maintaining and improving the infrastructure. Some of those shortcomings were tragically illustrated by the death and destruction caused by failures in which engineering designs, government funding, and the community oversight systems were all called into question. Civil engineers are painfully aware of the repercussions for public health, safety, and welfare when the infrastructure gets short shrift.

多年来，土木工程领导者们不断就维护和改善基础设施的资金缺乏等问题提出警告。由于工程设计、政府投资和社会监督等方面的一些原因已经导致了惨重的人员伤亡和工程破坏。土木工程师痛苦地意识到正是由于忽视基础设施建设而影响到公众的健康、安全和福利。

Yet those same engineers also know that they could do better in speaking out in the social and political arena, and in

becoming leaders in the policy-creating and decision-making process, so that the process is based on a sound technical foundation. Civil engineers know they must step up to the political and public service plate.

工程师们也知道，他们可以更好地在社会与政治舞台上发表见解，并引导政策制定和决策过程，从而使该进程建立在合理的技术基础上。因此他们应该更多地进入政治和公共服务领域。

The public has become increasingly aware that development need not come at the price of a compromised and depleted environment. Enlightened citizens see sustainability, not as an unattainable ideal, but as a practical goal. To answer that call, civil engineers realize that they must increasingly transform themselves from designers and builders to project life-cycle “sustainers.”

公众也逐渐认识到发展不应以威胁环境和无止境地消耗资源为代价。众多有识之士看到了可持续发展的前景，认为其是一个现实的目标而不是难以企及的空想。为此，土木工程师的自身角色应逐渐从工程的建造设计者向工程整个生命周期的“维护者”转变。

Such broadened responsibilities, along with the increasing breadth, complexity, and rate of change of professional practice, all put greater emphasis not only on continuing education but also on what a basic civil engineering education must deliver up front. The body of knowledge necessary to effectively practice civil engineering at the professional level is beyond the scope of the traditional bachelor’s degree, even when coupled with the mandated early-career experience. Education must meld technical excellence with the ability to lead, influence, and integrate, preparing the engineer to weigh the diverse societal

issues that shape the optimal approaches to planning, design, and construction.

责任的增加，同时工程实践的范围扩大、日趋复杂、变化加快，使得土木工程行业不但对继续教育而且对基础教育越发重视。土木工程实践所需知识在专业层面上已经超出了传统学士的教育范围，即便是加上初期的工作经验也仍嫌不足。教育应该把技术能力与领导才能、影响力以及综合能力融合在一起，培养能够针对不同的社会问题制定最佳规划、设计和建设方案的工程师。

面临的压力

Technology and market forces bring additional pressures on how civil engineers play out their roles. Knowledge-based civil engineering software increasingly shifts routine engineering tasks from the realm of the engineer to that of the technologist and technician. How will this trend play out in the years ahead? Will civil engineers move further into a **systems role**?

技术和市场为土木工程师如何发挥自己的作用带来了双重压力。土木工程软件的出现和发展，使得原本属于工程师的工作任务逐渐由技术人员和技师承担。这种趋势今后如何发展？土木工程师是否会进一步发挥其**综合的作用**？

Civil engineering risks becoming increasingly commoditized. Clients and owners may increasingly use low bid procurement—and thus the lowest innovation denominator—rather than qualifications-based selection and its opportunities to provide the best life-cycle options.

土木工程行业正面临日趋商品化的危险。客户和业主更多地根据较低的投标价格选择设计方案或施工队伍（这也导

致了工程中缺乏创新），而忽略了对工程质量及最佳生命周期的重视。

And how will civil engineers in advanced nations react as the need to have project teams all in one place continues to shrink, and lower-cost engineers from rapidly expanding technological workforces around the world vie for a piece of the global economic pie? Will economic forces make that pie expand, with more work for all engineers, or will barriers be proposed to slow the negative local employment impacts? How will civil engineers gain the needed knowledge of international business practices and cultural and linguistic issues and will they further address corruption in the global engineering and construction industry? In the future, some, now dominant countries may have a diminishing global role in engineering research and education and in application of new technology.

目前，多支工程队集中在一处作业的需求不断减少，同时迅速增加的技术性劳动力又产生了大批廉价的工程师，他们也要求在全球经济发展这块大蛋糕中获得自己的经济利益。发达国家的土木工程师们该如何应对这种局面？是否可以将那块经济蛋糕扩大，给工程师提供更多的工作机会，或者想办法减小对当地就业的负面影响？土木工程师如何获取国际商业、文化和语言方面的知识？能否进一步解决全球工程界和建筑业中存在的腐败问题？目前在工程研究、教育和新技术应用方面占优势的国家，其未来影响可能会逐渐减小。

Civil engineers, because of their work with infrastructure and the environment, can contribute to world stability. Consider one example: Virtually every nation on earth is either facing, or within 20 years will face, some type of water supply challenge. That demand for this life-giving resource, coupled with the need

to share it across national boundaries, could make for an explosive situation. The application of civil engineering knowledge and skills to enhance water supply and improve distribution could very well become one of civil engineering's greatest challenges.

由于土木工程师的工作与基础设施建设和环境发展紧密相关，因此他们将在维持世界稳定方面发挥作用。举个例子来说，目前地球上的每个国家正面临或者 20 年内就要面临某种形式的水资源供给危机。对这种基本生命资源的需要，特别是希望跨越国界共享水资源的愿望，可能会造成国家间的紧张局势。应用土木工程的知识、改善水资源的供给和分配是土木工程面临的最大挑战之一。

职业要求

All these issues represent critical tests for civil engineers, with new responsibilities looming for a new generation. For many years, the profession has wrestled with its career appeal to a diverse population of the best and brightest. How can pre-college students learn more about the civil engineering opportunities for both helping mankind and building a fulfilling life for themselves at a competitive compensation? And when on-the-job assignments do not match the promise of stimulating work, how can management step in to help while still building the bottom line?

上述这些问题将成为下一代土木工程师们所肩负的新责任。多年以来，土木工程努力吸引最优秀、最杰出的人才加入本行业。如何能让预科大学生（进入大学前的学生）了解土木工程是一个不仅有益于全人类而且有利于他们在竞争中

实现自身价值的行业？当工作成果与预期的工作激励不相匹配时，如何在保证最低要求的基础上加以协调？

未来方向

Civil engineers thus find themselves as keepers of an impressive legacy while raising concerns about future directions. They know they must take more risks. They know they must show more leadership. They know they must control their own destiny and not let events control them.

作为前辈们遗产的继承者和发扬者，土木工程师们也关注着未来的发展方向。他们深知自己必须承担更大的职责。他们深知自己必须展示更多的领导才华。他们深知应掌控自己的命运而非被命运掌控。

The Summit on the Future of Civil Engineering in 2025 represented an ambitious step on the road to that new future. Participants asked: What will the civil engineering world be like 20 years from now? What aspirational role will civil engineers play in that radically transformed world?

