

Is It Easy Being Green?: MIT Sloan Considers the Opportunities and Threats of Sustainable Building

John Sterman, Ankita Kaulberg, and Bethany Patten

It was early 2000, and MIT Sloan School of Management Dean Richard Schmalensee sat in his office reviewing the proposal for a new MIT Sloan building. The building committee he had convened to develop and manage the project had been hard at work assessing the needs of MIT Sloan and studying the facilities of other schools. The committee members were asking him to make a decision that would shape the future of the school for decades to come: Should the desperately needed new building be built quickly, using traditional design methods and features, or should the Dean commit to a sustainable, “green” building? If the latter, what did a “green” building really mean? In what ways would it help or hurt MIT Sloan’s image? What were the risks? How much more would it cost than a traditional building? How much longer would it take to complete? Would it require new and unfamiliar technologies? What if it went over budget? In a few minutes the Dean would meet with the building committee to weigh the pros and cons of both options. To keep the project on track he needed to decide.

Dean Schmalensee knew that the new building presented an opportunity for MIT Sloan to differentiate itself from peer schools. But what was the best way to differentiate? Did sustainable design matter to faculty, staff, current and potential students, alumni, and recruiters? Did it matter to MIT’s senior leadership? What about the prospective donors who would be needed to fund the project? None of the other top business schools had built green yet, so this was an opportunity for MIT Sloan to be a leader in sustainability – if it could deliver a green building before the rest. The new building would be the home of MIT Sloan for generations, so it was critical to consider the school’s future, not only current, needs.

This case was prepared by Professor John Sterman, Director of the MIT Sloan Sustainability Initiative, Research Associate Ankita Kaulberg, and Lecturer Bethany Patten, Senior Associate Director of the MIT Sloan Sustainability Initiative.

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The Dean also knew that pursuing a green building would mean additional work for the building committee, for MIT, and for himself. Neither he nor MIT had prior experience in sustainable design. There was a lot to learn, and mistakes could be costly and permanent. Green design promised lower environmental impact and energy use, thereby lowering operating costs. Those savings, however, required features such as extra insulation, high performance windows, efficient lighting with occupancy sensors, and high-efficiency HVAC (Heating Ventilation and Air Conditioning) systems with heat recovery ventilation. How much would these increase up-front capital costs? Worse, the incremental costs of green design were highly uncertain. And, of course, the value of any savings from sustainable design would depend on future energy costs, which were volatile and difficult to predict. Was there a business case for building green? What was the return on investment (ROI)? Payback time? Net present value (NPV)? Could these even be estimated?

Green building isn't a "yes/no" proposition. Rather, it is a continuum, from adding a little more insulation than building code requires to designing a "net zero" building that produces as much energy as it used (e.g., through solar power). Insulation might have a positive NPV, but, presumably, the marginal cost of reducing the next kilowatt-hour of energy use would rise sharply as the low-hanging fruit of cheap and easy green features is harvested. How green could the building be to generate reputational benefits without becoming too costly? Finally, even if some green features offered economic benefits, under MIT's accounting system, any savings from lower energy and operating costs would accrue to the Institute, not Sloan, while the burden of raising the additional funds to cover the capital costs of green features would fall on Dean Schmalensee's shoulders.

