**INTERVIEWER:** Today is May 17, 2010. I am Karen Arenson.

We are talking today with Subra Suresh, Vannevar Bush professor of engineering, and dean of the School of Engineering. He is the former head of the Department of Materials Science and Engineering, and is still affiliated with that department, as well as with the Departments of Mechanical Engineering, and Biological Engineering, and also with the Harvard MIT Division of Health Sciences and Technology. He has also served on the governing board of the Singapore-MIT Alliance, the MIT Portugal Program, and the IMDEA Materials Institute in Madrid, Spain, and as a member of the Advisory Board of Technology Review India.

Subra, thank you for talking to us today.

**SURESH:** My pleasure.

**INTERVIEWER:** As dean of the engineering School, you not only lead the largest school at MIT, but one that has many departments that are ranked in the top of their fields. What makes them so special, and how have they managed to remain special for so long?

**SURESH:** MIT has historically attracted some of the very best students from around the world, from all over the world. We are also fortunate to attract the top faculty from all over the world, as well as retain them through most of their career. The combination of outstanding faculty, outstanding students, outstanding staff, both research and academic administrative staff, in conjunction with an ecosystem that places emphasis not only on brilliant fundamental science, but also translating that science into useful tools, products and processes that benefit society, has made engineering at MIT a very, very powerful entity that has had huge impact on a global scale.

**INTERVIEWER:** A growing number of American universities seem to be putting more emphasis on engineering and applied science. How will you and MIT ensure that you remain at the top with this growing competition?

**SURESH:** I think it's very important for us to make sure that people come to MIT in many different fields of engineering and many different departments because this is the place where they can do the best science and best technology. It's very important. This has served us very well, and I think we should continue to keep that edge in order to keep the School of Engineering at MIT at the forefront.

This means we have the infrastructure, the physical infrastructure, namely labs, facilities, both for education and research. We have the type of people who excite young minds. And we have an ecosystem that continues to provide the opportunity to take an idea and put that into practice, either whether it is for a student or for a faculty member. This is why I think it's very important that we continue to recruit the best minds from around the world.

**INTERVIEWER:** As you've mentioned, American research universities have long attracted the best and the brightest students from around the world - students like you. But now other countries are trying to create their own world-class universities, and some of them are investing heavily. Building the greatest research university is a lot more complex than building the tallest building, but probably not out of the question. How serious do you think the global competition will be, especially in the face of the money that's being poured in in some countries?

**SURESH:** I think MIT became what it is today, just like many leading institutions in the world, not because of overnight success, but because of cultivating and nurturing a certain set of principles and then using them to continually strive for excellence. The competition that we face from a global scale is a lot more today than it was a decade or two ago, and it is something that we should pay a lot of attention to. Complacency for any institution, including MIT, is not a good thing. But at the same time, I think one should not panic either. I think it requires careful thought, careful assessment of competition.

This also means both at the institutional level, at the national level, we continue to place emphasis on science and technology in providing support, especially for young people to want to go into science. It also means that we make science and engineering an attractive destination for high school students. This is something that goes well beyond what a university can do, but it's very important for the country. Once we lose the edge in science and engineering and its impact on society, it'll take a long time to regain this.

So I think it's very important, especially in the 21st century which is going to be the century of science and technology, more so than the 20th century, that we pay attention to this. A part of the trick here will be to communicate to the young people that some of the biggest challenges that are facing humanity on a global scale have solutions that can be found through science and technology.

**INTERVIEWER:** The post World War II arrangement that funneled abundant Federal aid into basic science research at MIT and other leading universities has been eroding. And no broad support system has arisen to take its place. Instead there have been moves to spread the support among more institutions or to cut it. Do American research universities need Federal investment beyond what exists today? And what form do you think it should take? And do you think that's possible politically?

**SURESH:** I think we are in very tough economic climate with huge national debt and a physical infrastructure in many institutions that needs to be renewed on a massive scale. Having said that, government support over the past many decades has had a profound impact in transforming higher education from the GI Bill to the Apollo Program to a lot of other things that one can think of have galvanized generations to go into not only higher education, but also to study science, math and engineering.

It needs to come from a variety of sources. No single source alone will suffice. I think we need to look at telling the public why science and engineering is important. Exciting the bright high school students why they should go into science and engineering. We should also provide incentives for young people to go into science and engineering. This may mean addressing two career issues, making it easier for young women to take up academia while balancing all the demands of raising a family.

I think the approaches are multi-prong, but the government support is an important one, and it's not the only one. One can also think of support from industry, which needs to take a longer view rather than short three month cycles in which they assess the success or failure of funding.

**INTERVIEWER:** How do you do that?

**SURESH:** Well, I think if we look at historically institutions like the Bell Labs, which created an ecosystem where scientific discoveries could be made and put to practical use, I think that kind of an infrastructure has not been sustained in the last few decades. It's very important, and we have different systems that have evolved. Our younger people have become much more entrepreneurial in recent years.

I think creating an ecosystem to foster that kind of creativity, but at the same time not taking the short term view. The research in energy is a very good example. We cannot formulate energy policies based on the fashion of the day or today's price of oil. One has to take a long term view in this. And same with renewable energy sources.

So it's very important that at all levels one takes a longer term view and not a short term view.

**INTERVIEWER:** Like many universities, MIT has been entering into a variety of partnerships around the world, and you've been involved in some of them. Why is MIT reaching out now, and does it have a set of guiding principles for what makes sense to do and what doesn't?

**SURESH:** MIT is not reaching out internationally now; it has always reached out internationally. For example, after the Second World War, MIT was one of the institutions that created a unique system called the Industry Liaison Program, which is the largest industry liaison program of any American university at the present time. So MIT faculty have always be entrepreneurial on an international scale.

What is new now with the increase in interest in science and engineering, especially from rapidly developing very large countries, like China and India, Brazil and Russia, and so forth, there is a greater emphasis on coordinated large international programs. With respect to guiding principles, MIT faculty always engaged on an international scale. As long as they engaged, they delivered their MIT duties, and then create unique opportunities for education and research for their students and for their research groups, MIT has increased this within the confines of their regular policies and procedures of MIT.

At the same time, there are major, large scale programs which will require top level discussion between leaders at MIT and their counterparts in other organizations. So it has to be a combination of coordinated activities, and also activities that bubble up from the faculty level based on faculty interest. Ultimately, no activity will survive or succeed unless it has the buy-in of the faculty. I think this is something very important, whether it's bottoms-up or top-down, it excites the faculty, it excites the students.

Another guiding principle is that MIT has an obligation to take care of its students in Cambridge, Massachusetts, and that's the first and the foremost. And there is only one MIT degree at the present time or for the foreseeable future, which is in Cambridge, Massachusetts. That's very important.

The second guiding principle is that if we want to do something in a remote part of the world, it has to benefit MIT students and faculty, both intellectually, and possibly infrastructurally or in terms of a geographical dividend. So what the value-added in a particular collaboration? It could be strategic -- the strategic advantage could be geographical, it could be in terms of access to a unique set of facilities or cohort of people which benefits the MIT education. Many of our international programs provide all of this.

A growing desire on the part of MIT faculty and students in recent years has been to increase the level of international exposure to our undergraduate students who will increasingly work in a highly globalized world. This also calls for greater levels of formal engagements with multiple entities around the world.

**INTERVIEWER:** Do you think that MIT is moving fast enough on the international front? And are the support systems for whatever faculty do get interested in of the right sort? Are there things you'd like to see added or created to make it easier to facilitate what the faculty do overseas?

**SURESH:** I think there are some areas of which MIT has been a leader in international engagement. I mentioned the Industry Liaison Program, the engagement of international industry, large industries, with MIT faculty and students has been a pioneering effort.

The other major international effort which started eight years ago where MIT has been a pioneer is in OpenCourseWare, and that's our virtual engagement around the globe. So those are two examples. We also partnered with various institutions in Singapore well before many other institutions from the US started collaborations. So in some areas we've been leaders, we've been ahead of the game.

There are also areas where we have constraints, where we are not where we would like to be. For example, unlike undergraduate education in humanities or social sciences, it's very difficult for engineering and science students to go abroad for junior year, especially given the demanding schedule constraints of their undergraduate education at MIT. So in that sense, our international engagement for undergraduate students has not been as much as in other areas or other disciplines or compared to other institutions that don't have an engineering or science heavy undergraduate population.

