

INTERVIEWER: This is the MIT 150th anniversary interview with Professor Cynthia Barnhart. Since you're on the steering committee, I have to sort of ask first what your goals are for the celebration.

BARNHART: Well, I think that the goal is to bring visibility to MIT, first and foremost, and to bring together the former students and the faculty and staff here to celebrate MIT's great history, and to think about our future.

INTERVIEWER: So, for the information about you, let's go back and can you tell me where you were born and where you grew up and a little about your family?

BARNHART: Sure. I was born in West Point, New York. I grew up in a small town called Barre in Vermont. I have one sister and one brother. We lived in Barre up until the time I went off to college. Both my siblings and I, all of us went to the University of Vermont as undergrads.

INTERVIEWER: Were there any particular influences when you were young that you think helped to propel you toward your career path?

BARNHART: Interestingly enough, there's not the usual things to point to. But I guess in my case, both of my parents probably daily said things like you can do whatever you want if you're willing to work hard. That just sort of stuck. I think what I did was I sort of followed my interests and worked hard at them. I liked math when I was in school a lot, and that's how I followed that path of math and then engineering.

INTERVIEWER: Why did you pick the University of Vermont?

BARNHART: There were a few reasons. One, of course, it was new and I grew up in Vermont. I think it was maybe more why I didn't pick other places that's relevant. My sister is one year older than I am, my brother's one year younger. So my parents had three of us in college at the same time. So, for financial reasons primarily, I ended up going to the state school at home.

INTERVIEWER: How did you make the transition between math into engineering?

BARNHART: Well, I guess that came maybe through high school guidance counselors, and then again in college. When I started at the University of Vermont I was undecided. I was thinking about being a math major or an engineering major. I think again what drove me to engineering was in large part, financial considerations. So everybody said do engineering, you can get a job. So that was I think a big motivation for me to check it out. I mean what they told me was engineering is about math, so if you love math you should also love engineering.

INTERVIEWER: Did that turn out to be the case?

BARNHART: Yes, it turned out to be the case. But I have to say I went through a few different engineering disciplines before I found the one that matched me. I blew up a few ammeters in labs and things like that. But I found that I actually didn't fit really nicely into any of the traditional disciplines in engineering. I did get my degree in civil engineering, but I was different even as an undergrad in terms of my interests.

I already at that time started migrating to operations research, which I think I was attracted to because it pulled together math and computer science and engineering problem-solving. I liked the fact that it required some creativity to think about how you approach the problems, and how you model them with operations research. I didn't find that element in all of the engineering disciplines, all of the subjects I was taking.

I found sometimes they were kind of here's your problem, here's the approach to solve it, step one, step two, step three, done. I didn't really like that. I wanted to have more of an element of uncertainty in it. There is, perhaps, no right answer. I liked that uncertainty and kind of messiness, but I also liked the rigor and structure of math. So that's where I found operations research to be something I really enjoyed.

INTERVIEWER: You like that modeling.

BARNHART: I do. I really like that.

INTERVIEWER: How did you approach the idea of graduate study?

BARNHART: That was kind of easy because after undergrad I went to work. And so after about a year, maybe less, of work, I said hmm, I don't want to do this the rest of my life, I better go back to graduate school. I worked for a year and a half helping -- I was part of Bechtel in Washington, DC; they were the construction managers for the Metro at that time. So I was the a) planning and scheduling engineer, which was fun but I didn't see myself spending a career doing that. I knew I needed to go to graduate school.

INTERVIEWER: That may not have been the best company to hook your future into anyway.

BARNHART: Right. Yeah, it was a good decision to go to school.

INTERVIEWER: How did you wind up coming to MIT?

BARNHART: Well, it was kind of easy again. I wanted either to come to MIT or go to Stanford or Berkeley. It turned out that I ended up applying only to MIT because I was newly married and my husband had a job offer in Boston, and so came here.

INTERVIEWER: Do you remember when you first came to MIT what your first impressions were?

BARNHART: Yeah. There were a number of different impressions. First, I remember probably on my first day meeting a student who had just defended his doctoral dissertation. He was now a PhD, a doctor. I remember saying to him, you must be so proud. He said well, not really. I thought how can that be? You've just completed a PhD. So I think when I entered I thought it's amazing the students who are here, and the quality of education one can get and to actually succeed and complete the degree I found really impressive. Later on through the years I learned yeah, when you live with it every day it doesn't feel as impressive as maybe when I entered.