2025 峰会提出了土木工程未来的大胆设想。与会者提出：20 年后的土木工程界将会怎样？在那个发生根本改变的时代里，土木工程师将会起到怎样的作用？

Clearly, looking ahead toward the unknown presents considerable risk. Future realities may not be captured and some aspects of the vision may prove to be a mirage. But the visionary gauntlet has been thrown. A diverse group of accomplished individuals gathered at the Summit to look beyond today's strategic issues—which were outlined here—to place their signposts for what the civil engineering profession should attain by 2025. The march toward those markers, and the enlightened struggles that will be needed to get there, are only just beginning.

The global civil engineering profession has taken up the challenge.

显然，探索未知有着巨大的风险。未来本身就难以捉摸，某些展望可能被证明是只是虚幻，但是展望已经向我们发出了挑战。在峰会上与会专家及代表讨论了当前的战略问题，为 2025 土木工程行业指明了具有前瞻性的方向，在此只是简要说明。朝着这些目标前进的征程仅仅是开始。全球的土木工业都已准备好迎接这个挑战。

峰会的目的及意义

毋庸置疑，哪怕是一小群信仰坚定的人也能改变世界，这也是人类历史上一直都在发生的事。

(Margaret Mead, anthropologist)

(玛格丽特 梅德，人类学家)

The Summit on the Future of Civil Engineering was convened in response to the status of, concerns with, and opportunities for the civil engineering profession as described, for example, in the previous chapter. A highly-varied group of civil engineers, engineers from other disciplines, architects, educators, association and society executives, and other leaders, including participants from eight countries other than the U.S.,⁷ attended. All gathered in Landsdowne, Virginia from June 21 to 23, 2006 to participate in the Summit.

针对上述有关土木工程的现状、面临的问题和未来的机遇，美国与另外八个国家的土木工程师、其他学科的工程师、建筑师、教育工作者、协会和学会的主管以及其他领导人于 2006 年 6 月 21 日至 23 日齐聚弗吉尼亚州兰德斯敦市参加此次峰会。

The Summit's purpose was to articulate an aspirational global vision for the future of civil engineering addressing all levels and facets of the civil engineering community, that is, professional (licensed) civil engineers, non-licensed civil engineers, technologists and technicians. The Summit's goal reflects the organizers' and the participants' preference of choice over chance. Statesman William Jennings Bryan highlighted those options when he said: "Destiny is not a matter of chance; it is a matter of choice."¹ Broadly speaking, there are only two

futures for civil engineering around the globe; the one the profession creates for itself or, in the void, the one others create for civil engineering. Civil engineers came to the Summit to choose their profession's future.

峰会的目的是寻求来自不同专业和层面的群体（包括职业土木工程师、非职业土木工程师、技术人员和技工等）关于土木工程未来的共同展望，并反映组织者和参加者对未来的选择。政治家威廉·杰宁·伯延（William Jennings Bryan）强调说：“命运不是机会，而是选择。”从宏观上看，全球土木工程业只有两种未来：一种是行业本身创造自己的未来，另一种靠其他行业为土木工程创造未来。土木工程师参加此次峰会正是为了自己选择行业的未来。

The purpose of this report is to outline the highly-interactive process used during the Summit and more importantly, to present, in detail, the Summit's results. The report's primary audience is any individual or organization that can help to achieve the vision that resulted from the Summit, as presented later in this report.

报告描述了会议期间热烈的交流过程，更重要的是，详细地提交了会议的结论。报告的主要读者是为实现本报告所提出展望而有所帮助的团体和个人，详见附录。

The Summit on the Future of Civil Engineering in 2025 proved to be a stimulating, uplifting, collaborative, and creative experience for participants. Breakout groups generated wide-ranging discussions and post-Summit synthesis of the ideas that were generated yielded the final vision.

对与会者来说，参加 2025 峰会是一个激励、促进、协作和创新的过程。分组会议的讨论内容和会后一些思想的综合形成了最终的展望。

As valuable as that may be, the Summit is intended to be just the beginning of an on-going influencing process. Summit organizers, and probably the vast majority of participants, want the global vision, as presented in this report, to guide policies, plans, processes, and progress within the global civil engineering community. This vision can exert influence within civil engineering around the globe and possibly within other engineering disciplines and other professions. The civil engineering community is global and, as such, could and perhaps should share a common vision.

尽管有着重大的意义，但此次峰会仅仅是实现展望进程的一个开始。会议组织者以及大多数参会者，希望本报告提出的展望可以引领全球土木工程界的政策、计划、进程以及发展。本报告将会在全世界土木工程业内部或者对其他工程学科以及其他行业产生影响。土木工程界是全球性的，能够且应该共同分享这一展望。

土木工程展望

敢于挑战强大的事物

去获得辉煌的胜利

即使因此落败

也胜过与那些缺乏勇气、既不能享受挑战的乐趣、也不能面对

更多挑战的人为伍

因为他们将度过灰暗的黎明

既不知道胜利也不知道失败

(提奥多尔·罗斯福，美国第 26 任总统)

展望

The Summit produced a series of aspirational visions stimulated by participant views of the world of 2025. The resulting integrated global aspirational vision is:

峰会与会者集思广益，提出关于 2025 土木工程未来共同展望如下：

土木工程师肩负着创造可持续发展世界与提高全球生活质量的神圣使命。为此，他们应具备团队合作精神与职业道德观念，成为合格的、专业的：

- 社会、经济与环境发展的规划者、设计者、建造者和运营者；
- 自然环境及资源的管理者；
- 在公共、私人、学术领域，思想与技术的创新者与整合者；
- 自然灾害、突发事件与其他风险的管理者；
- 讨论和制定公共环境与基础设施建设决策的引导者。

As used in the vision, “master” means to possess widely-recognized and valued knowledge and skills and other attributes acquired as a result of education, experience, and achievement. Individuals, within a profession, who have these characteristics are willing and able to serve society by orchestrating solutions to society’s most pressing current needs while helping to create a more viable future.

在报告中，“专业的”意思是拥有土木工程的基础知识和技能以及其它通过教育、工作经历和后天努力形成的素质。拥有这种素质的土木工程师们愿意、同时也能够为社会的紧急状况提供解决方案，创造更加美好的未来。

2025 年的土木工程师

The Summit addressed this question: What could civil engineers be doing in 2025? Addressing this question naturally led to describing the profile of the 2025 civil engineer, that is, the attributes possessed or exhibited by the individual civil engineer of 2025 consistent with the preceding aspirational vision for the profession.

峰会提出了这样的问题：2025 年土木工程师能做些什么？这自然引发了对 2025 年土木工程师的思考。即，2025 年土木工程师所具有的或表现出的个人素质应符合行业的要求。

Attributes may be defined as desirable knowledge, skills, and attitudes. As used here, knowledge is largely cognitive and consists of theories, principles, and fundamentals. Examples are geometry, calculus, vectors, momentum, friction, stress and strain, fluid mechanics, energy, continuity, and variability.

素质可以分别定义为有益的知识、技能和态度。

这里所说的知识包括理论、法则和基本原理。例如几何学、微积分、向量、动量、摩擦、应力和应变、流体力学、能量、连续性和变异性等。

In contrast, skills refer to the ability to do tasks. Examples are using a spreadsheet; continuous learning; problem solving; critical, global, integrative/system, and creative thinking; teamwork; communication; and self-assessment. Formal education is the primary source of knowledge as defined here, whereas skills are developed via formal education, focused training, and certain on-the-job experiences.