But we're trying to overcome that with providing opportunities for our undergraduate students through a variety of means. The MISTI Program has been very successful in recent years in sending hundreds of students every year abroad. We've internationalized the UROP Program called IROP, International Research Opportunities Program. We started a program called UPOP, Undergraduate Practice Opportunities Program a few years ago, which hundreds of engineering students benefit from. We have now internationalized that as well called IPOP.

So there are many opportunities available, but it'll be great if all of our undergraduate students get opportunities at least to be exposed to international students and faculty during the course of their four years at MIT.

**INTERVIEWER:** Some years back MIT faced criticism in Congress and elsewhere for educating students from overseas. Are you hearing any criticisms like this now, either from inside MIT or from outside?

**SURESH:** No. I think one of the fears now is that the scientific enterprise of the United States has been very strongly influenced in a very positive way by the inflow of immigrants, especially students. I'm a very good example of that. I came to the US as a graduate student to get my graduate degree. I stayed in the US, became a US citizen. And the United States, compared to any other country in the world, has been a leader in providing opportunities for science education and jobs for people who come from anywhere in the world. I think it's that particular infrastructure that we have had, that ecosystem that we have had that has enabled us to be at the forefront of science and engineering.

Take MIT today, School of Engineering, 43 percent of our faculty in the School of Engineering at MIT are foreign born. More than half of the MIT affiliated Nobel Laureates have been foreign born. If we do not have access to this pool of talent from around the world, top students from around the world, our scientific enterprise will be very severely hurt.

With the growing competition from different parts of the world and the improving economies and the emphasis on science and engineering that's being placed now around the world, we may run the risk of losing a talent pool in many different ways. We may not have as many students from abroad, top students, come to the U.S., places like MIT, to do science and engineering. And even those who may come here may not choose to stay here and pursue careers in the US and this could adversely affect the scientific enterprise in the US in the long term.

**INTERVIEWER:** You seem to be a person who cuts across boundaries. You've worked in multiple cultures. As you just mentioned, you came from one country to here. You've worked across a number of disciplines -- the material science, mechanical engineering, bioengineering, health sciences. Are you conscious of being a bridging sort of person? And have you always been this way?

**SURESH:** I think the way science and engineering is evolving, the problems are so complicated and they more frequently now cut through disciplinary boundaries. For example, take energy as an example. It's not just scientific or technological research into energy that's going to solve the energy problem. It's also other things which are not often affiliated with engineering or science. Taxation, political considerations, political science, geographical considerations.

So if technologists were to address energy as an area -- same applies to transportation -- it's not just science and engineering that will influence the global society, it has to be multi-disciplinary. It has to cut through all five schools at MIT in many of the complex areas. As a result there is a growing realization that we have to, as we talk, tackle larger and larger problems which institutions like MIT have the expertise and the bandwidth to do. We have to become increasingly interdisciplinary.

But I also want to add a note of caution there. We don't want to sacrifice depth in the interest of broadening width, our bandwidth. So it has to go hand-in-hand. I think we need to be very careful about while we create opportunities for multi-disciplinary and interdisciplinary work, both in education and research, we want to make sure that that expanded scope doesn't come at the expense of rigor and depth. And this is something that we constantly struggle with in all of our initiatives.

**INTERVIEWER:** When you became dean of engineering you asked your department heads to think about offering more flexible majors so that engineering students, could indeed, take a wider array of courses, perhaps even management or economics, so they could tackle broad problems like energy or transportation. Tell us what's happening with that, and how well did that sit with the departments and how many of them have moved in this direction now?

**SURESH:** This idea of providing greater flexibility to students, as they seek to broaden the scope of their undergraduate experience at MIT, was part and parcel of our strategic planning effort, which I started in 2007 soon after becoming dean. We had two independent groups that looked at strategic directions for the school with respect to the possibility of a flexible degree. Roughly around the same time, the Institute faculty were also looking at opportunities to make interdisciplinary undergraduate educational experience much more flexible.

At the Institute level we had two major things happen. The requirements for a double major were changed so that it made it easier for an undergraduate student to get a double major. At the same time, it was also made easier for the student to get a minor in a broad area of interest such as energy. So we have an energy minor that was approved by the MIT Faculty.

At the School of Engineering, the strategic planning committees that looked into this came back with the recommendation that the School should consider taking up or at least exploring the possibility of a flexible engineering degree program. We were fortunate to have an example already with a lot of data points in mechanical engineering. The mechanical engineering department offers something called the 2-A Degree Program, which is ABET accredited. Now about 45 percent of the undergraduate students in mechanical engineering opt for the 2-A Degree Program. So we have a lot of information on what works, what the challenges were, so we could use that in formulating a plan for the flexible engineering degree program.

Just this semester, the Institute Faculty approved a program called 16-ENG, which is a flexible undergraduate degree program in engineering that will be launched by the aero and astro department this coming fall. The plan for the department is to take the degree program and seek ABET accreditation two to three years from now. These are the two departments that have launched this program. Intentionally we have made this program voluntary on the part of the departments. This was the recommendation of the Faculty committee. By that I mean the department can opt in or opt out.

Two departments are already launching this program -- mechanical and aero and astro. Other Faculty from another department have just voted to take up this issue to prepare for a possible launch next year. There are two other departments in engineering that are in the process of doing a strategic planning effort in their own department, and they'll be coming back with some recommendations later in the fall of this year.

So, my expectation is that in about two to three years, a number of departments in engineering will be offering this flexibility engineering degree program.

**INTERVIEWER:** Was ABET somewhat slow in deciding to approve the mechanical engineering path back in '02? Did it take a long time before they said OK? And what do you expect now?

**SURESH:** No, ABET was not slow to approve it, but the ABET has a requirement that the first cohort of students graduate and then there'd be data before they actually approve and give accreditation to that program. So there is a time delay of a few years. So mechanical engineering, once they had the cohort of students graduate in the new program, they did seek approval and were successful in their accreditation.

**INTERVIEWER:** What does it mean for the several years of students who come out before it's accredited, anything? Does it matter?

**SURESH:** Of course, it's a consideration. A lot of the students it did not bother them it was not ABET accredited, and that's how we launched the program. But the enrollments did go up after ABET accreditation. But also the enrollments did go up broadly in mechanical engineering -- we don't know whether it's just a coincidence or whether there is a cause and effect related to this year.

**INTERVIEWER:** Have you looked at the experience of the students once they graduate? Is industry hiring them? And are you getting any kind of feedback as to whether or not they think that you've given up some depth or that the students have or that it's OK and that the trade-offs you've made are good ones?

**SURESH:** It's a little bit too early, but we do conduct exit surveys, and exit surveys are conducted at the time of graduation and five years down the road. They're conducted periodically. Our experience has been the perceptions of students, and also the data points that we receive, are a function of time. Students' perceptions soon after graduation is somewhat different from their perspectives five years after they've graduated. We have found that the fondness for MIT grows with time, and the appreciation of experiences that they have at MIT grows with time as well.

**INTERVIEWER:** That or their lack of fondness diminishes with time?

**SURESH:** That could be too, but from the recent exit polls that we know, the vast majority of the students are in a category of either being satisfied or very satisfied with their experience at MIT.

**INTERVIEWER:** What do you know about how many of the students who graduate in engineering, undergraduate, go out to work in engineering as opposed to, say, going into business or some other field?

**SURESH:** Well, the data points are changing very fast. If you had asked me this question two years ago, a number of our top students, not just in engineering but also in the sciences, were going into either management consulting or finance or Wall Street. In the last couple of years that has changed dramatically. We've seen a significant increase in the number of applications to graduate school. We've also seen a significant increase in applications for faculty positions, junior faculty positions -- some people who may have gone to non-engineering careers have chosen to stay in engineering.

There are also interesting possibilities abroad. There are new but significant numbers of new institutions focused on science and engineering coming into existence, especially in the developing part of the world. There are opportunities for our engineering graduate students to seek academic careers abroad, more so than, say, 10 or 20 years ago. I think the combinations of these factors will play out and will have a greater set of data points a few years down the road.

**INTERVIEWER:** On one of your websites you say this, and I quote, "When addressing issues today, especially those affecting the climate, it is not sufficient to take complex problems apart and merely investigate incremental improvements to their components." What did you mean by that, and why do you think it's important?

**SURESH:** I mean if we take energy as an example, or carbon-based energy as an example, if we focus just on engineering issues, I don't think that's going to address the issue. We have to look at a variety of geopolitical issues. Issues related to the environment. Short term versus long term gains. Cost just not of energy expenditure, but the effect of climate change precipitated by that particular form of energy. That's what I meant by that statement.