I was amazed in meeting the students who were from all around the world, how interesting they were and how smart they were. At times I thought oh, this is kind of a weird place. When you walk through the basement halls -- of course, that's where my office was -- at all hours of the day and night there are people walking around. So sometimes it does feel a little like you've entered a different world. That was one of my first observations that sometimes it could be a bit strange around here.

Then I guess other impressions as I went along were -- the impression I've had many students of mine tell me since, and that is I think you've made a mistake. I shouldn't have been admitted. It's interesting because I remember feeling that, and so many of my students have said it to me since. It's part of the process it seems. You just have to find your way and regain your confidence. But initially it can be pretty daunting.

INTERVIEWER: It must have felt different than Vermont did.

BARNHART: Yeah, it felt really different. When I took an exam at the University of Vermont, I can remember distinctly sitting and being maybe stuck on a problem and thinking I can get this, if anyone can get this I can get this. Here, sitting and taking an exam and being stuck on a question, that was not what would to my mind. So it wasn't very different. It's kind of the big fish in a little pond versus the opposite effect.

INTERVIEWER: Did you ever think about going somewhere else for your PhD?

BARNHART: Once I got here?

INTERVIEWER: Yes.

BARNHART: No. I found that the students here provided me this really incredible community. So we would every day sit and work together on problem sets, something that the faculty encouraged because they know that learning comes by interacting with each other. I can remember sitting and arguing about how to prove something, stealing the chalk out of my friend's hand and saying no, no, no, this is how you do it. And they would come right back and we'd have these really exhilarating debates.

It was really fun and I just learned so much from -- because what you learned usually was we often were both right. That you could prove what we were trying to do either way, but we were both doing it in different ways. And so you learned how to think a little bit differently. Then sometimes you just learned that you were just wrong and your fellow students had something to teach.

So, once I was here I never thought about switching to a different school.

INTERVIEWER: What made you focus first on transportation?

BARNHART: I think my focus on transportation was something that was started as an undergrad. I was in civil and environmental engineering. As I said, some of the subjects I had in structural engineering -- I don't want to offend anyone -- but it just didn't do it for me. I didn't find what I was looking for. But when I took transportation subjects I found that there was the element of hmm, how does one solve this problem? There was no answer, so there are different ways you can approach it and different trade-offs and you have to make these design decisions.

I liked that element of design. So I first got into that as an undergrad. Then, working for Bechtel involved me more in transportation systems. So it was kind of a natural thing to follow up on here.

INTERVIEWER: So you sort of drift to the more complex?

BARNHART: Yeah. I like things that don't have a right or wrong answer. But I also like things that are amenable to rigorous structured mathematics. So it's kind of there's a dichotomy there. But I like putting them together.

INTERVIEWER: When you were in graduate school here, did you have any important mentors?

BARNHART: Yes, and the same one, in particular, has followed me through my career. So one of the faculty that I met quite early on here was Professor Amedeo Odoni. He gave me wonderful advice as a student and encouragement. He was the editor and chief of *Transportation Science*, the journal that's kind of the premiere journal in my field. So he helped me tremendously with how to write papers and how to get them through the review process.

Then when I joined the faculty here at MIT, I was actually assigned a mentor, or they were in a process of assigning a mentor. I asked if I could instead have Amedeo Odoni. So they said of course, and he has just been amazing. He's an incredibly insightful, dedicated man, and it's been really wonderful to have him to turn to for advice.

INTERVIEWER: In what ways do you think is it important to have a mentor?

BARNHART: I think mentors serve different roles for different people. If I step back a little bit, when I finished my PhD, I worked for four years as an assistant professor at Georgia Tech. And at Georgia Tech I also had mentors, wonderful mentors-- many of them actually, at least four. I remember one of them saying to me one day, I don't know why I keep giving you advice, you never take it. He was right. I'm not good at taking advice. But I do seek advice, because I like to hear how they think about whatever question I'm pondering. It doesn't mean that I'll follow it or that I agree, but I like to hear how others would think about it.