与之相对应的，技能指的是完成工作任务应具备的能力。例如使用电子制表软件的能力；持续学习的能力；解决问题的能力；严谨、全面、综合或系统、富于创造性的思维能力；团队协作、沟通、自我评价的能力等。正规的学校教

育是知识的原始来源，但技能是通过学校教育、集中培训和工作经历形成的。

Attitudes reflect an individual's values and determine how he or she "sees" the world, not in terms of sight, but in terms of perceiving, interpreting, and approaching. Examples of attitudes conducive to effective professional practice are commitment, curiosity, honesty, integrity, objectivity, optimism, sensitivity, thoroughness, and tolerance.

态度反映了一个人的价值观，决定他或她如何“看待”世界，不是用“眼睛”，而是如何发现、分析和处理问题。好的工作态度包括有责任感、有进取精神、诚实、正直、客观、乐观、洞察力强、一丝不苟和宽容。

The Summit identified many and varied attributes, organized into the preceding knowledge, skills, and attitudes categories. The results are presented here.

峰会界定了不同的素质并分别将其纳入知识、技能和态度范畴。下面分别列出：

The civil engineer is **knowledgeable**. He or she understands the theories, principles, and/or fundamentals of:

- ***Mathematics, physics, chemistry, biology, mechanics, and materials*** which are the foundation of engineering
- ***Design*** of structures, facilities, and systems
- ***Risk/uncertainty*** such as risk identification, data-based and knowledge-based types, and probability and statistics
- ***Sustainability*** including social, economic, and physical dimensions

- **Public policy and administration** including elements such as the political process, laws and regulations, funding mechanisms
- **Business basics** such as legal forms of ownership, profit, income statements and balance sheets, decision or engineering economics, and marketing
- **Social sciences** including economics, history, and sociology
- **Ethical behavior** including client confidentiality, codes of ethics within and outside of engineering societies, anti-corruption and the differences between legal requirements and ethical expectations, and the profession's responsibility to hold paramount public health, safety, and welfare

土木工程师应具备丰富的知识。他们应掌握以下方面的理论、法则和基本原理：

- 作为工程基础的**数学、物理、化学、生物学、力学和材料学**。
- 结构、设施和系统的**设计理论**。
- 风险识别、**基于数据和知识**、概率以及统计学的**风险或不确定性**。
- 社会、经济和自然界的**可持续发展**。
- 政治、法律法规、资金机制方面的**公共政策和管理知识**。
- 所有权的法律形式、利润、收入报表与资产平衡表、决策或工程经济以及市场营销等的**商业基础知识**。
- 包含经济学、历史和社会学在内的**社会科学**。

- 商业机密、工程界内外的道德准则、反腐败、法律要求和道德期望之间差异、保障公共健康、安全和福利的责任等**道德行为**。

The civil engineer is **skillful**. He or she knows how to:

- **Apply basic engineering tools** such as statistical analysis, computer models, design codes and standards, and project monitoring methods
- **Learn about, assess, and master new technology** to enhance individual and organizational effectiveness and efficiency
- **Communicate** with technical and non-technical audiences, convincingly and with passion, via listening, speaking, writing, mathematics, and visuals
- **Collaborate** on intra-disciplinary, cross-disciplinary, and multi-disciplinary traditional and virtual teams⁸
- **Manage** tasks, projects, and programs so as to provide expected deliverables while satisfying budget, schedule, and other constraints
- **Lead** by formulating and articulating environmental, infrastructure, and other improvements and build **consensus** by practicing inclusiveness, empathy, compassion, persuasiveness, patience, and critical thinking

土木工程师拥有熟练的技能，他们知道如何：

- **应用基本工程工具**，如统计分析、计算机建模、设计规范标准、工程监控方法。
- **学习、评价和掌握新技术**来提高个人和机构的效力和效率。

- 通过倾听、演讲、著述、数学计算和形象教学，与专业的和非专业的人士进行充分**交流**。
- 进行学科内、跨学科和多学科领域的**合作**。
- 对任务、项目、计划进行**管理**，在满足预算、进度和其他限制条件的前提下使其按期望目标交付使用。
- 通过规划和表述环境、基础设施以及其他方面的进步来进行**引导**并通过包容、理解、同情、劝导、耐心和评判性的思考来**达成一致意见**。

The civil engineer embraces **attitudes** conducive to effective professional practice. He or she exhibits:

- **Creativity** and **entrepreneurship** that leads to proactive identification of possibilities and opportunities and taking action to develop them
- **Commitment** to ethics, personal and organizational goals, and worthy teams and organizations
- **Curiosity** which is a basis for continued learning, fresh approaches, development of new technology or innovative applications of existing technology, and new endeavors
- **Honesty** and **integrity**, that is, telling the truth and keeping one's word.
- **Optimism** in the face of challenges and setbacks recognizing the power inherent in vision, commitment, planning, persistence, flexibility, and teamwork
- **Respect** for and **tolerance** of the rights, values, views, property, possessions, and sensitivities of others
- **Thoroughness** and **self-discipline** in keeping with the public health, safety, and welfare implications of most

engineering projects and the high-degree of interdependence within project teams and between such teams and their stakeholders

土木工程师拥有良好的工作态度。他们表现出：

- 预先判断并进一步发展机遇的**创造性和开创精神**，
- 对道德规范、个人和集体目标、团队利益**负责的精神**
- 持续不断的学习，找到解决问题的新方法，对新技术的推广或对现有技术进行革新并努力完善的**进取精神**
- **诚实和正直**，即说真话、守信用。
- 在瞻未来、承担责任、规划前景、坚持原则、灵活处理工作和团队合作时，面对挑战和挫折所具有的**乐观主义精神**。
- 对他人权利、价值、观点、财产、所有物和感受的**尊重和宽容**。
- 为了保证工程中的公共健康、安全、福利，体现工程队内部和他们投资人之间的高度依赖性，要坚持**一丝不苟及自我约束的态度**。

Many of the preceding attributes are shared with other professions. Civil engineering's uniqueness is revealed in how the attributes enable the profession to do what it does and, more importantly, to become what it wants to be. This is inherent in the global aspirational vision.

其他行业也同样拥有上述的品质特征。而土木工程的独特性体现在这些品质特征不仅推动本行业完成其现有的工作，更重要的是引导它的下一步发展。这在共同展望中也有所体现。

2025 年的土木工程业

在这个急剧变化的时代，
只有勤于学习者才能把握未来。
而停步不前者往往发现
他们已经不再适应这个世界了。

(Eric Hoffer, self-taught philosopher)

(埃里克·赫非，自修哲学家)

The Summit generated many and varied ideas as a result of discussing the civil engineer's world of 2025. More specifically, the breakout groups addressed these two questions:

- What will be different in the world of 2025?
- What could civil engineers be doing in that different world?