I think looking in isolation, one nano issue of a very large complex problem will not solve the problem. INTERVIEWER: How widely do you think this is recognized at MIT or within the School of Engineering?

**SURESH:** I think it's in the last few years it's come much more on the spotlight. For example, the energy initiative of which the School of Engineering is a major player, also benefits from participation from the humanities, arts and social sciences, management, architecture and planning, and the science School. And giving opportunities for faculty to engage at the institutional level gives a much greater appreciation of the issues related to engineering than just focusing on energy research within the school of engineering.

The same is true for energy minor at the undergraduate level. While the students take courses in engineering, they also take courses in management and economics, which is a great benefit.

Another example I want to give in this regard is at the intersection of engineering and life sciences. Here I can cite two recent trends. Engineering faculty are increasingly engaging in research, not only in biology but also in biomedicine and public health as it relates to human health.

Secondly, this pursuit has become much more international. One of the first programs to start in our SMART Center, Singapore-MIT Alliance for Research and Technology is infectious diseases. Half of the participants in this program are from the School of Engineering looking at infectious diseases. The Regan Institute for HIV/Aids is another effort where research is being done into HIV/Aids by engineering faculty members at MIT. This is a new effort.

A third example is the Koch Institute for Integrative Cancer Research, which will have about 25 labs when it's completed next year. Half of those labs will be occupied by engineering faculty.

The recent trend has been not only to bring engineering in much closer contact with life sciences, but also to connect it in a seamless way with the medical research community, the clinical research community, and the research community that deals with public health.

**INTERVIEWER:** When you teach classes or interact with students in your lab, how explicitly do you talk to them about the need to have more breadth or to think of economics or political components of things that might touch on what they're working on? Or do you think that these are things they'll pick up in other courses?

**SURESH:** Part of the problem that we have, which goes back to the earlier comment I made about breadth versus depth, the undergraduate students have only four years at MIT. And within the four years they have to fulfill their GIRs, and they also have to take very rigorous and very demanding subjects in their areas of specialization. But having said that, it's important, and MIT has been one of the places that historically has done that probably as well or as better than anybody else to relate fundamental science and engineering to reality and societal relevance. And that needs to be done in every subject, in every course.

As curriculum changes, as issues change, as complex problems evolve, that affect this century as opposed to the last century or the century before, we need to adapt our curriculum to take care of that. That doesn't necessarily mean every undergraduate has to take a course in economics or a particular type of political science, but I think if we can integrate at least all the relevant issues it would be very beneficial.

In my own subjects, I try to bring in case studies and examples, classes that I have taught, and whether it's done either during the lecture hours or in recitation or as a homework problem or term paper, having that given to the students in some form would be very beneficial.

**INTERVIEWER:** Let's back up and talk about the path that brought you to the United States and MIT. Where were you born and what were you like as a child?

**SURESH:** So, I was born in India. I grew up in south India, and I did my undergraduate degree at Indian Institute of Technology in Madras, which is now called Chennai. The IITs are and still continue to be an institution which, at the societal level, was perceived as Ameritocracy. For me the path was not completely voluntary, but was set by the set of circumstances that I was in, and a ticket to success in a career at that time and still, to some extent, true today, would be to get a degree in engineering. This is the aspiration of most middle class families in India even today.

It was ameritocracy, and you got in because you did well in the exams, and there was no other way to get in. That propels you to do well in high school. That was the path to get into engineering. I was very good at math and science in high school and I thought naturally engineering was a very good profession to pursue.

Once I finished my undergraduate degree, at that time there was no question, if you want to do post-graduate studies, there was only one place to go to and that's the United States. I applied for a scholarship and I received it and I came to the US.

**INTERVIEWER:** So you weren't particularly interested in science or math as a child?

**SURESH:** I was good at science and math. I did well in high school, and I wanted to pursue a career, a rewarding and satisfying career, and engineering was deemed at that time, as a very rewarding career. Because I was the first one in my family to go to university, especially in engineering, there was no push from anybody that I should do engineering and it just happened naturally.

**INTERVIEWER:** Were either of your parents in any kind of related field or relatives or friends, and what did your parents do?

**SURESH:** My mother stayed at home to raise two children, so she did not have a career of her own, even though she's an extremely brilliant woman. My father got a diploma in a polytechnic and he worked for a local government organization, so he was not an engineer by any means or a scientist.

So my path into engineering was primarily through a desire to take up a profession that was a pathway to a satisfying career, which gave me an opportunity, despite the fact that I did not have the right push from the surroundings to get into it. It potentially provided opportunities to go abroad, and it was a path to financial success as well. That's what propelled me at that time.

**INTERVIEWER:** What do you think you might have studied if it hadn't been set up that way?

**SURESH:** I was very good at languages. I was in the high school debating team in three different languages. For a few fleeting moments, I dreamt of going into the foreign service and becoming a diplomat. Somehow I thought that being good at languages would be helpful in pursuing that career -- this was when I was in the ninth grade or 10th grade. I really enjoyed learning languages and participating in the debating teams. But in the end, engineering was my destination.

**INTERVIEWER:** What languages did you know?

**SURESH:** As a child I studied Sanskrit in elementary school. Then I studied Hindi for about eight years -- eight, nine years -- so I went very deeply into Hindi literature. I studied Tamil . In fact, Tamil was my medium of instruction through secondary school. I was very deeply into Tamil literature that goes back a few thousand years. Then I studied English throughout school. Then in my one year pre-university, I studied French, at Alliance Francaise in India.

Then at my undergraduate school in IIT, Madras, it was in collaboration with Germany, so we had a couple of semesters of German instruction. So I did a number of different languages and I kept my interest in some of the foreign languages when I came to the US So at MIT for my PhD I minored in French. I'm not as fluent as I would like to be, but I did study French for a few semesters.

**INTERVIEWER:** What kinds of elementary and secondary schools did you go to, and how was the preparation?

**SURESH:** They were all, what we would call them here, public schools, and they were nothing extraordinary. It was free education. They were just your ordinary public schools and--

**INTERVIEWER:** But they sent how many, what portion of their graduates went on to college?

**SURESH:** We lived in the same city in a relatively small city in south India from about second grade to end of high school. They were good schools, they taught me well. But I don't even know the numbers -- I would guess probably less than 10 percent of the graduates go to university, and even a much smaller fraction go to graduate school. At that time anyway. I don't know what the -- this was 35 years ago, so I don't know what the numbers are now.

**INTERVIEWER:** Was college free, IIT?

**SURESH:** IIT was almost free. You just paid for your dormitory and your living expenses. I had a scholarship from the government even to take care of that. So I would say my five years as an undergraduate, IIT was essentially completely free.

**INTERVIEWER:** How similar to MIT was IIT?

**SURESH:** If you look at the law of supply and demand, several hundred thousand students every year apply to the IITs -- only a few thousand make it. So the probability of getting in to an IIT today, and it was not that different 30 years ago, is almost one in 1,000. So the analogy I can draw here -- there's a lot of self-selection, it's very difficult to get into MIT, and this year it became even more difficult. I think the class that's coming in the fall of 2000, the acceptance rate is less than 10 percent.

**INTERVIEWER:** The 2011.

**SURESH:** No, the class of 2014, which will be coming into MIT this fall, the acceptance rate is less than 10 percent. It's a self-selecting group. But because of the numbers of people wanting to get in, and India's a country with a population more than a billion, the probability just from supply and demand and the number of slots available of getting into an IIT is likely to be much, much more difficult.

**INTERVIEWER:** Is the IIT systems government owned or government run?

**SURESH:** It's funded by the central government, the India Institutes of Technology.

**INTERVIEWER:** And there are a whole network of them around the country?

**SURESH:** There were seven campuses. There are some new IITs that have been created recently, so the numbers are growing. But still you're talking about a few thousand students getting admitted each year to these schools. It's very small compared to the cohort of students who would like to get into them.

**INTERVIEWER:** What was the preparation of students going into the IITs like, say, compared to the preparation of students entering MIT?

**SURESH:** MIT attracts really top students, valedictorians. But there is no entrance exam to MIT -- it's based on your performance in high school, and it's based on your SAT scores. A variety of factors -- how well you do in interview, your extracurricular activities, and so forth. With IITs it's very different. The criterion for admission to IIT is not based on your high school final exam or grade, it's based on the entrance exam for IITs that are administered jointly by the IITs -- it's called the joint entrance exam given by the IITs. So even if you are number one in your high school, if you don't make it into the top few thousand in the joint entrance exam you will not get in.