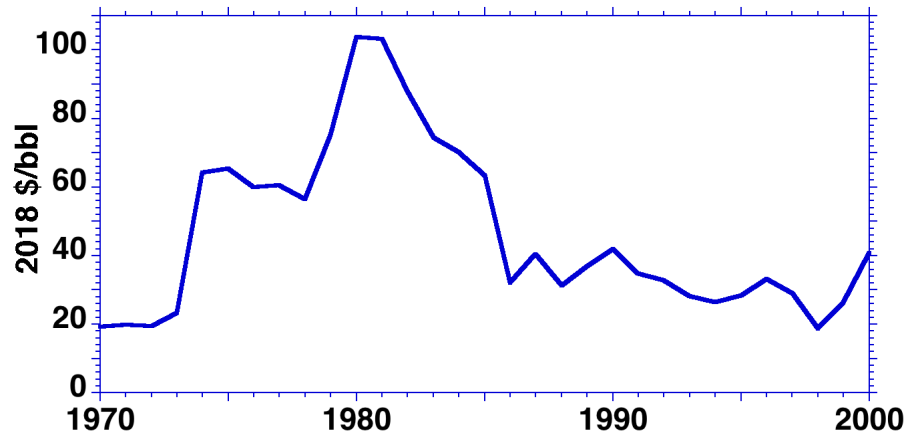
The building project also raised a host of political issues. Before selecting a site or beginning the design process, difficult questions about the future of MIT Sloan had to be negotiated: How large should the faculty be? How large should the MBA and other programs become? The MIT campus is small and dense. Competition for space is intense. The location and size of the new building were critical decisions in which the interests of the Sloan School were not necessarily aligned with those of other MIT Schools or the senior leadership of the Institute. Furthermore, faculty, staff, students, alumni, recruiters, and potential donors all had strong views about how a new building should look and what facilities it should have. Some in the administration wanted to hire a famous architect to deliver a building that made a bold statement, while others argued against the use of such "starchitects." Faculty, staff, students, and others who would work in the building were worried about the size of faculty offices, dining options, types and sizes of classrooms, and dozens of other issues. The Dean knew addressing these issues would require spending his political capital to negotiate good solutions for MIT Sloan and the Institute. Was it worth it to add an additional funding burden and take on the internal politics of building green?

Background

The Economic Environment

The energy crisis of the 1970s led to a decade of high oil prices. However, by the late 1990s, as planning for the new Sloan building began, oil prices had collapsed (**Figure 1**). The energy crisis of the 1970s was, for many, a fading memory. Gasoline and fuel oil were cheap again. Consumers were trading in the small, efficient cars they bought in the 1970s and 1980s for gas-guzzling sport utility vehicles (SUVs). Homeowners didn't see the payoff in spending their hard-earned dollars to cut their energy use. Businesses and other organizations, including universities, didn't feel much pressure to consider sustainability or energy efficiency when planning new buildings.

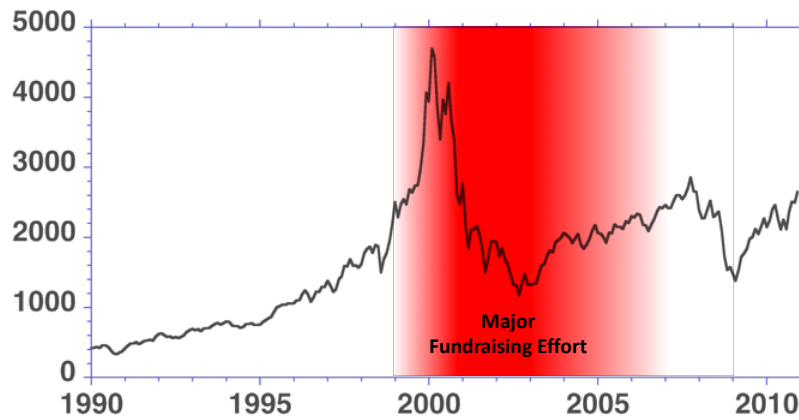
Figure 1 Real Crude Oil Prices, 1970-2000 (2018 dollars/barrel).



Source: US Department of Energy, Energy Information Agency, <https://www.eia.gov/outlooks/steo/realprices/>, accessed 28 January 2019.

Most of the funds for the new building would come from alumni and long-time friends of MIT. Serious fundraising began in 1999. Raising multimillion dollar gifts takes time, and just as the major fundraising effort was underway, the dot-com bubble burst (**Figure 2**). The Dow Jones Industrials fell 38% from its peak, and the tech-heavy NASDAQ composite index fell 78%. With many MIT alumni working in tech and finance, the collapse made fundraising a much tougher challenge.

Figure 2 NASDAQ Index, 1990-2012



Source: NASDAQ.