对于 2025 年土木工程师的世界，峰会经过讨论提出了许多不同的观念，着重强调了这样两个问题：

- 2025 年的世界有什么不同？
- 那时的土木工程师能做什么？

The answer to the first question defines the stage on which civil engineers will perform two decades from now. The second question's answer defines roles civil engineers could play. While civil engineers will not be able to greatly influence the stage, they can determine the acts in which they will appear and the roles they will play.

第一个问题的答案明确了 20 年后土木工程师发挥作用的舞台。第二个问题的答案则阐明了土木工程师能够扮演的

角色。虽然土木工程师无法对舞台产生很大的影响，但是他们能决定自己的角色及发挥的作用。

Using Summit results and a pre-Summit ASCE member survey regarding aspirations and visions for civil engineering in 2025, the following scenario was developed.

基于峰会的结论以及峰会前对美国土木工程师学会成员关于 2025 年土木工程展望的调查，可以推测出以下场景。

场景开始

The year is 2025. At the 2nd World Civil Engineering Societies Triennial Symposium in Rio de Janeiro, Brazil, engineers from industry, education and government met to continue the collaboration started six years ago in Oporto, Portugal. At the conclusion of deliberations, conference organizers submitted the following reports regarding the status of the sustainability of the world, research and development, risk management, innovation and integration, and reform in the preparation of engineers.

2025 年，第 2 届世界土木工程学会研讨会（每三年一次）在巴西里约热内卢召开，来自行业、教育和政府部门的工程师们相聚一堂，继续 6 年前在葡萄牙奥博多开始的合作。经商榷，会议组织者提交了以下关于世界可持续性发展的现状、研发、风险与管理、革新与整合、工程师培养改革方面的报告。

可持续发展的世界

The global civil engineering profession has increasingly recognized the reality of shrinking resources, the desire for sustainable practices and design, and the need for social equity in the consumption of resources. Civil engineers have helped raise

global expectations for sustainability and for environmental stewardship. The profession has led world acceptance of green design and has been at the forefront in making environmental considerations part of life-cycle and cost-benefit analyses. Civil engineers have urged clients to use new, environmentally-friendly technologies to improve the quality of life in urban environments. Designs routinely incorporated recycling, either by using recycled materials, or by making project components recyclable at the end of their useful life. New processes, less harmful to the environment, have been implemented, and most new construction is based on green- and smart-building technologies. Many new buildings actually produce more energy that they consume.

全球土木工程业逐渐意识到资源正日渐匮乏的现实和对资源消耗进行社会平衡的必要性，渴望运用可持续发展理念进行设计建造。土木工程师在促进全球可持续发展和环境保护方面不断努力。绿色设计理念正被逐渐采用，使环境效应成为生命周期和成本效益分析的重要组成部分。土木工程师鼓励客户采用新型的环保技术以提高城市生活质量，推动设计与循环利用相结合，或者采用可循环材料，或者使工程部件在其使用寿命终结后可被回收利用。大多数新建筑采用了绿色智能工艺。许多新的建筑提供的能源甚至大于它们自身所消耗的能源。

On the demographic front, the world is well on its way to a population exceeding ten billion people in 2050. Today, people occupy more space on the planet than they did 30 years ago, and they are straining the earth's environment, particularly the needs for energy, fresh water, clean air, and safe waste disposal. Over the past 30 years, gradual global warming has profoundly impacted the more than half of the world's population that lives

within 50 miles of coastal areas. These areas have become much harsher places to live because of sea level rise, increased storm activity, and greater susceptibility to flooding. Growing population, shrinking resources, and climate change have led to sustainability and have put sustainability at the forefront of issues requiring global attention.

2050 年，世界将拥有超过 100 亿人口。今天，人们在这颗地球上比 30 年前占有更多的空间，他们使地球环境承受着更大的压力，特别是对能源、洁净水、清洁空气和废物安全处理的需求日益迫切。在过去的 30 年里，全球逐渐变暖已经严重影响了世界居住在沿海 50 英里范围内的超过一半的人口。因为海平面升高、不断增加的风暴活动、更易受洪水影响等原因，这些地区已经变得条件恶劣、难以居住。不断增长的人口、日益减少的资源、气候的变化要求可持续性发展。可持续性发展已经处于全球关注问题的最前沿。

Shifting demographics and population growth continue to strain the overburdened infrastructure. The shift of people moving from rural areas to cities and ex-urban areas has accelerated causing increased population density around the world. In the developed world, infrastructure is aging, and maintenance or replacement has not kept pace with its deterioration. In the developing world, the need for new infrastructure outstrips society's ability to put it in place. Influenced by civil engineering leadership, people now better understand the crucial link between infrastructure and quality of life, which has caused a major public policy shift in favor of improved infrastructure maintenance and accelerated infrastructure construction.

人口的迁移和增长不断给已经超负荷运转的基础设施施加更大压力。在世界各地，人们从农村向城市及城市周边迁

移速度的加快引起人口密度的加大。在发达国家，基础设施在老化，维护与更换已经跟不上它们的劣化速度。在发展中国家，对新的基础设施的需求已经超过了社会的承建能力。在土木工程业的引导下，人们现在已经能够更好地理解基础设施同生活质量的重要联系，这使得公共政策向改善基础设施维护以及加速基础建设方向倾斜。

Twenty-five years after promulgation of the Millennium Development Goals, some progress has been made, but the goals remain for the most part un-met against a backdrop of increasingly urgent global demand for environmental security and restoration. Improved understanding of the environment and the acceptance of broadly shared environmental values have led to an increased understanding that global environmental problems must be solved with global solutions. Nations unwilling to accept these values face worldwide pressure to conform to global norms for sustainability to improve the quality of life around the world.

在颁布千年发展目标的 25 年以后，土木工程领域取得了一些进步，但是在全球对环境安全及恢复环境的要求不断提高的背景下，大多数目标仍然没有实现。人们对环境的认识日益深刻并普遍接受了环境共享的观念，从而更加意识到全球的环境问题必须要有全球性的解决方式。来自世界范围的压力，督促那些不愿意接受环境价值观的国家，遵照可持续发展的共同标准来提高生活品质。

Demands for sustainable energy, fresh water, clean air, and safe waste disposal drive infrastructure development on a global scale. Constrained resources and growing energy demands have led to the need for prioritizing energy resources and for use of alternative fuels. The use of clean coal along with carbon

sequestration; nuclear energy; and renewable sources such as wind, solar, waves, and geothermal have made it possible to meet growing demands. In addition, increased urbanization has led to greatly increased use of mass transit and much less reliance on personal automobiles, which has greatly reduced demands for fossil fuels. Most vehicles now use fuel cell technology or renewable resources such as ethanol.

对可持续能源、洁净水、清洁空气及废物安全处理的要求，促进了全球范围内的基础设施发展。资源短缺以及不断增长的能源需要鼓励了能源的分级使用以及替代燃料的采用。碳隔离清洁煤、核能和可更新能源（如风、太阳能、潮汐及地热等）的使用将满足不断增长的能源需求。另外，城市化进程的加快促使人们更多利用公共交通，而私人汽车的使用则大幅减少，从而大大降低了对化石燃料的需求。现在交通工具更多地采用燃料电池技术或者可更新资源如乙醇。

The need for fresh water continues to be a global issue. Rapid urbanization in developing countries has made it a challenge to meet ever-growing demands for clean water. Improved water purification methods, desalination technologies, and increasing use of closed-loop systems have helped meet needs. There is growing use of gray-water systems, and a changing philosophy to purify water at the point-of-use in decentralized systems, which has reduced the need to treat large quantities of water to drinking water standards when only a small fraction is taken internally by humans. This has also led to energy savings for water treatment.