The exams today are different. When I took them there were four exams -- mathematics, physics, chemistry and English, and each one was three hours, and each one was 100 points. So four of them 400 points. They will sum up your score for all four subjects, for all hundreds of thousands of students who take them, the top 2,000 will get in, the others won't make it. So the competition is so severe, that the difference between number one and number 2001 will be extremely small.

Today, and at that time, I remember I prepared for this over the course of two or three weeks. Two or three weeks before the joint entrance exam. After the high school exam was finished, I bought a few books, I studied at home for a couple of weeks, went and took the exam and got through. But now I understand talking to friends and colleagues that the students start in their sixth grade or seventh grade, they have special coaching, they study seven days a week, and they take the entrance exam. It's extremely demanding, and they have to give up some of the fun associated with high school life in order to get through the entrance exam these days.

**INTERVIEWER:** And what about the graduates of the IITs? By the time they've done four years, how would you compare their preparation, what they know and can do, to graduating seniors at MIT?

**SURESH:** I would say that -- if you look at that data points, how well IIT graduates have done around the world, a lot of them in the US. The IITs have done extremely well as an institution that prepares students in engineering.

But these are the students who are the cream of the crop from the country. So one could argue that as long as you have access to these kinds of students, you could put them in any institution and they are bound to do very well. And to a large extent, this is true of MIT students as well, that the types of students who are self-motivated, who are highly accomplished, who are driven.

So I don't have a basis for comparison. All I know is remembering my undergraduate experience from IITs and looking at the quality of the students that I went to school with in IIT, and comparing them to the quality of undergraduate students that I see at MIT, their educational experiences are very different. The social experiences are very different. Their possibilities are very different.

For example, when I was an undergraduate student, I did not have the same level of access to an international cohort of students or international faculty as MIT students do now. Of course it's 30 years later as well, and the circumstances were very different. But the quality of students is very high, and I would say that both are very high quality institutions.

**INTERVIEWER:** Did you choose an area of concentration while you were there, or did you all do a general engineering education?

**SURESH:** So, IITs work very differently. Based on your pecking order or rank in your entrance exam, you could either choose or be assigned an area of engineering that you will major in, and this fluctuates and this varies through generations.

So, at that time in the early 1970s, most of the students wanted to go into electronics because that was very popular. So, a lot of the top students would go into electronics. At that particular point in time, areas like civil engineering were not that popular because there were no major construction projects in the country.

So, you would see a shift, a particular skewed demographics towards areas like microelectronics among top rankers. I was in electrical engineering initially. You don't really get into your major until you're third year of a five year program. At that time it was five years, now it's only four years. They changed some time during the 1980s. So while in the beginning of the third year, you really get into your program. The first two years are common among all engineering students.

At the beginning of my third year I switched to mechanical engineering, so I received my degree in mechanical engineering because I found a set of subjects that that particular department was offering in that particular institution really appealing. So I graduated in mechanical engineering.

**INTERVIEWER:** What drew you in? What about it appealed to you, do you recall?

**SURESH:** We had some projects in my first couple of years and I enjoyed doing those projects. They were much more mechanically oriented and oriented towards electrical engineering, so I decided I would pursue a major in that.

**INTERVIEWER:** Do you remember any of them specifically?

**SURESH:** I think the idea of building mechanical things appealed to me.

**INTERVIEWER:** Did you do it as a child? Did you have lots of little things that you played with?

**SURESH:** No. No, we didn't have a workshop or anything in our home for me to play with. But it was mainly the experience of my first couple of years.

**INTERVIEWER:** So your aim had been to go abroad to do graduate school?

**SURESH:** That's correct.

**INTERVIEWER:** And the United States, was that the only country you considered?

**SURESH:** No other country even entered my thought. At that time, the place to do graduate education was the US.

**INTERVIEWER:** And how did you pick a college to do it at?

**SURESH:** Well, I picked a college because at that time I did not have an relatives or very close friends other than people I knew in my undergraduate school who had previously gone. In any American institution, we didn't have any relatives, and I was the first one in my family to go abroad, let alone as far away to a place like the US.

At that time, if you did not have access to resources outside of the country it was not that easy to get foreign exchange. I don't remember the exact numbers. If I remember correctly, we went allowed only 100 US dollars in foreign in exchange, with which I had to take my GRE exams, I had to apply for my US Visa, I had to pay for TOEFL, plus I had to come and settle down here with those resources.

So I decided only to apply to those universities that did not have an application fee. And if I remember correctly, MIT's application fee at the time was $15, so I did not apply to MIT, even though probably my grades were good enough to get in to MIT.

So I applied to seven or eight universities that waived the application fee. Because of a very attractive offer I received, I went to Iowa State and there were a few students from earlier batches in my undergraduate school who had gone to Iowa State and they had some nice things to say about Iowa State. So I went there. My eventual goal was to do research in an institution like MIT. So I went to Iowa State, received my Master's, and I applied to MIT for a PhD and came here for my PhD.

**INTERVIEWER:** So you had full funding to go to Iowa State -- they offered you a scholarship?

**SURESH:** I had a fellowship for my first year and then I had an assistantship, which without that I would not have come.

**INTERVIEWER:** What was your time at Iowa State like? Did you work for a particular professor or in a specific lab, and how was it?

**SURESH:** Iowa State was a wonderful location to arrive in the US. This is middle America, and it was also a cultural change in a different way. I had grown up in large cities. So the Indian Institute of Technology is in Madras, which now it's much bigger than the population of Chicago. At that time it was probably about the population of Chicago. So I was used to living in big cities. Ames, Iowa where Iowa State University is located, during the school year it had a population of 45 thousand people. During summer about 10 thousand people. One end of the town to another end is about two and a half miles.

That was a very big culture shock, but it was a wonderful place to arrive in, to get to know a small town America, you get to know the culture. It's a very good way to ease into a new surrounding without being overwhelmed by a very big city environment. I had wonderful friends, very friendly community, and I got an opportunity to get to know the local Iowa community where I had host families I spent Thanksgivings and a few long weekends with local families. So it was a very good social experience.

With respect to research experience, the particular areas that I had the opportunity to start with were not very well funded at that time. So it took a little bit of time. Because of some funding issues I was also a teaching assistant, which was very beneficial in a way later, because I very quickly soon upon arrival in Ames, Iowa, I had the opportunity to teach undergraduate students and I realized how much I enjoyed teaching students.

That probably set a path for me to contemplate going into academia. Also, my thesis advisor at that time, I was at Iowa State a year and eight months or so. During about 10 of those months he was on sabbatical abroad. So unfortunately, I did not have the benefit of having him close by. But nevertheless, it gave me a good education, a good exposure to the US. Then I defended, I got my Master's degree. I applied for a PhD degree, and I came to MIT right after my Master's.

**INTERVIEWER:** Did they give you any kind of training or coaching in teaching, or did they just say here's your classroom, go to it?

**SURESH:** Well, I was a teaching assistant. I did not teach the lectures. I was a teaching assistant in a class working with a professor, and the professor was an excellent teacher, a very popular teacher. So working with them was a very good experience.

**INTERVIEWER:** Did you have to do any language study when you got here or were you completely proficient?

**SURESH:** So I studied English throughout, almost from elementary school. But my medium of instruction fluctuated between a local Indian language and English. But in undergraduate school everything was in English. So by the time I came to the US I had excellent proficiency in English.

**INTERVIEWER:** To MIT next in 1979 for your doctorate. Tell us about how that happened and what your plans were then.

**SURESH:** I wanted to work within the area of mechanical properties of materials. I found a thesis advisor who was a young assistant professor at that time in mechanical engineering. I had the opportunity to start at the beginning of summer of 1979. And remarkably, I started doing experiments as soon as I arrived, and by the end of the summer I had some very interesting results, even before I took a single class at MIT. It really energized me and motivated me and I was working very closely with that professor.

I took classes during the following academic year. I finished my qualified exams in 1980. That summer I had an opportunity to go work at Lockheed in California, so I spent the whole time in Palo Alto, working at Lockheed Palo Alto research labs. I came back, and just in little more than a year it turned out that my research work had really taken off, and I was already writing papers for journals and a couple of papers got accepted.

Then I was really pleasantly surprised when my thesis committee said I could defend by PhD thesis the following May, which would have been less than two years since I arrived on MIT campus. So I defended my PhD thesis.

Then I realized that I hadn't taken enough classes at MIT, so I had to stay through an extra summer, the summer of 1981 and finish my doctorate. My advisor from MIT moved to California, and I hadn't had time to even look for jobs because everything happened so quickly. I decided that I'll continue that work for a couple more years. So I followed him to Berkeley and I was a postdoc there for a year and a half. Then I applied for faculty positions, and Brown University offered me a faculty position. So the experience at MIT was brief but wonderful.