The Emergence of Green Buildings

The energy crisis of the 1970s accelerated work to boost the energy efficiency of commercial and residential buildings. After the first oil shock in 1973, many new buildings were heavily insulated and their building envelopes tightened to reduce costly losses of heated and conditioned air. Unfortunately, these tight buildings led to serious indoor air pollution problems arising from stale air, including the accumulation of CO₂, VOCs (volatile organic compounds), and other pollutants. High humidity promoted mold and mildew. A new term, Sick Building Syndrome, was coined to denote the health and environmental risks such buildings caused. A 1991 U.S. Environmental Protection Agency (EPA) report noted that in buildings with SBS,

...occupants complain of symptoms associated with acute discomfort, e.g., headache; eye, nose, or throat irritation; dry cough; dry or itchy skin; dizziness and nausea; difficulty in concentrating; fatigue; and sensitivity to odors...[and] [m]ost of the complainants report relief soon after leaving the building.¹

Reduced ventilation was a major contributor. Prior to the energy crisis,

...building ventilation standards called for approximately 15 cubic feet per minute (cfm) of outside air for each building occupant, primarily to dilute and remove body odors. As a result of the 1973 oil embargo, however, national energy conservation measures called for a reduction in the amount of outdoor air provided for ventilation to 5 cfm per occupant. In many cases these

¹ "Indoor Air Facts No. 4: Sick Building Syndrome," *Environmental Protection Agency*, January 1992 (https://www.epa.gov/sites/production/files/2014-08/documents/sick_building_factsheet.pdf, accessed January 28, 2019).

reduced outdoor air ventilation rates were found to be inadequate to maintain the health and comfort of building occupants.²

SBS gave efficient buildings a bad reputation that lingered for decades even as architects and engineers worked to address the issue. The solution to SBS was heat recovery ventilation (HRV). Instead of simply venting stale inside air while bringing in fresh outside air, HRV systems pass the inside and outside air through a heat exchanger without mixing them. In winter, the warm but stale inside air preheats the cold, fresh outside air; in summer the cool but stale inside air chills the warm outside air before it is distributed throughout the building. The HRV provides the fresh air needed for healthy indoor air quality without wasting huge amounts of energy. Basic HRV systems recover the sensible heat (the higher the air temperature, the more sensible heat it contains). More advanced, efficient, and expensive Energy Recovery Ventilation (ERV) systems also recover the latent heat, that is, the heat embodied in the water vapor in the air, boosting their energy efficiency, cutting energy losses from ventilation by up to 90%, while also helping to keep the humidity in buildings at comfortable levels, winter and summer.

To address SBS and similar issues, architects and engineers began to focus on buildings as whole systems instead of viewing the components in isolation (e.g., adding insulation without considering its impact on indoor air quality). Indeed, the term “green architecture” only came into use in the 1990s.³ It took several decades to develop evaluation methodologies and standards for healthy, sustainable buildings, and construction. The Building Research Establishment Environmental Assessment Method (BREEAM), established in 1990, became the world’s first sustainability assessment method for buildings.⁴

In 1993, the United States Green Building Council (USGBC) was established with a mission to promote sustainability-focused practices in the building industry. The council would later go on to establish Leadership in Energy and Environmental Design ([LEED](#)) Standards in 2000. However, adoption initially lagged, with an average of only 60 LEED projects registered per month across the United States in its first six years.⁵

The Stakeholders

Stakeholders for MIT Sloan’s new building project included individuals who would be long-term occupants (faculty and staff), shorter-term occupants (students), MIT’s Department of Facilities, which would manage design, construction, and maintenance, and the senior leadership of the Institute including the president, provost, chair of the MIT Corporation (board of trustees), and, of course

² “Indoor Air Facts No. 4: Sick Building Syndrome,” *Environmental Protection Agency*, January 1992 (https://www.epa.gov/sites/production/files/2014-08/documents/sick_building_factsheet.pdf, accessed January 28, 2019).

³ “The Rise of the Green Building,” *The Economist*, December 2, 2004.

⁴ <https://www.breem.com>, accessed February 21, 2018.

⁵ Robb Tufts, “LEED by the Numbers,” *USGBC*, May 26, 2016 (<https://www.usgbc.org/articles/leed-numbers-16-years-steady-growth>, accessed February 21, 2018).

donors, without whom the project could not go forward. Each of these parties had their own vision for the new building.

Faculty, Staff, and Students

MIT Sloan's facilities had long been outdated and cramped (**Figure 3**). The main Sloan building, E52 in MIT's numbering system, was built on the banks of the Charles River in 1938 as the corporate headquarters of Lever Brothers, whose massive soap manufacturing complex was a few blocks away in what became Technology Square.⁶ Despite a new classroom wing in an adjacent building added in the 1990s, MIT Sloan's classrooms remained inadequate. There weren't enough break-out rooms for study groups, student collaboration, or recruiter interviews. The undersized cafeteria offered limited menu options and long lines. The parking lot was too small. Conference rooms were too few, too small, and chronically overbooked, causing inter-departmental conflict and territoriality. Research groups, key staff, and some faculty were housed in satellite buildings, eroding collaboration and community cohesion.