洁净水的供给需求依然是全球性的问题。发展中国家的迅速城市化使满足洁净水的需求成为一项新的挑战。改进的水净化方法、脱盐技术及闭环系统的使用为满足供水需求提供了帮助。可再利用废水系统的使用不断增加，并形成一种

理念，即在分散系统的使用终端进行水的净化，因为仅有一小部分水被人类饮用，这样就不必将大量水处理到饮用水标准，从而减少了水处理的能耗。

The principles of sustainability have also driven demands for safe waste disposal and for increased recycling and re-use to make substantial reductions in the waste stream. Advances in nuclear technology have changed the requirements for disposal of highly radioactive nuclear waste. Life-cycle design philosophies have taken hold resulting in nearly zero net waste and great savings in energy consumed for waste disposal. Virtually everything is recycled and re-used.

可持续发展原则也推动了废物的安全处理和循环再利用，从而相当大程度上减少了废物流。核技术的进步改变了高辐射核废料处理的要求。生命周期设计理念得到采用，其结果是几乎没有纯废物的排放，在废物处理方面节约了大量能源。事实上每样东西都可被循环使用和再利用。

New global standards for sustainable design, promulgated by non-government organizations (NGOs), have been implemented to meet the global demand for sustainability, overtaking the ability of any one country to maintain its own unique standards. Adoption of these international standards and best practices for sustainability has been facilitated by a growing awareness of liability concerns on a global scale. Increasingly, drivers for individual projects address regional and global issues as well as local issues because of converging environmental outlooks in the global community, and the need for the sustainability and project integrity.

为满足全球可持续发展的要求，由非政府组织(NGOs)颁布实施了新的可持续发展标准，取代了任何一个国家自己的标准。在全球范围内，不断增加的责任感推动了国际标准

的采用和可持续发展战略的实施。由于全球社会对环境以及对项目可持续性和完整性的认识加强，单个项目的管理者也逐渐致力于解决当地、整个地区甚至全球性问题。

One key to stability in the world is better equalizing of the standard of living. Ahead of plan, leadership and collaboration with major stakeholders around the world have closed the gap between advanced, developing, and underdeveloped nations. Innovative approaches have resulted in infrastructure addition, removal, repair, or replacement based on the changed societal requirements. Engineers are recognized as leaders, teachers, and learners in a wide range of environmental and infrastructure topics. Infrastructure financing routinely involves life-cycle costing analysis with public debate as to tradeoffs for different issues.

世界稳定的关键因素之一是更好地平衡各地区的生活水平。对全球投资者的引导与合作已经缩小了发达国家、发展中国家和欠发达国家之间的差距。根据社会需求的不同，可以分别采用新方法对基础设施进行建造、拆除、修理及更换。工程师被认为是解决诸多环境与基础设施问题的引导者、知识传授者以及专家。应在公开讨论的前提下，对基础设施投资进行生命周期成本分析，以此权衡不同方案的利弊。

研究与开发

Facing daunting issues following multiple global natural and manmade disasters in the first decade of the 21st century and the seeming lack of data pertaining to design, maintenance, and lessons learned, an international commission was established to define a strategic direction for global investment in research and

development. Civil engineers have led the shift from a remedial to preventive approach.

鉴于 21 世纪前十年发生的众多自然和人为灾难，以及土木工程设计、维护和损害评估相关数据的缺乏，为此成立了一个专门的国际委员会，为全球研发投资提供战略方向。土木工程师引导了从灾难后补救到提前预防灾难思想的一个转变。

The profession has defined a balanced view in driving the research agenda, spearheading intra-disciplinary, cross-disciplinary, and multi-disciplinary collaboration in prioritizing basic research needs on national and global levels. Civil engineers provide critical technical guidance in defining public policy throughout the government and global commissions.

土木工业在研究进程方面提出了统筹规划的观点，在国家 and 全球层次上区分基础研究的优先次序，带头进行学科内、跨学科及多学科合作。在政府和世界委员会中，土木工程师为制定公共政策提供了关键性的技术指导。

At the turn of the century, a major challenge in the area of risk assessment of technological innovation lay in validation of results **where the body of knowledge was minimal at best**. A protocol established over the last decade, which embraces the practice of conducting clinical trials, has led to breakthrough advances in research for application in the manmade and natural environments. In addition, the **methodology** calls for greater transparency and sharing of information with the public sector.

世纪之交，技术革新风险评估领域面临的主要挑战是技术成果的确认。过去十年的研究计划，包括现场试验等，为人工环境和自然环境中的应用研究带来了突破性进展。另外，研究方法需要更大的透明度以及更多的公共信息共享。

Civil engineering quickly moved to the forefront to define the research agenda for nanoscience, nanotechnology, and biotechnology applications in the 2025 infrastructure environment. Engineers recognized that nanoscience and nanotech products are the vehicles for major technological innovation across a spectrum of products affecting virtually every industry sector. Civil engineers from across industry, academia, and government worked on the development of instrumentation, metrology, and standards to realize a robust nanomanufacturing capability. This permitted the physical dimensions, properties, and functionality of the materials, processes, tools, systems, and products that constituted nanomanufacturing to be measured and characterized. This in turn enabled production to be controlled, predicted, and scaled to meet market needs.

土木工业迅速地制定了 2025 年基础设施建设中纳米科学、纳米技术以及生物技术应用的研究进程。工程师们认识到纳米科学和纳米技术产品几乎可以影响到所有工业领域的产品，是技术革新的主要载体。从产业、学术领域到政府部门，土木工程师在仪器制造、计量、标准等方面的工作使得纳米工业生产能力大大提高，使得纳米工业材料、流程、工具、系统和产品的尺寸、性质及功能形成标准并各具特色，使生产能够得到控制、预测，并满足市场需要。

In 2025, the civil engineering enterprise is focused on fast-track development and deployment of technologies. Steps taken by the profession over the past two decades in the areas of information technology and data management, have significantly improved how facilities are designed, engineered, built, and maintained.

2025 年，土木工程企业将集中力量进行技术快速研发和合理调配。过去 20 年土木工业采取措施，在信息技术和数据管理方面极大地改进了设备的设计、操作、建造和维护。

Civil engineers and the profession are now within the “tornado of the learning curve” focused on using application to drive technology. That being said, research now shows that **technology improvements today may enable applications not yet identified**. Civil engineers have reversed the image of being risk averse to new technology, instead relying on and leveraging real-time access to living databases, sensors, diagnostic tools, and other advanced technologies to ensure informed decisions are made.