So I think that's how I use mentors is more to make sure I'm not missing some things that I think about it, think about whatever it is I'm thinking about. Then I make my own decision about what's right for me. What I tell my students or junior faculty who I am serving as a mentor, I give them my opinion and then I say, but my advice is to ignore most advice you get. Because I really think that if what you do is follow what's right for others, if it's not right for you it's not going to work.

So you really have to sort through advice and figure out what it is that works for you. Everybody has different priorities in their life, different things going on in their life. So different solutions fit different people.

INTERVIEWER: Have you found that the advice you've gotten from mentors, has it been more useful in the professional world or more useful in the personal side?

BARNHART: That's interesting. I would say for the most part definitely professional.

But I can point to one person who I think has given me really good advice on the personal side. Now she isn't an official mentor, but she is someone who is in a very high level position in a research lab at IBM, actually, and who has four children. So she has somehow navigated the waters -- she's a few years ahead of me in the process -- of balancing family with career. I find that in talking to her she had personal advice that resonated, where a lot of times personal advice especially didn't quite work for me from others.

INTERVIEWER: So how did you wind up getting from Georgia Tech to MIT?

BARNHART: The husband again. So when I finished MIT, I took the position at Georgia Tech. It was in their School of Industrial and Systems Engineering. That is where their operations research faculty are housed. It's an incredible place. It was a great place to go with a fresh PhD. But I went there and my husband stayed here with his job. So for four years we commuted. At one point we said, well this won't work long-term -- four years already was pretty long. So we put in place a plan, and it worked out that I was offered a position here at MIT and came back.

INTERVIEWER: So did you seek out something at MIT?

BARNHART: Yes, I did.

INTERVIEWER: How is it different being a faculty member here as opposed to a student?

BARNHART: It's quite a bit different being a faculty member here than being a student. I think one of the big differences is the number of things you do. Maybe not how hard you work, but certainly the number of things.

So, as a student, you take your classes, and then at some point you focus pretty much exclusively on your research. Usually it's one research project. Whereas as a faculty member, you have multiple research projects, supervising multiple students, teaching a subject a semester, maybe more. You're involved in committees, you're involved in a number of external activities, maybe like with your professional community. You write proposals. So you have a lot of balls in the air at the same time. Fundamentally, it's a different set of skills I think that you have to call into action to manage your time effectively and be successful as a faculty member, where those sorts of skills I think aren't as critical as a student.

INTERVIEWER: Do you see the Institute differently from the two different perspectives?

BARNHART: You understand much more about the Institute as a faculty member than as a student. I would say you see a lot more and understand a lot more of the Institute when you're in an administrative role than as a faculty member.

So as a student, you interact with your fellow students and the faculty in your program, the faculty teaching your subjects. That's kind of the extent of it I think, for the most part, unless some students get involved in student government.

As a faculty member, I think you cast your net more broadly. You certainly are familiar with the faculty in your department or departments in which you interact -- your department head, and maybe a little your dean. But again, it's a broader view of MIT. But even as a faculty member, you can hole yourself up pretty well and focus on research and not see a lot of the Institute.

Being in the dean's office, that's one of things I've really liked is that I have met many more faculty from all different departments, and I understand more of the breath of activities at MIT. I know that I don't know even a fraction of what goes on here, but being in the dean's office I've seen a lot more and it's pretty remarkable.

INTERVIEWER: As an administrator, what would you tell students and faculty members that they don't know about the Institute that would help them, or understand the place better? **BARNHART:** Well, I think the thing that you hear from junior faculty right up through the ranks is that it's hard to understand the scope of activity here, to know who's doing what where. People who you can or should engage with because it could help you in your own research. So one of the things I've seen in the dean's office is that there is this broader view of the kinds of activities going on.

If that vantage point could be shared by faculty, then I think it would help them a lot in just doing their job more effectively because they could make connections with other faculty. It could lead to really interesting and exciting research. I think that that's just one of the challenges here at MIT, to connect with people who it would make sense for you to connect with. There's just so much opportunity here.

INTERVIEWER: I have this long list of interests and expertise, I wonder if you could just walk me through how your research has evolved over the years?

BARNHART: So, I think when I first started as an assistant professor, my focus primarily was on developing algorithms. So here's a mathematical model, figure out a way to harness the computer's power and solve this mathematical model for transportation problems where maybe there are billions and billions of possible decisions that can be taken. Figure out how you can get today's, or yesterday's, computing power to solve the problem.