Figure 3 *The Original MIT Sloan Building (E52) in the 1950s*



Source: MIT News <http://news.mit.edu/2015/mit-names-building-honor-morris-and-sophie-chang-1202>.

Office space in E52 was in such short supply that storage rooms were gradually converted into offices. The pressure for office space was so severe that Sloan cut a men's bathroom in half to

⁶ Nidhi Subbaraman, "The Evolution of Cambridge," *MIT Technology Review*, December 21, 2010.

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squeeze in extra office space – twice. These windowless offices were so undesirable that no faculty or staff were willing to occupy them, so they were assigned to Ph.D. students.

The space crunch constrained the growth of the school and harmed the working environment. Evidence mounted that the poor quality of the facilities made it harder to attract and retain students, staff, and faculty. Students hoped the new building would be a place where they would feel comfortable spending long hours. They wanted dedicated space where they could study, hold group meetings, and collaborate with their peers.

However, there were strong and different opinions about the amenities the new building ought to have. While there were a few proponents of building green, most faculty, staff, and students were more interested in aspects of the building they felt would affect them personally, including parking, dining, and office size. For example, despite some remodeling over the years, faculty offices varied dramatically in size. Some senior faculty had very large offices, originally held by Lever Brothers' top executives, with views of the Charles River, Beacon Hill, and Back Bay, while others had small offices overlooking the parking lot. Naturally, the faculty with the large, river-view offices rarely moved. Ironically, while many MIT Sloan faculty pioneered research on flexible, agile organizations and the ways office design could foster collaboration, enhance productivity and boost employee well-being⁷, the legacy of Lever Brothers' hierarchy resulted in strife. Physical sclerosis constrained organizational flexibility.

MIT Leadership

MIT's senior leadership team (president, provost, deans, and MIT Corporation) viewed the Sloan School's building project with some apprehension. As the project took shape, the Institute was still completing a flagship project, the Stata Center, designed by renowned architect Frank Gehry (**Figure 4**). However, after a number of late scope changes, the Stata Center ended up both significantly behind schedule and hundreds of millions of dollars over budget.⁸ To make matters worse, MIT later sued Gehry over design flaws including "pervasive leaks, cracks and drainage problems that have required costly repairs."⁹ The lawsuit was settled a few years later.¹⁰

The Institute's leadership team was determined to avoid similar problems by keeping the costs of the new Sloan building as low as possible. Proposals to build green would face increased scrutiny if senior Institute leadership thought doing so might cause delay or drive up costs.

⁷ MIT Sloan Professor Emeritus Thomas Allen, pioneered the field. See: Thomas J. Allen, *Managing the Flow of Technology: Technology Transfer and the Dissemination of Technological Information within the R&D Organization* (Cambridge, MA: The MIT Press), 1984. The literature is now vast. See also: Manuel Sosa, Steven Eppinger, and Craig Rowles, "The Misalignment of Product Architecture and Organizational Structure in Complex Product Development," *Management Science*, 50(12), (2004): 1674-1689, and Catherine Turco, *The Conversational Firm* (New York, NY: Columbia University Press), 2018.

⁸ Alex Beam, "The Boston Globe on MIT's Stata Center," *The Boston Globe*, September 11, 2003.

⁹ Robin Pogrebin and Katie Zezima, "MIT Sues Frank Gehry, Citing Flaws in Center He Designed," *New York Times*, November 7, 2007.

¹⁰ "Stata Center Lawsuit Amicably Resolved," *MIT News*, March 30, 2010.