土木工程师与其行业目前的重点是以应用推动技术的进步。有研究表明，现在的技术改进是通过其被应用推广而最终被确认的。土木工程师们改变了以往反对新技术的形象，已经能够借助数据库、传感器、诊断工具及其他先进技术实时做出决策。

Highly-integrated planning and construction tools, supported by four-dimensional databases, have been enabled by significant research investment in expanded computing capability. Data flows freely and is available at all times, representing current conditions. Latent defects are addressed early in the design, and flowed back into the parent database.

由于在扩展计算机处理能力方面研究资金的大量投入，可以利用四维数据库技术进行高度集成化的规划与施工应用，并随时根据数据流来显示当前的状况，使得设计中潜在的缺陷尽早得到处理并且返回母数据库。

Intelligent infrastructure (e.g., embedded sensors, real-time onboard diagnostics) have led to this transformation of rapidly advancing and adapting high-value technologies in the material fixed “pre-preg” and design phases. Real-time monitoring, sensing, data acquisition, storage, and modeling, has greatly enhanced prediction time leading to informed decisions. Robotics, emulating the human factors, provide another greater dimension for non-human intervention in high-risk areas of infrastructure.

智能设备（如：内置传感器、实时便携诊断仪）使得在材料准备阶段和设计阶段能够迅速应用与更新技术。实时监控、传感、数据读取、存储和建模等技术的应用大大地缩短了结果预测的时间。模仿人类特征的机器人技术，为高风险基础设施建设区域进行非人类操作提供了更大的空间。

Intelligent sensors have put productivity at an all-time high. Smart chip technologies enhance materials tracking, speed construction, and reduce costs. Wearable computing devices facilitate communication among onsite engineers, workers, and inspectors and provide access to remote documents, and resources across global divides.

智能传感器空前提高了生产力。智能芯片技术提高了材料调配效率、加快了施工进度并降低了成本。便携式的计算机设备方便了现场工程师、工人和监理进行实时交流，并且为获得全球各地的远程文档和资源提供了快捷途径。

风险管理

The world of 2025 presents a high-risk environment, with the ongoing threat of large-scale natural disasters and possible acts of terrorism. Civil engineers are at the forefront in developing appropriate approaches and designs to managing and

mitigating risk, realizing that high reward can come from high-risk solutions. Project-specific risk decisions are made at multiple levels as engineers become leaders of enterprise risk management, with some carrying the title of Chief Risk Officer.

大规模的自然灾害和恐怖主义威胁等使得 2025 年的全球环境趋于高风险。因为意识到高风险解决方案可以带来高回报，土木工程师们努力提出方案和设计来管理和降低风险。当工程师成为企业风险管理的引导者且其中一些拥有首席风险管理者的资质时，将能够在不同层面上制定项目的风险决策。

Risk is clearly a major driver of innovation, as engineers evaluate what new materials, processes, and designs might be used while weighing the potential for failure—balancing risk versus reward. Engineers reduce risk and, therefore, liability exposure by building living models of major structures that incorporate untried technologies, investigating in a flexible way the long-term performance. To aid the process, governments have instituted faster turn-around times for new regulations, permitting ever accelerating innovation.

风险无疑是革新的主要驱动力，工程师们将评价哪些新材料、工艺流程和设计可以被采用，同时也将评估失败的可能性，即权衡回报和风险。工程师采用灵活的方式，通过主要结构的仿真模型来检验未成型的技术，考察结构的长期性能，从而降低风险。为帮助这一进程，政府为新规范的修订制定了更快的周期，不断推动其更新。

The application of global, performance-based codes and standards has become widespread in enhancing the world's infrastructure, and civil engineers have been at the forefront in developing such guidelines. To address heightened threats and threat variability from place to place, the global codes and

standards have become risk-based, thereby more readily addressing local conditions. Natural and terrorist threats continue to change as world conditions evolve, and developers of codes and standards have become more proficient and proactive in adapting standards accordingly. In addressing the variations of local risk, engineers are also educating society on the limitations of new technology so that educated decisions can be made on adapting the way infrastructure is constructed while also managing expectations. However, such realistic management of expectations has not degraded the standard of care.

土木工程师一直致力于制定基于性能的工程规范和标准并加以普及，提高全球的基础设施建设水平。由于各地区所面对的威胁不断升级和变化，全球的规范和标准的制定将以风险为基准，从而更容易与当地的情况相适应。随着时代的变化，源于自然和恐怖主义的威胁也在不断改变，规范和标准的制定者也更专业、积极地对其进行修订。根据各地风险的不同，工程师们针对新技术的局限性对社会大众进行培训，以便根据建造设施的需要做出恰当的决定。当然这些灵活的处理方式并没有降低标准的权威性。

Large, multi-national corporations have continued to expand and become major economic forces on a global scale. The total revenues of these corporations exceed the GDP of many nations, and the interrelated nature of their global production and supply network has given them great influence over environmental norms and standards across nations. These multi-national corporations are now major drivers of global environmental standards, and the opportunity for promoting tougher standards in all countries has grown. Economic forces help drive such environmental improvement, but less stringent

environmental standards still prevail in some lesser developed countries. Local compliance issues also remain a challenge.

持续发展的跨国公司已经成为全球的主要经济力量，其收入总和超过了许多国家的国民生产总值。由于全球生产和供应网络的内在联系，它们在各国的环境规范和标准制定方面拥有巨大的影响力，是全球环境标准的主要推动者，并督促世界各国推行更为严格的标准。经济力量促进了环境保护的进步。但是在一些发展缓慢的国家依然存在不够严格的环境标准，地方保护问题仍然是巨大的挑战。

专业的创新者与整合者

In the civil engineering profession, project delivery has become an increasingly complex and diverse process. Twenty-five years ago, an owner often hired a design professional to develop a detailed design that was given to a contractor who transformed it into a finished product. The design team of 2025 includes a multitude of participants, many of whom are not in the engineering profession, but in related areas of management, environmental sciences, social sciences, legal, planning, geographic and other disciplines. Likewise, the contractor's team no longer comprises a few trades, but dozens of trades that are specialized in particular areas coming together in a managed process to complete the constructed project.

在土木工业，工程的建造越来越复杂化和多样化。25年前业主通常只雇佣一个专家来进行详细设计，然后由工程承包商建造。2025年的设计团队将包括许多参与者，他们中的多数并不属于工程业，而是属于相关领域，如管理、环境科学、社会科学、法律、规划、地理以及其他学科。同样，

承包方的队伍不再只包括少数专业，而是由许多不同专业共同参与，进行工程建设。

As the master innovators and integrators, civil engineers are the leaders that help develop and implement new technologies to create appropriate competitive advantages. Civil engineers are educated, trained, and well-equipped to be at the forefront of adapting and integrating these new technologies into both the design and construction areas. Civil engineers recognize that a narrowly focused perspective of the construction project is no longer valid. The focus must be multi-faceted, multi-disciplined, and holistic.

作为创新者和整合者，土木工程师们不断开发和应用新技术，从而赢得竞争优势。土木工程师经过教育培训，掌握应用设计和建造方面的新技术。他们认识到在建设中狭隘的知识面已远远不够，多层次、多学科、综合全面的知识才能满足要求。

Civil engineers are also the leaders in developing and implementing appropriate continuing education that encompasses the master builder/integrator concept. The team and integrator attributes are a part of the continuing education curriculum.