I worked a lot on that, and just working to find a way to try to address these really large scale problems with existing optimization theory and computing power that we had. I think that that first step kind of morphed into a second step. Instead of trying to solve given problems, I moved to figuring out how to mathematically state the problem.

So, what I found was that when you take a given, a particular problem statement, then somebody else has decided what's important, and what it is you're trying to do, what are your goals in trying to come up with a solution to the problem. But because of limitations in computing power, the decisions made aren't necessarily what I would consider, and others would consider, to be the right ones.

So, for example, maybe what somebody was trying to do when they were figuring out how to assign their fleet of aircraft to the flights in that airline's schedule, they wanted to maximize profit. But when you look at the old models of that problem, they don't take into consideration things like things go wrong, there's bad weather that upsets the schedules and imposes delays, and then disrupts passengers were are left at the airport or elsewhere for hours on end.

In my research, I turned more to thinking about what are the components of the problem we want to capture and what are our objectives? Then, given that, how do we write this mathematically so that we can use our algorithms and our computers to solve those problems. So it's in some ways combining the representation of the problem with an understanding of what's solvable, and trying to advance our capabilities to build solutions that are good in some sense for these complex problems.

Then I think that trend kind of just continued. I think if I look at what how my research has changed, I think that I've begun to focus more and more on issues of -- well, I guess societal issues. So it might be congestion in our transportation system and the issues that congestion causes in terms of delays and pollution and energy consumption.

Now can we re-position how we think about designing and operating these transportation systems with these other objectives in mind that have to do with not further harming the environment or even improving it. With issues in mind of like energy and the experience of the travelling public or the passenger.

INTERVIEWER: You might be one of the only people on the planet who understands the issues of airline delays. One of the great mysteries.

BARNHART: My experience is a lot of people think they're experts at that, having experienced delays a lot. I have found that when I'm on an airplane, and I learned this really early in my career, when I'm working on my research, reading a paper, editing one of my students papers, I cover the paper. Because as soon either flight attendant or a fellow passenger sees you're working on airline optimization, you immediately are blamed for all that is wrong with the industry. So I have learned never to admit that I work on those problems.

INTERVIEWER: You keep a low profile when you travel.

BARNHART: Exactly.

INTERVIEWER: When you think about your research over the years, what contributions do you feel are the most impactful, or even the most interesting to you?

BARNHART: I think it has varied with time. When I worked on algorithms, I was really excited about the algorithms we were able to develop that allowed us to solve problems with, as I said, many, many billions of decision variables, and to say something about how close to optimal these solutions were. Then I think as I moved to working more on modeling, I think that I am proud of work where we put a different focus on things.

So, for example, I have a body of work that's actually ongoing that is passenger centric, thinking about how you balance the interest of the airlines, which of course you have to -- their interests have to be protected or they won't be here -- with those of the passengers. What's interesting is it's not necessarily a lose for the airline or win for the passengers. So that's part of the work that I've done that I've been excited about.

I think the work that we're just launching in Singapore now. It's a new project on future urban mobility. This I think also is really exciting work. We have a team of about a dozen faculty from MIT who serve as principle investigators, together with another large group of at least 20 faculty from Singapore and MIT involved in the project. It's working to think about how do we meet these growing demands for mobility around the world in a way that's sustainable. There's I think really exciting opportunities here.

One of the things I've liked best about this project is it is truly interdisciplinary. So we have faculty members involved from the Sloan School of Management, several engineering departments, from the School of Architecture and Planning, and they all come together with different ways of thinking about the problem, and different areas of expertise. I think most of us on the team didn't know each other before the team was put together. So we have this great opportunity to interact with colleagues who we had before not known, and to meld our different approaches.

For example, take some of the advances in mobile computing and communications, information technologies together with the autonomous vehicles, electric vehicles, and optimization and control theory, and think about how we can put these pieces together to try to realize this future urban mobility system.

INTERVIEWER: Will you talk a little bit about SimMobility?