**INTERVIEWER:** Do you remember your first impressions when you arrived at MIT? Here you were back in an urban area, somewhat different from Iowa.

**SURESH:** Well, I had my own car -- I drove across from the midwest to here. I arrived in Cambridge actually on my birthday, on my 23rd birthday I arrived. It was initially a culture shock. But what I had done was there was a student who was graduating from Sloan School, and before meeting him, and having never visited Cambridge, Massachusetts before, I decided to take his room and also his furniture. So I bought the furniture from him. When I arrived I already had a place to live and a furnished apartment on campus in graduate student housing. So I took that up.

**INTERVIEWER:** How did you find him? Was this a network of friends? Friends of friends?

**SURESH:** It was through a network of friends and through the department here they put me in touch with them.

**INTERVIEWER:** When you were in Iowa and then Cambridge, was there a support network of Indian students?

**SURESH:** There were some Indian students that I knew, and there were also graduates of my undergraduate school from a few years before me and they were very helpful in the initial stages. But because I had a room already in the dorm and I had a roommate. So on the day I arrived I went and met my new roommates, both were US citizens. One was from Nevada and one was from California. So we quickly became good friends, and that provided a social network for me.

Then I got engrossed in my research work very quickly. So there was also a support network through my lab mates and my research group.

**INTERVIEWER:** And MIT, did you find that collegial as well?

**SURESH:** The groups that I was affiliated with, they were very collegial, and we had an opportunity -- we not only did a lot of things professionally, but we also did a lot of things socially together, going to movies or going to restaurants in the city, and so forth.

**INTERVIEWER:** How much was MIT like your previous two campuses, and in what way did it seem most different when you got here?

**SURESH:** It was very different from both of my previous two campuses. My undergraduate school was a small, elite institution with only about, at that time there were 1,250 or so undergraduate students for all five years. And the faculty lived on campus. It's a beautiful 700-acre wooden campus in the middle of a metropolitan area. So even though you were in a big city, you were secluded from the city. Inside you had deer and monkeys and forests, and you lived on campus, the faculty lived on campus, you walked from your dorm to your school, you ate on campus -- everything was done on campus. Occasionally you will venture out.

Iowa State was very different. It was more of a rural campus, a campus community. There was nothing for tens of miles or hundreds of miles nearby. It was in the middle of farm country, and it was much more international. Whereas my first campus was all Indian students, all Indian faculty. The second campus was very international. There were very few Indians in the State of Iowa at that time.

Coming to Massachusetts, in one sense it was exciting because it was a metropolitan campus. I think the difference between both of my previous universities and MIT was the pace of research and the pace of education was much faster. Even though the pace at IIT and the competition from your fellow students was equally fierce, MIT has a certain rhythm to it -- just even walking along the Infinite Corridor, you sense a pace that I did not sense anywhere else before, both in an exciting sense and in the sense of making you feel nervous about the pace.

The opportunities that were available in MIT were much greater. Even as a student I could feel it. We had a lot of visitors, a lot of international visitors. So as a PhD student I had an opportunity to meet them. We had visitors from industry -- I never had so much opportunity to meet people from industry before. The opportunities to attend seminars, not only in my field but in other fields. So it was a very exciting place as a student.

**INTERVIEWER:** You said that when you got here you already knew what you wanted to focus on. How did you know and what was it and how did you make that decision?

**SURESH:** This was mainly based on subjects I had taken as an undergraduate student, and in my Master's program at Iowa State. The area is called mechanical properties of materials, and within that a sub-area called fracture and fatigue of materials. So essentially, why things break and how to prevent them from breaking, whether it's a pipeline, an oil rig or an airplane or a blade of a helicopter, failure is a major topic of engineering interest in so many different fields.

I found that area very fascinating mainly from taking subjects in those areas. I decided that this will be a nice area to pursue. And this was an area in which there was quite a bit of research funding available. I was able to work with a young faculty member. I was his first PhD student. So my success depended -- you know, would influence his success. I was his first PhD student, so he was almost like a colleague to me and a friend more than an advisor. So we used to work together.

**INTERVIEWER:** How did you line him up? Had you looked over the department when you were still in Iowa and said this is the person who's doing work that's closest to what I'm interested in or what I've done?

**SURESH:** That's right. So this is before the age of internet. So I got an MIT catalog and looked through the list of faculty, and this was an area that I decided I liked. I contacted him by phone, explained to him why I was interested in. Getting into MIT is very competitive, and especially applying from an institution like Iowa State University to MIT, you're competing with students from top institutions all over the world.

So I talked to him by phone, I explained to him my interest, sent him my transcripts, and then I applied formally. I was really delighted to receive a call from him saying that he would offer me a research assistantship. I asked him I planned on coming in September, can I come in June so I can get started during the summer, and he had the funding available so I came early.

**INTERVIEWER:** After you got your doctorate you said you headed for Berkeley and then Brown. What was Brown like to be a faculty member at, and how was your adjustment there and teaching responsibilities and student interest?

**SURESH:** So I became a permanent resident when I was in California, University of California at Berkeley. University of California sponsored me for my permanent residency. So I could have gone anywhere because I was already -- I didn't have to worry about Visa and things like this. While I was at Berkeley I had the opportunity to work with industry in California, especially the aerospace industry -- companies like Lockheed, Northrop, Rockwell, and so forth.

I briefly contemplated the possibility of going into industry, but then my research was going so well, I was excited at the prospect of going into academia. I interviewed at several universities. I had several offers. Brown University, historically in the '60s, '70s and '80s had been considered to be a place that was at the forefront of the field of mechanical properties of materials, which was the area I was in.

Even though engineering at Brown is very small -- it's a small, almost like a department at MIT. There are only 40 professors in all of engineering at Brown. The group that recruited me was a very strong group and a very collegial group. Brown was considered for a long, long time to be the top place to be in the area of mechanical properties of materials.

So when I got a faculty offer from them, again, I didn't have to think twice. I decided this is the place I should go for my next career move, and I joined Brown. I received the offer in the spring of 1983. So I decided to leave Berkeley some time during the summer at the end of June. But I also realized that this was my last opportunity to take some time off before I plunge into an academic career. So I took three months off.

I decided that I was going to go to Europe for a little while. So I went to England to Sheffield University for a month. Then I spent a month in Stockholm at the Ireland Institute of Technology working at universities there. Then I did some consulting for Lockheed in Palo Alto for about a month, continuing on some of the things I was doing while I was at Berkeley. Then I went home to India for a brief vacation for a few weeks.

Then I came back and I drove my car across the country from California to Rhode Island. I decided to start in the spring semester, but to get started early to prepare my lectures and to write some proposals, I decided to come at the beginning of December before people went on their Christmas vacation. So during Thanksgiving week I drove across the country and came to Rhode Island and started in the beginning of December.

**INTERVIEWER:** So did you do any sightseeing in either America or Europe when you were in these places?

**SURESH:** Actually, I probably did more sightseeing in the U.S. from the time I arrived in the US the first time to the time I joined Brown. So, when I was a graduate student at MIT, I flew to California when I worked in Lockheed for the summer. But then I bought a car in California and I drove across the country all by myself. So I took a particular route to get back to Boston.

Then when I was in California, I also did a coast to coast trip with some friends during a summer break. Then when I joined Brown, I drove coast to coast as well. So, in a span of about three years, I had driven coast to coast three times, three different routes, so I saw most of the country. Since that time I haven't driven coast to coast even once. But in three years I did it three times.

**INTERVIEWER:** Were there any surprises when you came back to MIT? I guess how did you make the transformation, the transfer from Brown to MIT?

**SURESH:** I was very happy at Brown. I joined Brown almost in the early 1984. A year and a half later, they had to start thinking about a process for my three year renewal, because I joined them as an assistant professor on a three year appointment. But I took half a year off before I joined them, and then I was only a year and a half into my stay at Brown, and this was a year before my three year appointment was to end, they already started thinking about renewal. And the renewal process would require external letters and internal letters.

So they had to start very early. So in 1985 they had to start the process of the renewal of my three year appointment. I was very pleasantly surprised they came to me and they told me that it looks like your stay the last year and a half at Brown has been going very well. We decided to put you up for tenure at the same time. So within a year after that I had my tenure already at Brown. So it was a relatively painless process, very enjoyable process of getting my tenured position.