土木工程师在发展和完善继续教育方面也起到了带头作用，这种教育包含了塑造专业和复合型人才的概念。团队协作和综合素质也是继续教育的一部分。

As master innovators and integrators, the real-time exchange of ideas between engineers and other professionals has facilitated great team work in decentralized work environments. In those locations where cyberspace is still not available, the provision of wireless hand-held, voice-activated devices has kept engineers connected. Projects are now staffed and managed as if the project team were its own company. This has greatly cured

the “curse of the matrix” as well as clarified, unambiguously, the role, responsibility, and accountability for each team member. Some have reported that the focus on the project outcome, not which discipline was in charge, has led to dramatic changes. The civil engineer, as a master integrator, facilitated this improvement.

作为专业的创新者和整合者，即使是在分散的工作环境中，工程师和其他专业人士的意见交流也使团队合作变得容易。在没有网络的地方，工程师们通过无线声讯设备保持着紧密的联系。现在，项目人员调配及管理使项目部成为了一个团体，明确了每个成员的角色、责任和义务。有报告指出，在项目中如果着眼于总体成果，而不再仅仅是哪个学科占主导地位，将带来巨大的变化。土木工程师作为整合者，促成了这一进步。

工程师培养的改革

Led by civil engineers, the global engineering profession has implemented broad changes to the academic prerequisites to professional practice. Today, those seeking admission to the professional practice of engineering must demonstrate that they have fulfilled the appropriate body of knowledge through education and experience. The process of change to gain acceptance of the body of knowledge concept took over 20 years, but is now common practice over much of the globe.

在土木工程师的引导下，土木工程界在学术观念方面有了显著转变。现在那些希望参与实际工程建设的人必须证明，通过教育和实践，他们已经具备足够的知识和技能。尽管这种观念的转换用了 20 年，但现在这已成为全球的共识。

普遍

Civil engineering education and early experience have been reformed. Part of this change was driven by the recognition that academia and industry need to cooperate and partner in the delivery of baccalaureate, post-baccalaureate, and lifelong learning educational activities. Industry has aggressively brought real-world issues into university classrooms and has implemented broad steps to ensure continuing professional development of engineers throughout their careers. The academic-industrial partnership has enabled formal education to keep pace with new technologies and rapidly-changing current practices.

土木工程的教育和初期工作实践已经发生了改变。学术理论和行业实践的结合，学士、硕士教育与工程师终生教育的结合，推动了这种变化。大学课堂不但传授理论知识，同时也与工程实践密切联系。与此同时，应确保工程师的继续教育和发​​展贯穿于其事业终身。学术理论和行业实践的结合使学校教育能跟上新技术和快速发展变化的工程实践步伐。

The sea change in engineering education, both formal and on-the-job, has transformed civil engineering into a “learning profession,” further enhancing its image as a problem-defining and problem-solving profession in the eyes of the public. This enhanced reputation as a learning profession that identifies opportunities and addresses major problems has been cited as a key reason why great numbers of young people are making civil engineering their career of choice. Civil engineering’s outreach to help build capacity in the developing world has “put a human face” on the profession, which in turn has attracted more women, minorities, and people interested in social justice to the ranks of civil engineers. Because of this influx of new faces, the civil engineering profession today mirrors the population it serves.

这种在工程师培养方面的巨大变化，无论是学校教育还是工作培训，都使土木工程专业成为了一个“不断学习的职业”，在公众眼中，进一步强化了它判断问题和解决问题的专业形象。作为学习型职业，其提供的机遇及所应对的重大问题，使得许多青年人选择土木工程作为他们的事业。帮助发展中国家发展使土木工业“呈现了人性化的一面”，吸引了更多女性、少数民族和关注社会公平的人士加入土木工程大家庭。这些新面孔的加入，使今天的土木工业更加真实反映出它所服务的人群的状况。

In addition to requiring body of knowledge fulfillment for entry into professional practice, the civil engineering profession has led the way in recognizing specialty certification as a means of demonstrating competency in specialized areas of civil engineering. Over the past 20 years, specialty certification has become widely recognized, both within and outside the profession, as a measure of proficiency in a technical field. As a result of both board certification, and reform in the preparation of civil engineers, the public perception of civil engineers as knowledgeable professionals has steadily improved.

除了要求具备相应的工程实践知识，在土木工业领域还要进行专业资质评定。过去 20 年，作为评估技术能力的标准，专业资质证书在本行业内外被广泛认可。通过设立资质评定委员会与改革土木工程师的培养方式，使公众进一步认识到土木工程师是拥有专业知识的优秀人才。

Civil engineers have also been at the forefront of curbing corruption in the construction industry worldwide. Engineering ethics is one of the cornerstones and academia and industry have fostered lifelong learning in this key area.

土木工程师正在全球工程业内努力抵制腐败现象。行业道德是规范工程师行为的基石，它需要终生学习和不断完善。

现在回到 2007 年...

下一步工作

当我们建造一座工程时，不仅仅是为了目前的使用，
更应让它成为一件后人会感谢我们的作品。

（约翰·罗斯金，哲学家）

The aspirational vision presented in this report represents a beginning—the springboard to launch a sustainable, influential process so that the vision for civil engineering in 2025 can be attained. The Summit's sole goal was to define this aspirational vision; it was not to create the roadmap on how to achieve it. That map-making begins now—with you. If we are to succeed, we must rally everyone in the engineering community to help move this process forward.

对 2025 年土木工程的展望只是一个可持续的、影响深远的目标实现过程的开始。峰会的目的是明确这一展望，而不是计划如何完成它。行动现在开始了，就从你开始。如果要获得成功，我们必须集结工程业内每个人的力量来推动这一进程。

Now that the vision has been set and the future envisioned, leaders have a target to guide their policies, plans, processes, and progress on a broad and diverse front, within and outside the engineering community. After all, simply publishing the vision for the future will accomplish little.

随着展望的提出，在工程领域内外的各个方面，领导者们有了明确的目标来指导他们的政策、计划和进程。但仅仅出版这个展望是远远不够的。

In moving forward, leaders in the civil engineering community should recognize that:

- A variety of partners must be engaged, and opportunities for collaboration and action identified.
- The international engineering community must also be engaged to maximize the reaches of the vision to the global civil engineering community.
- The public and policy-makers must be engaged so that the profession serves society to the fullest.
- The education and training of future civil engineers and the continued development of today's civil engineers must include and go beyond the required technical competencies.