BARNHART: SimMobility is the platform on which we all kind of hook in. So as I was saying, these different areas of expertise will actually be integrated in this SimMobility simulation platform. So it will serve as a place on which we can perform experiments that are not physical. So we might want to try to establish the potential effectiveness or impacts of different technologies or policies, first in this SimMobility platform, and then based on the results, try physical experiments in the real environment.

So that is the mechanism by which we will be sure to integrate the different activities of the faculty.

INTERVIEWER: So how do you think, when you look toward the future, how are we going to be getting around?

BARNHART: Ah. I think we're going to be getting around differently than we get around today. I think that's our biggest challenge with our future urban mobility work. What we have to do is much more than create new technologies and be more efficient in our operations of these transportation systems. What we have to do is change the behavior of people. Because we cannot have a system in which each person gets into their vehicle and each person goes where they have to go. We have to figure out a way where it's people want to take public transportation, people want to rideshare.

So there are different approaches to this, and I focus on the want rather than must. There are strategies around sort of the stick strategies of well, we can impose different prices, congestion pricing. We can not allow people to drive their car only every other day. There are lots of rules, regulations that could be put in place and might have to be put in place. I have focused more on the flip side of it. How do we design a system where it's actually more convenient and economical for someone to use public transit than their own vehicle?

So that's the kind of thing that we're working on. As I said, it needs to bring together different areas of expertise. I think it relies heavily on information, real time information and communication. I think it relies heavily on a very dynamic, responsive transportation system that can adjust to the demands, the transportation mobility demands, in real time, and right now we don't have that. So those are the kinds of things we're thinking of.

INTERVIEWER: So more collective traveling.

BARNHART: That's right.

INTERVIEWER: I'd like to go back to the administration stuff for a little while. Can you, first, summarize for me your responsibilities as associate dean for academic affairs in the School of Engineering?

BARNHART: My responsibilities are around academic affairs, so that's to just delineate. There's also an associate dean for research, Karen Gleason, and she's in charge of kind of all things research. So all things not research are what fall under me.

The really great thing that I found in the last three years now in this job is there has been an effort, when Subra Suresh came in as the new dean three years ago, he launched a number of different strategic planning exercises. I was involved in I think pretty much all of them. It was really fun. We looked at a number of different questions from things like dual faculty appointments, to team teaching, to things that fall under this category of barriers. The mandate, really, was to bring down the barriers. So where are there barriers to interdisciplinary, cross unit interactions, whether in teaching or research, and how do we bring them down. So that's been one of the primary things on which I focused.

We also looked at undergraduate education, and again, this was really exciting and fun thing. The result is a flexible undergraduate engineering degree that is modeled after 2A, the degree in mechanical engineering. It was an interesting process involving a lot of faculty, pretty much all department heads in the School of Engineering, thinking about how we meet the teacher needs, education needs, for engineers. The result was the flexible degree.

That was a really fun process to go through and I think an important step that was taken. I think it'll be something that serves our students really well, because it provides our students with the option to follow their passions. It gives them enough flexibility, I hope -- we all hope -- so that they can take the sets of classes that best serve their interests. At the same time, continue to provide MIT's rigor and depth of experience in the engineering classrooms.

INTERVIEWER: So that was a change to reflect the need for greater interdisciplinary knowledge to solve today's problems?

BARNHART: I think yes, in part. There are a number of motivations for this. What we found was that course 2A, which is a degree that has actually been around for decades, but has been accredited for only about 10 years. Once accredited, what course 2 found was that the 2A degree steadily increased in terms of its enrollment. So much so that if I remember correctly, something on the order of 45 percent of the incoming sophomores into mechanical engineering last year chose 2A as their degree option.

Why they chose it I believe is because there are some students who rather than wanting to be an aeronautical engineer or a mechanical engineer or a civil engineer, instead perhaps want to have an impact on energy, or on development in developing countries, or transportation. So once you pick a problem area, now to best meet your needs, you really should draw from the Institute, not just even the School of Engineering, you should draw from the Institute and its set of course offerings to help you be best positioned in that area.

So, that's what the flexible degree is aimed at helping us to do. The idea is that at the core, you have the depth and rigor you would find in the core of any one of our traditional degrees. However, what's different is that there's flexibility provided for the rest of the degree, much of the rest of the degree, allowing the students to identify these interdisciplinary areas, and take subjects across disciplines in that area.