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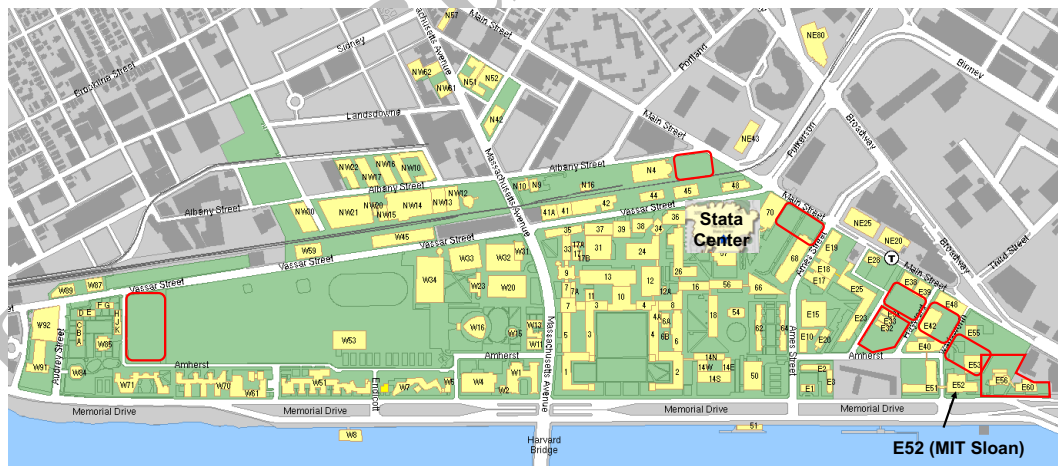
Figure 4 MIT Stata Center, designed by Frank Gehry



Source: Paulo Valerio, https://commons.wikimedia.org/wiki/File:MIT%27s_Stata_Center.jpg.

At the start of the project, there was no agreed upon site for the new Sloan building, though many options were considered (Figure 5).

Figure 5 MIT Campus circa late 1990s



Note: The map shows the Stata Center, building E52 (the main existing MIT Sloan School building) and a few of the potential sites considered for the new Sloan building.

Source: John Sterman.

Some senior Institute leaders wanted the Sloan School to be closer to the Engineering School and main campus to facilitate greater collaboration between the two, while Sloan wanted to build next to

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E52 to bring its faculty together and keep the management faculty close to other social science departments, especially economics. However, the space immediately adjacent to MIT Sloan included building E56, which housed the Dibner Institute, a center for the study of the history of science and technology not affiliated with the Sloan School. Building on that parcel would mean finding a new home for the Dibner Institute. MIT Sloan's preferred site also included the parking lot used by Sloan, other east campus departments, and residents of Eastgate, a tall MIT apartment building which housed married graduate students. Building on that land would require adding costly underground parking beneath the new building.

Facilities and Maintenance

The MIT Facilities Department (Facilities) managed all design-build projects on campus, including new construction and renovations of existing facilities. The MIT repair and maintenance group handled preventive maintenance and repairs to address equipment breakdowns and failures. Facilities and maintenance each had strong interests in the features of a new Sloan building.

Facilities had no experience with green building. Meanwhile, the repair and maintenance group struggled daily to keep up with existing maintenance needs throughout the campus and was understandably wary about the upkeep of a new building, particularly if it included unfamiliar "green" systems. Through the years, MIT had accumulated a large backlog of deferred maintenance. Maintenance technicians had to deal with a growing volume of breakdowns and urgent repairs, squeezing out time for preventive and scheduled maintenance, which then led to more breakdowns in a vicious cycle. Technicians felt that maintenance was "one of the first places to get cut" when budgets were tight – as they always seemed to be. As one mechanic reported, "It's a fire drill...it's who's screaming right now. So your priorities change on an hourly basis, probably a half-hourly basis during the day, and it's basically a constant fire drill." Another mechanic expressed frustration:

We're at the high level of breakdowns and heat and cold calls. We're doing as much PM [preventive maintenance] as we can within that timeframe, [but] something's got to give. So we tweak something until no one is complaining, and then . . . walk away. I find systems that are heating and cooling at the same time because that makes the customer satisfied.¹¹

The Facilities Department included a mix of advocates and adversaries for building green. Some strong champions emerged, including the head of the department, Victoria Sirianni; the director of engineering, Walt Henry; and utilities manager, Peter Cooper. However, others opposed it, citing cost and schedule concerns, risks associated with unfamiliar technologies and worry that a new type of building would impose additional stress on themselves and their staff.

¹¹ John Lyneis and John Sterman, "How To Save A Leaky Ship: Capability Traps and the Failure of Win-Win Investments in Sustainability and Social Responsibility," *Academy of Management Discoveries*, October 29, 2015. 2: 7-32. Video abstract can be found at <http://bit.ly/leakyshipvideo>.