在前进的道路上，土木工程领域的领导者应当认识到：

- 要有更多人的参与并提供更多的合作机会。
- 国际工程界各团体也必须加入进来，使展望尽可能渗透到全球土木工程的每个领域。
- 公众和政策制定者必须参与进来，使本行业最大限度地为社会提供服务。
- 对未来土木工程师的教育和培训以及今天土木工程师的继续教育必须涵盖且超越现有的技术要求。

Forging a long-term action plan to achieve the vision will require input and cooperation from a diverse group of leaders

and organizations. Individual leaders within the civil engineering community must build awareness and excitement for achieving the vision. Additionally, civil engineering organizations have to create momentum toward the attainment of the vision within their organizations. Specific opportunities to present the vision for 2025 at board meetings, annual conferences, and the like must be identified and pursued. Organizations need to share knowledge and work together to make measurable progress toward the vision. For example, within the U.S., ASCE, the American Association of Engineering Societies, the American Council of Engineering Companies, and others might collaborate, holding joint workshops or conferences that focus on how to accomplish the vision for the civil engineering profession. Partnering with sister organizations such as the American Institute of Architects, the American Planning Association, and others will also maximize the success in meeting the goals for civil engineering. In addition to technical and professional organizations, client-related organizations must also be engaged. Finally, civil engineers must also obtain input from the public—the primary beneficiaries of civil engineering services. Such efforts among individuals and organizations around the world will be key to the achievement of our vision.

制定实现展望的长期行动计划需要不同组织和领导者的参与及合作。土木工程领域的领导者必须具有实现展望的意识和动力。此外，需要在土木工程机构内部激发实现展望的热情。董事会、年会以及诸如此类的会议是宣传 2025 未来展望并加以推动的有效途径。组织机构应共享信息、共同工作以推动展望的前进。比如，在美国，美国土木工程师学会、美国工程协会联合会以及美国工程公司委员会以及其它组织之间开展合作，可以成立联合工作组或召开联席工作会

议研究如何实现展望。为实现土木工程业的目标，可与兄弟机构如美国建筑师协会、美国计划协会等开展合作。除了技术和专业机构，也需要客户机构的参与。最后，土木工程师也必须要争取公众的参与，他们是土木工程服务的主要受益人。上述努力是实现展望的关键。

Today's civil engineers will need to transform themselves to meet the challenges of tomorrow. They must stay abreast of changing technologies, market trends, and business developments. Civil engineers need to develop and implement new methods and products which are sustainable and sensitive to the environment. Moreover, they must cultivate the new technologies, direct the market, and develop new business practices to lead the transformation into tomorrow.

今天的土木工程师需要为迎接明天的挑战改变自己。他们必须随技术更新、市场趋势和商业发展而进步。土木工程师需要开发和使用可持续性的、环保的新方法和新产品。另外，他们必须开发新技术、指导市场、创造新的商业机会，引导改革走向明天。

Educating future civil engineers is also an essential component of the vision for the civil engineering profession in 2025. Fulfilling the vision requires an expanded set of knowledge, skills, and attitudes, highlighting the need for curricula reform today to develop that knowledge and those skills and attitudes needed in 2025. Colleges and universities must examine their curricula as they relates to the future civil engineer so advancement toward the vision can be realized. In the U.S., ABET, Inc would be a targeted partner in this area.

未来的土木工程师教育也是 2025 土木工程业展望的主要组成部分。实现展望要求进一步拓展知识、技能和态度，

这是当前课程改革的重点。学院和大学必须检查相关课程是否与未来土木工程师教育的要求相符，这可以促进展望的实现。美国的 ABET 公司就是这样的一个目标伙伴。

Several aspects of the vision relate to the civil engineer's interaction with the public. Civil engineers aim to be—and be perceived as—trusted advisors to the public and policy-makers regarding infrastructure. To accomplish this, civil engineers must show the public how their services daily touch the public and improve lives. In particular, the civil engineering community must increasingly seek opportunities to influence more lives in more areas of world with our services. Now is the time to develop workable and economically feasible solutions to the world's infrastructure needs. The public must be engaged in this continuing process to raise the quality of infrastructure.

展望中的某些方面涉及到土木工程师和公众的相互影响。在基础设施建设方面，土木工程师努力成为（或被认定为）公众和政策制定者所信任的专家。为实现这点，土木工程师必须展示出他们日常是如何为公众服务并提高其生活质量的。特别需要指出，土木工程业必须创造更多的机会，为更多人提供服务。现在应寻找经济、合理、适用的方案以满足全球基础设施建设的需要。公众必须参与此进程以提高基础设施的质量。

U.S. civil engineers can be catalysts in sharing the vision with the global civil engineering community. The surest path to success is the integration of knowledge from civil engineers within a broad range of economies, cultures and circumstances. Conferences conducted by international engineering groups, such as the World Federation of Engineering Organizations, are excellent vehicles for obtaining concurrence and determining a

direction for the international civil engineering profession of 2025.

美国的土木工程师可以在向全球土木工程界推广本展望方面起到重要作用。最可靠的途径是经济、文化和环境等不同领域工程师的知识整合。世界工程联合会等国际工程团体召开的会议，有助于达成一致意见，并可为 2025 年国际土木工业确定方向。

Collective, long-term actions to help achieve the vision might include:

- A more robust educational path for civil engineers that prepares them for leadership and provides the multifaceted non-technical skills to serve on projects affecting the public good.
- A more clearly defined organizational structure for the engineering team, where the licensed civil engineer takes on the role of master program/project integrator.
- More civil engineers involved in public policy forums where future directions for society are developed and where civil engineers can gain the public's trust.
- More civil engineers elected to public office where they can directly influence infrastructure and sustainability policy and legislation.
- A greater level of collaboration and communication among civil engineers and those non-engineer stakeholders, seeking to balance a sustainable environment with needed infrastructure.
- Increased research and development to mitigate the effects of natural disasters, with civil engineers playing

a leading role in devising and implementing the innovations.

- Greater education and training of engineers in ethics and a greater emphasis on ethics in global engineering practice, allowing engineers to serve as role models.
- Sharing the vision with pre-college students, and their parents and counselors, to better inform them about the profession and thus attract even more of the best and brightest to the profession.

实现展望的长期行动包括：

- 为土木工程师提供更有力的教育途径，培养他们的领导能力和多方面的非技术技能，使他们能在影响公众利益的工程中发挥作用。
- 为工程队制定更加清晰的组织结构，其中有执业资格的土木工程师是专业工程计划的整合者。
- 更多的土木工程师参加社会未来方向的公共政策论坛，并获得公众的更多信任。
- 更多的土木工程师参与到公共部门，直接对基础设施建设和可持续发展政策及立法产生影响。
- 通过土木工程师之间以及他们同非专业投资人之间更高层次的合作与交流，来寻求发展可持续环境与基础设施建设之间的平衡。
- 加大研究和开发力度以削弱自然灾害的影响，其中土木工程师在设计和实施革新方面起到领导作用。
- 通过教育和培训，在全球工程实践中更加强调工程师的道德准则，使工程师们起到模范带头作用。
- 向进入大学前的学生以及他们的父母和顾问介绍本展望，使他们更好地了解本行业，从而吸引更多优秀人才的加入。

We hope that through these first sketches of possible action, you, the reader, will begin to contemplate how you, your organizations, and your countries can begin planning and implementing the next steps to making this vision a reality. This will be no small task. However, a united civil engineering community can start the hard work that will ultimately fulfill that promise.

我们希望通过以上描述，读者能开始思考自身以及其组织机构和国家怎样开始计划和实施以后的行动，以便将这一展望变成现实。这不是件容易的任务，然而，一个团结一致的土木工业能够开始并最终完成这个艰苦的历程。