So a lot of times these areas are motivated by important societal problems, and it reflects how our students, and I think students in general, are interested in making a difference, and in addressing these really complicated, hard societal problems. Now sometimes the interdisciplinary topics are actually maybe something different, like computational engineering that cuts, again, across disciplines, but isn't specifically aimed at solving some societal problem perhaps.

So we have a mix of students who are interested in this degree, and we expect that it will be increasingly popular as students learn about it and understand that they can still have the MIT rigor and depth, but as well the flexibility.

Right now we have Mechanical Engineering and Aero and Astro offering this degree. We expect additional departments over the next few years to bring that degree on line as well.

INTERVIEWER: Am I correct that you're the first woman in this associate dean position?

BARNHART: I have never actually thought about that.

INTERVIEWER: I thought I heard that somewhere.

BARNHART: It could be. I think of another woman. Of course, Karen is -- so I guess I was appointed a few weeks before she was. You might be right.

INTERVIEWER: You've been here 25 years, right?

BARNHART: Well, it depends. As a faculty member, I've been here -- as old as my daughter and she turned 18 about a few weeks ago. So before that here as a graduate student for four and a half years.

INTERVIEWER: I can't imagine there was a woman before then.

BARNHART: Yeah. That's interesting. I just have never thought about it.

INTERVIEWER: Is gender an issue here for you at all?

BARNHART: Well, it depends what you mean by that. So, it's an issue I work on a lot. In my role as associate dean chair something called the Faculty Search Chairs Committee. So the idea is to bring the chairs of all the faculty searches together and share best practices around recruitment -- identification of women and minorities who can apply for our open faculty positions. Then trying to successfully identify MIT caliber women and minority faculty and bring them here. So, in that way, yes, it's certainly an issue I spend time on.

In terms of my personal experience, it's been really interesting. I feel that I've been on cusp of change. So when I started at Georgia Tech, I attended women faculty meetings that they had for their School of Engineering. It was interesting because essentially those women faculty meetings were about all the issues, injustices that the women faculty were facing. When I came to MIT, I also participated here in women faculty meetings, and I was really struck by how different the women faculty meetings were. It wasn't about complaining. It was about identifying what we wanted to do and doing it.

There is an attitude that whatever we want to do, we'll get support in doing. All we need to do is identify what it is we want to do, how we're going to do it, why it's important, tell the dean or the provost or the president, and we'd get support. So that was really refreshing to me, because at Georgia Tech I couldn't honestly identify with the issues the women were raising. Here what I find that I think some of the women more senior to me who have been here longer, face something quite different from what I faced. I think when I came, I have found, truly, support. I can't point to a gender-related issue.

INTERVIEWER: And you don't find it--

BARNHART: For myself.

INTERVIEWER: --From colleagues either that it's an issue.

BARNHART: No. I remember when I first started here that I was sometimes surprised. I remember once I was standing in line at a faculty meeting getting my lunch, and one of the very senior faculty was behind me and he started talking to me about how are you doing with balancing work -- when I started here I had a newborn -- with your child and how are you finding--? He asked me all sorts of questions. What do you do with this? Aren't you kind of tired?

I was just surprised that he was, it seemed, relating to my life. Because he was very senior and I thought surely he's not experiencing the same thing and probably didn't experience it. And then he said, yeah you know, I have a daughter your age and she's a professional and she has a young child and it's really hard.

So what I found was that many of the senior faculty were some of the most sympathetic and supportive, because they could relate -- it turns out they could relate because they were seeing it through the lives of their children, but nevertheless they understood. So that was interesting.

INTERVIEWER: In another interview that I had with a pretty senior male administrator, he said that -- I guess he'd been here maybe 40 years -- he said that a lot of the senior faculty member did not to think that women would be able to handle what's expected of them as faculty members. And wound up being surprised and also a little humbled because many of the women who came in did just as well professionally, and also were handling--.

BARNHART: I can't tell you how many times my male colleagues have said to me, I don't know how you do it all. I remember thinking well, it's not that big a deal. I mean not easy, but I was surprised always by that comment, and I heard it a lot.

INTERVIEWER: Have you found it an issue balancing family and work?