**INTERVIEWER:** What do you think that resulted from? Were you publishing a whole lot or was it your industry work?

**SURESH:** I think the combination of things. My PhD work at MIT very quickly gave me an opportunity to know pretty much everybody in my field, and everybody in my field knew me.

**INTERVIEWER:** Because it was small field?

**SURESH:** No, it's a very large field, but I think we were one of the first people to get into this area of fatigue, and the PhD work got a lot of visibility very quickly and it received a number of awards in the following year when I was at Berkeley. The two years of Berkley were extremely productive, and I was able to publish a lot of papers, including some papers on my own, some theoretical papers. Then I also had cultivated a lot of international contacts during that time.

When I came to Brown, I very quickly wrote some proposals, and they were all funded. The combination of that and my teaching evaluations in my first year, and the fact that I was getting to be known in my community, probably played a role in the decision of my colleagues at Brown to put me up for a very early tenure. So that took the pressure off.

Then the group was going very well, so I continued that path for a few more years.

**INTERVIEWER:** What bumped you off that path and back to Cambridge?

**SURESH:** So, I got married in '86 and we had two children -- one in 1988 and one in 1990. In 1990 I took a sabbatical leave because my wife was pregnant at the time, we were expecting a child, we decided not to go anywhere outside of home. So literally I stayed home for the sabbatical and I wrote my first book, which was published by Cambridge University Press in the area of fatigue of materials. We got a nice home and our second child arrived, and I was very -- by this time I was already a full professor at Brown, and I thought I will stay there forever. I was very happy and we had a very good research group. I was very well funded. In 1992, my book had come out, it was very well received by the community.

I was sitting in my office one day and professor Merton Flemings who was the head of material science and engineering, I received a call from him one afternoon, I was sitting in my office at Brown. He said, you know we are looking for a faculty position in your area of interest at MIT. Do you have any recommendation on any names? And I had an outstanding student who was about to graduate and she was already receiving faculty offers.

So I strongly recommended her for the position at MIT. He said would you send her CV. So I walked to her office and I said I just recommended your name to a position at MIT , could you give me a CV, and she was already interviewing so she had a CV available. Emailed it to me. I emailed it immediately to MIT.

Within about half an hour I received another phone call from Professor Flemings. He said, you know I showed it to a few colleagues very quickly. We were very impressed by your students, but we thought it'll be good if we were to get a senior faculty member in this area because we really want to grow this area and it'll be good to have somebody who was already a full professor. We were wondering whether you would have any interest in this position. So I said I haven't really given it a thought, and secondly, I really don't want to undercut my own student if you're going to hire her.

So I walked up to her, I mentioned to her what was going on, and she had already had several offers. She said no, no, if they're looking for a senior person, you should definitely consider. But then she told me don't leave until I finish my PhD. Anyway, that's what started this process.

**INTERVIEWER:** Did the area you specialized in, the fatigue, lend itself to applications more than other things? Were you conscious of that? You sounded like you had some pragmatic thoughts about is this going to be a field with legs, so to speak.

**SURESH:** So, fatigue is a very important area, whether you are talking about aircraft structures or automobiles or bridges or railways and things like this, a power generation equipment, nuclear reactors. Tens to hundreds of billions of dollars are spent every year handling fatigue. The work that I did in the 1980s influenced a lot of industrial practice in the aerospace industry, in metal producers and other industries.

But when I moved to MIT, my book had just come out, I had worked in the field for 10 years, and I thought this is a great opportunity to pursue things other than what I was doing. And that in conjunction with the fact that I started collaborations with a few faculty members at MIT who were working in mechanical property issues but for microelectronics, which had nothing to do with the applications that I was dealing with where I could apply what I knew but bring in something new to a completely new milieu.

So I started working in that area soon upon coming to MIT. That led to in the 1990s a lot of work in my group looking at thin films and coatings for microelectronics applications, flat panel displays, coatings for power generation industry, and so forth.

I hadn't planned it this way, but I when I look back, the way my career has evolved, I work in a field for about ten years, write a book and go to a new field. So I started writing a book in the thin film area in the late '90s and early part of this decade. I finished the book in 2002, 2003 and then I moved into biological materials.

So the underlying theme is still the same, mechanical properties, but completely different applications going from fatigue of aircraft structures to the role of stress in the reliability of computer chips in microelectronic applications to the integrity of flat panel displays for TVs, now to mechanical deformability of red blood cells in the human body and its effect on malaria. So the theme is still mechanical properties, but the applications, the target audience, is completely different.

**INTERVIEWER:** As you made each of these moves in terms of the applications, to what extent did you have to re-ground yourself? How did you familiarize yourself with the microelectronics and then later with the biology? Did you attend any classes or do a lot of reading, or is it simply huddling with a couple of other professors?

**SURESH:** In the case of transition going from large structures to microelectronics, it evolved mainly through collaborations, and then working with this group of very talented students and postdocs in trying to come up to speed and trying to stay a step ahead of the students, and really good students push you very hard. I think that's how that transition took place.

But the transition from thin films to biology is a huge transition, and compared to that, the moving in to microelectronics was nothing. The biology transition took about two to three years. First, because it was a completely different field to me, I had to learn the language of the biologist. Literally, I had to learn a different language. Secondly, the last time I had done biology was in middle school, and that was not in English. So I had to essentially start with high school level biology and then build it up.

I volunteered to teach a class in bioengineering department, which also was attended by a number of biology students. So preparing for the class I had to -- I co-taught it, I didn't teach it by myself. I taught it with two other professors.

**INTERVIEWER:** In biology?

**SURESH:** In bioengineering, and it was also co-listed with other engineering departments.

**INTERVIEWER:** But the two other professors knew biology?

**SURESH:** They had worked in biology for 20, 30 years -- a lot longer than I had worked in. So I had to come up to speed, at least in the areas that I was covering very quickly. I was also studying all the basics and going into labs and trying to learn the basic tools and techniques, because it's not a direct adaptation of what I did in engineering materials. Even though I was looking at mechanical issues, I knew what the subject matter was. But learning the biology side was completely new to me.

It took me about two years to identify the right problem. So I wanted to do something that had to do with human diseases. That means I had to create a physical infrastructure for my students to work in, a lab which I did not have. Which I did not have the experience in and expertise in. Which I did not have the funding for. And I had to do it while I was a department head. While I was doing other work for which I was funded, which had nothing to do with bioengineering. So this was a challenge.

So the way I did was I started very slowly, I didn't drop everything else that I was doing in engineered materials. And tried to talk to a large number of people, tried to educate myself on what the issues were. So I wanted to pick an area where I had something significant to contribute. And I wanted to contribute -- I didn't want to do just bioengineering or just biophysics, but I wanted to do bioengineering and biophysics in mechanical properties that had a connection not only to biology, but it had a connection to human health and public health. And how to do that.

So it started with some discretionary funds that I had. I had to get some quick results. So I picked a system, namely human red blood cells and nanotechnology, which I was working on in engineered materials, to do the first set of experiments, to bring a unique experimental tool to study live human red blood cells. Once I had that I wanted to study a human disease.

So we had collaborations already with the National University of Singapore, so I talked to some senior administrators and faculty at the National University of Singapore, and decided that I will being in my expertise and if they could provide me the infrastructure as part of our collaboration between MIT and the National University of Singapore, I would help set up a lab inside the medical School at the National University of Singapore where my MIT students could run experiments.

So we decided to study malaria. The reason I picked malaria was it's a major human disease that affects 7 percent of the world population every year. One to two million people a year die from malaria, and I don't have to convince the malaria experts and the microbiologists that mechanical properties of red blood cells play a huge role in the pathogenic basis for malaria. So it's not -- I don't have to tell them that what I have to offer is of importance to them; they already knew. So that made my job much easier.

Once I had some initial results with malaria parasites inside human red blood cells, we made a discovery that the effect of parasite being inside the red blood cell for just 48 hours meant that the deformability of the invaded red blood cell changed by a factor of 100 -- up to 100, 50 to 100. Rather than the factor of two to three that people thought was the effect until my work.

Once we established that, I started talking to microbiologists. So in 2004 I took a sabbatical leave and I went to France, to Paris, and soon after I had arrived in Paris, I made connections to Institut Pasteur, which is sort of mecca for research in this area, and I made a presentation to them. Being able to work with them on this particular project in collaborative research meant that I was forced into a culture by my choice. It was my choice, but that opportunity forced me into immersing myself into a microbiology community where I had to learn the language very quickly.