Other Academic Units

Sloan had long shared space with other departments, including Political Science, the Science, Technology & Society (STS) Program, and the Economics Department. A number of MIT Sloan faculty held joint appointments in economics or political science. The building project required close collaboration with these groups and others in MIT's School of Humanities, Arts and Social Sciences (SHASS).

Potential Donors

Potential major donors consisted primarily of MIT and MIT Sloan alumni. They, too, had ideas about the new building's features and aesthetics. They sought to ensure that their gifts were put to good use and that their names would be attached to something beautiful, functional, and memorable.

Getting Started

Dean Schmalensee assembled a small taskforce to manage the building project. The taskforce consisted of one Sloan staff member, Cindy Hill, and two members of the Sloan faculty, Paul Asquith and John Sterman. Hill, a long-time member of Sloan senior staff, became the director of capital projects. Professors Asquith and Sterman, who had been colleagues for a number of years, looked at the building project through very different lenses. As a finance professor, Asquith stressed financial viability and return on investment for any proposed features. Sterman, a professor of system dynamics with long-standing interests in energy and the environment, believed going green was the future and was a vocal proponent for an energy-efficient, sustainable building.

To address the needs of all the stakeholders, a broader building committee was assembled to complement the taskforce team, including a project manager from Facilities, a faculty member from economics, and a senior staff member from SHASS.

Asquith, Hill, and Sterman proposed a variety of green features for the new building (**Figure 6**). They believed that these features would increase the building's up-front costs but would lower energy and other operating costs, yielding a positive NPV and benefit MIT Sloan's image. However, they could not quantify these savings because there were so few comparable green buildings and the uncertainties about costs and benefits were great. As they began their presentation, they wondered whether Dean Schmalensee would decide to go green.

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Figure 6 Proposed Green Features for the New MIT Sloan Building

Site Prep	Use low emissions equipment for demolition of existing building on site.
	Recycle materials from demolition of existing building on the building site.
Building Envelope	Additional insulation for building envelope to cut energy losses and ensure tight building envelope. Blower door test to identify and repair air leaks.
	High performance, double/triple glazed windows with protection against thermal bridging.
	White, solar-ready upper roof.
	Green (living) lower roof to reduce summer heat transfer to building and store storm water.
HVAC	HVAC to include energy recovery ventilation (ERV) with enthalpy wheels to recover sensible and latent heat while providing sufficient fresh air.
	Ground-source heat pumps to supply energy for heating and cooling.
	Efficient, chilled beam air conditioning in offices (no fans or moving parts).
	Radiant floor heating/cooling for main public spaces.
	Variable speed fans with CO ₂ sensors in conference and class rooms.
	Variable speed fans with CO sensors in underground garage.
Lighting	Building orientation, window and interior design to increase daylighting.
	Automatic window shades/screens for southern façade to control solar gain.
	High efficiency lighting with daylighting controls and occupancy sensors to reduce energy use.
	Light pollution reduction measures.
Water	Waterless urinals; low flow water fixtures, and other measures to reduce water use.
	Irrigation system controlled by weather station to minimize watering.
	Swales to reduce peak storm water runoff and storm water filtration system to improve the quality of water reaching the Charles River.
Materials	Low-VOC materials throughout (adhesives, sealants, paints, carpets, etc.).
	Design for recycling, e.g., recycled materials for flooring, recyclable carpet squares.
Amenities	Ample bicycle racks outdoors, secure bicycle cage in garage.
	Shower facilities to encourage low-environmental impact commuting and exercise.
	Stairs next to elevators from first to top floor to encourage exercise and reduce elevator congestion and wait times.
	Internal stairs between faculty office floors to reduce elevator use, increase collaboration across faculty groups.

Source: John Sterman.

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Questions:

1. **Diagnosis:** Compared to a traditional (code compliant) building, what do you think the design and construction costs for building green would be in the early 2000s? What do you think the relative costs of a high-performance green building are today?
2. **Pitch:** How would you make the case for building green?
3. **Recommendation:** Should Dean Schmalensee pursue a green or traditional building? Why/why not?
4. **Action Plan:** How would you build stakeholder alignment on the project?