**INTERVIEWER:** In French.

**SURESH:** Well, they spoke very good English. But still, I had to immerse myself. And that led to new opportunities. And one of their PhD students who got the PhD there decided to come and work in my lab as a postdoc and she's a microbiologist. So this led to a lot of interesting opportunities. Then I set up a lab here, after the postdoc came here, and we started collaborating with a number of entities within MIT and also outside, and very quickly the group began to increase. We also received funding from NAH and the work began to be recognized in the community.

**INTERVIEWER:** Let's say you hadn't had that Singapore connection or even Paris later. Could you have done it here, and as you think about being a manager here and you look at younger people who may want to do things like this, how do you create the platform so they can make those jumps maybe without Singapore or Paris?

**SURESH:** I think if you are a young faculty member or a postdoc or a research associate, and you have a lot more at least time to develop an area and then make contributions in that area, it's possible to do that but it takes time. In my case, I had the additional complication that I was a department head. I was running a department -- it's a relatively small department, but nevertheless, a lot of administrative work. I was already running a large research group in material science. So on top of it I had to do this, and that was the challenge.

So how do you do this? If you want to be successful in research funding in a completely new area, to gain the credibility of your peers and to be successful with the peer-reviewed proposals for any agency, you have to demonstrate that you have results and you have capability in that area. But to get results you need funding. So it's a chicken and egg argument. So the way I was able to do this was we had a project funded through collaboration with Singapore, and we had ongoing interactions, and we had connections to the medical school.

So rather than cultivating a new connection that did not exist with the medical school in the US, I knew the people. So going to the people and telling them this is an important area, would you be interested in collaborating was much easier. Plus we were not competing for the same funding source. In the US to develop such a collaboration initially you have to offer something and I did not have anything to offer because I was just starting to work. So I think both Paris and Singapore were very helpful. Once I had results from there, it was much easier to cultivate collaborations within the US.

**INTERVIEWER:** Let's talk about how you entered the management track. So you came to MIT as a professor, and at some point somebody said, wouldn't you like to chair the department? How did that happen?

**SURESH:** So I was involved in administration and leadership roles of different kind since coming to MIT. So I came to MIT in 1993. In 1994 I was invited to be the key editor, chief reader for one of the major journals in material science called *Acta Materialia*, and this is a large international journal and I was in charge of coordinating a number of editors from different countries, and that was a major administrative role, but it's a research administrative role, as an editor.

Then MIT started this Singapore-MIT Alliance in 1997, '98. I was part of the MIT team that helped prepare this proposal. Then in 1999 I was asked to be the chair of this first program to start, as part of the Singapore-MIT Alliance. Again, that was an interesting administrative opportunity. This was in a very short order to create a Master's degree program between MIT and Singapore which did not exist.

It was also to create a distance education program, which was still in a very gestational stage at that time, both in terms of technology and in terms of experience. So it was a major new effort, and it was very difficult to launch. It was a great learning experience. And putting it together in a small period of time and developing the technical content and the intellectual content was a major challenge.

So this was a very good training ground. So a year after I became chair of the advanced materials programs for SMA, there was a change of leadership in the department. I was interviewed for the position and I was offered the position and I thought it would be a natural transition into department leadership at that time.

That's how I got into an administrative role. While I was department head, I was able to also sustain my research activities. So it was not a giving up one to take on something else, it was taking on something in addition to what I was doing. Fortunately, I was able to manage both.

**INTERVIEWER:** How would you describe your managerial style?

**SURESH:** I like to listen to all perspectives on an issue. One of the things, especially in academia, that you learn is that every issue has multiple perspectives, and before you can make an informed decision, you have to carefully listen to all different points of view and try to build a consensus as much as possible. It's not possible to get 100 percent consensus on every issue, or even an overwhelming majority on every issue, but it's very important to listen to every point of view and to make an informed decision. So I try to do that as much as I can.

I think that, I would say, is probably my strongest management style.

**INTERVIEWER:** But you seem to come in with some kind of priorities, some things you wanted to look at or some things where maybe you thought change was warranted. What were they for the department?

**SURESH:** So, I had some perceptions on what would be -- as a faculty member at MIT and also having chaired a department, having served on the engineering council as a department head for six years, I had an idea of what the issues were. Then during the search as dean, for the dean position, the search committee itself had pulled large numbers of faculty and leaders, not only within MIT but outside of MIT. When I became dean, the search committee shared with me what the sentiments of the community was with respect to the issues facing the School of Engineering at MIT at this time.

So, the issues that I came to the office with were not only the issues on my mind, which I articulated to the search committee, but also the issues that arose in the search for the dean itself, which the search committee shared with me, of course, without attribution.

Then what I did was to form strategic planning committee groups. The strategic planning group came up with their own -- they interviewed faculty, they interviewed leaders inside and outside MIT, and they came up with their own set of issues and priorities. What I did was I categorized them into low-hanging fruits and medium height fruits and really longer term issues. Some of them did not require any resources and they were relatively easy to implement.

**INTERVIEWER:** Such as?

**SURESH:** Such as forming a committee to explore a flexible engineering degree program leveraging the practices that we already had. That did not take a whole lot of effort. The second one was the recommendation of this committee that we form a virtual center of computational engineering. That was very easy to do.

So I quickly, based on the recommendation of the faculty and the strategic planning committee, I decided to form a center for computational engineering, which very quickly brought together a large number of faculty, not only the School of Engineering but outside the School of Engineering to talk about curriculum development and to join the search proposals. It didn't require too much resources.

A third activity that came about because of this exercise was the creation of the transportation initiative, Transportation at MIT. We did a survey of all the faculty and researchers at MIT, and we found that a large number of faculty were already doing research in transportation. I knew that just in the School of Engineering, we were receiving funding to the tune of about $25 million a year based on individual faculty effort, which is totally uncoordinated per year.

So I thought wouldn't it be great if we provide some incentive for these faculty to come together. So I talked to the dean of the Sloan School, I talked to the dean of the School of Architecture and Planning. The three of us together seeded an activity which we call Transportation at MIT, and we appointed a director for the transportation at MIT initiative. Within a few weeks this group came together and they wrote a proposal, which was funded last year, to the tune of $38 million over five years.

This group was able to go after new research project over and above the funding they would receiving so that they could tackle major problems on a global scale. I provided a new faculty slot for this effort.

Another suggestion that came from the strategic planning committee was to bring down the barriers across departments and across schools. One suggestion was to organize a school-wide faculty search, so we would have multiple departments participate in the search, would recruit a faculty member in an area that's the broad interest to many departments at the school. Then we will ask the faculty member what department would you like to be in. This provided increased competition, it provides a new dynamic, and hopefully over a long period of time, it'll help bring down the barriers across departments. This is how the school-wide searches came into existence.

**INTERVIEWER:** That sounds nice in theory, but when it comes into practice, everybody doesn't get very protective of their turf?

**SURESH:** In any academic institution that will happen. So when-- so even though this idea came from the strategic planning committee, not from me, when I first proposed it, the biggest concern that people had was that if I had search committee for an interdepartmental search that consists of faculty members from many different departments, perhaps the faculty member would be in a very subtle way, the newly recruited faculty member will be steered into a department that's the home department of the chair of the search committee. This was a valid concern that was raised. I have data points to counter argue.

So we had four searches in the first year, four school-wide searches. All four searches recruited the top candidate. In each of the four searches, the top candidate who accepted ended up in a department that was different from the home department of the chair of that search committee. So I decided that this should prove the point beyond a shadow of doubt.

**INTERVIEWER:** As dean you're part of MIT's academic council, the small group of top officials, who meet weekly with the president. What are those meetings like, and have they given you perspective on MIT that's different from what you had going in?

**SURESH:** Absolutely. One of the remarkable things about MIT, which many people outside may not know about, is that the entire leadership of the schools and the institute meet for two hours every week. The president, the provost, the executive vice president, all the vice presidents of different units, the deans of all the schools and the undergraduate school dean, and undergraduate education dean and the graduate education dean, we all meet for two hours.

This gives an opportunity to discuss major issues in one place -- of course, it's advisory to the president and the provost, but it gives an opportunity to be aware of all the issues, not just the issues that I face in the school, but also the issues that affect the entire university in one location. It gives you a much higher altitude view of the academic enterprise from setting undergraduate tuition, to the research volume, to the issues with a particular international engagement. All of these issues you discuss well before you make a decision. And being part of that group gives you a very high altitude view of the academic enterprise.

It also give us an opportunity for me to interact with the leadership of other schools in ways in which other institutions may not have the same opportunity for different deans to interact, and this has created new opportunities. The sidebar conversations during academic council are very helpful in creating new collaborations between schools at MIT.

**INTERVIEWER:** What are the biggest surprises you've had from that higher altitude?

**SURESH:** It's not a surprise, I knew, but the extent of which I did not know. I think the level of detail that's paid to every issue in a place like MIT. I knew that was the case, but being member of academic council, I was pleasantly informed that that is true. The data that goes into every activity, background work, the seriousness with which issues are taken up and discussed. I think the rigor with which issues are pursued is very heartwarming.

**INTERVIEWER:** How much fundraising did you do as a faculty member, and how much did you do as a department chair, and how much do you do as a dean? What are the lessons you've learned from all this?

**SURESH:** I think it's a great question. I think MIT is a place which is highly entrepreneurial in nature. Having been associated with many different institutions, I know for a fact that perhaps MIT faculty members on average, individual faculty members, directly or indirectly, pay a huge role in the fundraising enterprise. Whether it's talking to an ILP member who comes to that office. Whether they're talking to a technology licensing officer. Whether it's hosting a dinner along with other faculty members to a potential major donor. Whether it's part of an international program where you go as part of an MIT team and you meet with international counterparts. Whether it's from industry or from government to talk about future collaborations, which inevitably requires fundraising, or participating in studies in Washington that lead to policies, that lead to creation of major programs.

So all of this is part and parcel, I would say, perhaps much more so of the daily life of an MIT faculty member than your typical professor in many of our peer institutions.

So personally as a faculty member, I was -- of course, in my own research I was involved in fundraising both from industry and from government and from overseas government. Then I was also part of MIT's efforts in creating the Singapore-MIT Alliance Program. That's institutionally participating in creating a new program. So it's not fundraising per se, but it's a creation of a new effort for which funding has to be raised as well.

Then as department head, I was involved in significant fundraising activities for the department, creating new endowed chairs. And one of the things I did early on in my first six months was to create one of the most ambitious infrastructure building projects that led to the creation of new labs along the Infinite Corridor -- the glass labs that you see, labs with glass walls, as you walk along the Infinite Corridor. And this was at a time where I had to raise a significant part of the funding for that.

So getting the funding and getting matching funding from donors and alumni and getting matching funding from CRISP, and this was a major part of my effort. So we probably had the most infrastructure building project for materials science and engineering during my six years in the last 30, 40 years' history of the department.

This also led to a number of conversations outside of the department. For example, in collaboration with the Department of Physics where Marc Kastner, the current dean of science was the department head at that time, we orchestrated a space swap, and that led to the project called PDSI that led to the creation of the new theoretical physics green center building, which also led to the creation of new labs along the Infinite Corridor for material science and engineering. New space renovation on the second floor of Building 8, and new office space for our department of material science and engineering headquarters and the headquarters staff.

So all of this was part and parcel of a much larger conversation and outside fundraising. I also raise funds abroad for the department. Then that only intensified when I became dean. The School of Engineering roughly has about half the living alumni of all of MIT. So MIT has approximately 125,000 or so living alumni, and half of them are engineering alumni. So as dean of engineering, I engage with a large fraction of them all over the world. So whenever I travel now as dean, I meet without alumni, I give talks at MIT alumni associations in different parts of the world, and that's one of the fun parts of my job.

**INTERVIEWER:** It sounds to me like if I had to sum up what makes your fundraising successful, it's partly having a set of interesting ideas that people will get excited about, and then having the energy to go out and sell them? Is that the recipe? Am I missing something?

**SURESH:** I think those are definitely an ingredient. But also I think what is helpful, especially in a place like the School of Engineering, is that we have passionate students -- students who are very passionate and good at what they do. Faculty who are very passionate and good at what they do. And we have alumni who are very passionate about MIT. MIT's global reach is such that a lot of people in a lot of institutions would like to partner with us. We have to be very selective and careful about how much time we can afford, and what is the benefit to MIT.

So I think showcasing the excitement of what goes on on MIT campus to potential donors, engaging the alumni pool, and engaging even non-alumni who are passionate about science and engineering, and getting all the stakeholders to participate in this -- the students, the faculty -- it's central to resource allotment at MIT, and department heads in the School of Engineering and center directors. I think that's the thing.

So one of the things I did fairly early on in my tenure as dean is to strengthen the infrastructure for resource development within the School of Engineering that will work closely and seamlessly with central resource allotment to help facilitate this process.

**INTERVIEWER:** So the deanship gave you one new perspective of the Institute. I understand that you're also now an MIT parent, which has that given you some new understanding of the MIT as an institution?

**SURESH:** Absolutely. So, I had a perspective of MIT as a student. I had perspective of MIT as an alumni outside of MIT, as a faculty member competing with MIT faculty. When I came back to MIT I had the perspective as a faculty member, then as a department head, and then subsequently as dean. But being a parent at MIT gives you a completely different perspective. For example, I had visited only very briefly undergraduate dorms at MIT. But when you visit as a parent, you look at the dorms very differently than you do as a professor or a department head or as a dean, because you want to see how suitable this is for your child from every angle -- from living quarters to eating facilities, and so forth.

I also look at the curriculum as a parent. As a faculty member, I always looked at it as how intellectually challenging this curriculum is, and as a fellow human being I also look at it as am I being unreasonable in my expectation when I demand a lot from an already self-demanding student population. As a parent, you ask that question even more deeply. Is MIT putting too much pressure on my child? This is a question that every parent will ask.

You also have to question -- one of the things I found as a parent is that what a wonderful experience MIT education is. Which I knew as a professor and as a dean, and also talking to students, but as a parent you get a completely different perspective on this.

So I would say that being an MIT parent gives you a new vantage point to look at the MIT experience.

**INTERVIEWER:** You had a piece in *Business Week* early last year where they had called upon a set of experts to recommend ways that the economic stimulus money ought to be spent or focused. You called for faster, more efficient, more affordable high speed railways. What made you decide to focus on that, and did you get much response to the piece?

**SURESH:** OK. So, I spent two sabbaticals in Europe -- once in Stockholm, and the second time in Paris. Both those cities have wonderful public transportation. Take Stockholm as an example. From the Stockholm airport to the city is more than 40 kilometers or so by car or by taxi, it used to take almost an hour depending on traffic conditions. They built a new train system from the airport to the city and it's very frequent, very inexpensive, and a stressless journey, especially after you arrive after a long over night flight. Paris was the same.

In both cities we lived for six months without having a car using public transportation. That really opens your eyes. So take the northeastern corridor as an example between Washington DC and Boston. It's one of the most congested air corridors, it's one of the most congested areas of the US and we always have traffic problems. In the winter time we have weather problems almost every day. Plus we have huge pollution issues in this area.

Part of the reason for my comment in that particular piece that you caught is that public transportation broadly, whether it's high speed transportation or low speed public transportation, especially in congested metropolitan areas or regions of the country, would be beneficial long term, both with respect to the ability of the people to commute to work, their productivity levels, their morale, protecting the environment, as well as economic issues related to price of oil and price of fuel broadly.

**INTERVIEWER:** Do you think there's much likelihood that people will take your advice and do something?

**SURESH:** Well, what happened was because of my comment, but last year the US Government announced that it was going to devote $8 billion to high speed rail transportation. I don't think it was because of my comment, but nevertheless I was heartened to see that this was something that happened. There are some states now that are looking at public transportation, especially high speed rail transportation.

California as an example, given the budget crisis that California is in, it remains to be seen how successfully it will happen, but nevertheless I think it has come to the attention of the public. And now with the discussion of renewable energy sources and the fact that other countries, including rapidly emerging countries like China are becoming world leaders in rail transportation, and the US has lagged behind in that area, hopefully will give some momentum to that discussion.

**INTERVIEWER:** Do you find that as dean of the engineering School there are more opportunities to make pronouncements on public policy issues?

**SURESH:** I think being a large engineering school that's ranked at the top of the field in many different fields of engineering, and MIT having the respect and the reach in the global engineering community, gives a unique vantage point. I think historically, faculty members, department heads and deans at MIT have had the good fortune to talk to even heads of states from around the world. We have visitors all the time, and we have the opportunity to travel to many countries.

This gives us an opportunity to provide our input from a scientific and technological perspective, and also in Washington. Hopefully this will lead to informed discussion on the part of everybody to look at issues coming from people who deal on a day-to-day basis with education and research and science and technology.

**INTERVIEWER:** So we'll all stay tuned. Thank you very much for your time and the conversation.

**SURESH:** Thank you.