BARNHART: Of course. I get asked this a lot by my students and by junior faculty, it's impossible to give advice about what is the right thing to do. I think probably most of us always feel you don't have quite right the balance. But I found that that's true with everyone. When I talk to my friends who are stay-at-home moms or working part-time, it's very hard to find the right balance no matter what you're doing. There are only so many hours in a day. There are certain strategies that have worked for me that help. Partly one strategy that has helped me a lot is to be as disciplined about family time and leisure time as about work time.

So, when our kids were younger they ski raced. So that meant we would go to Vermont every weekend for ski races. I remember at one point saying to my husband, this leisure is going to kill me. Because being away all weekend, no laundry gets done, no grocery shopping. We had a wonderful time though skiing, and that will always be part of our family experience. But I had to say, oh no, the weekend we are going skiing and I'm not doing some of the other things that certainly probably could have been done or should have been done.

INTERVIEWER: You pay for it one way or the other.

BARNHART: You pay for it.

INTERVIEWER: I think the solution is it's your private time that gets sacrificed.

BARNHART: That's typically what--. Well, certainly your personal time -- that kind of came lowest on the totem pole. But you know, if you love what you do for work, it kind of fits as your private time and your time for yourself. So that's helpful anyway.

INTERVIEWER: Are there specific goals you have in mind as associate dean?

BARNHART: I think that the goals that I've been working on are the goals I'll continue to work on. So they're about figuring out how we ensure that this interdisciplinary activity can thrive here at MIT. I think there's still work to be done, especially on the education side with that. I'm also interested in this topic we've been discussing. I think that being a faculty member, I think it gets harder and harder in some ways. The bar just goes up and up, and the expectations are ever increasing.

So I think making sure that faculty women and men, can both have a life and succeed at MIT. It's something to think about. We've talked about flexibility for our students and providing that to them. I think we have to think about that for our faculty, too, to ensure that we get the most creative, the most enthusiastic and bring in people here, because it's a great job to have rather than it's a job that a few people can manage because it matches their lifestyle.

INTERVIEWER: When you're involved in the recruiting of more women and minorities, what are the difficulties in that?

BARNHART: Well, a major difficulty is the numbers. Little small numbers of people who are -- of course, there's a lot of women, but women and minorities who are MIT caliber. From that small pool there's intense competition for them. So that's part of the issue. I think we've done some pretty creative things to help us in that arena.

So we've tried to be very proactive in identifying these people. Then we've also tried to be very flexible from the dean side of it in terms of having slots available from the deans, from the provost, from the president side. Having slots available when such people are identified, even if they don't match exactly the area of the current search. So that strategy I think has been very effective, but I think there are more ideas and more work to be done, surely.

INTERVIEWER: When you identify people who are MIT caliber, is it difficult to recruit them to MIT?

BARNHART: I would say there's competition, but MIT does really well.

INTERVIEWER: Let me ask about some of these MIT projects that you've been involved in over the years. So why don't we start with about forming the large scale optimization group.

BARNHART: I think that was started when my second daughter was born. So, it was the collection of my students in my research group, as well as some additional students who were interested in our research. What we would do is get together regularly and share research talks. We would discuss what project we were working on, what challenges we were facing, what new approach worked or didn't work. We'd share with each other what we were working on and get advice and experience from the members of the group.

What I remember about this group and its formation was because my daughter had just been born, I wasn't coming in to MIT every day for the day. So I said how about if the group comes to me? So we had set up my older daughter's, you know the plastic big easels that kids used to have, and that was our board. We met in my dining room. I remember we had cappuccinos and muffins and the students all came out to my house weekly for awhile. I loved it, my kids I think -- baby had no idea what was going on, but my older daughter thought it was kind of interesting having all these students around, and I think it was a good break for my students to get away from MIT and spend a little bit of time at my house.

INTERVIEWER: How about your experience as co-director for the Center of Transportation and Logistics?

BARNHART: So, as co-director of the Center for Transportation and Logistics, I shared the job with Yossi Sheffi, who was the other co-director. My focus was primarily on the education side of things. So the Center for Transportation and Logistics is affiliated with two graduate degrees, a Master of science and transportation, and a PhD in transportation. Now they have another degree, Masters in logistics. But at that time there were two degrees and they were interdisciplinary degrees. So from the start, I have been involved in maybe what is somewhat atypical here, but increasingly common, and that is degrees that they don't have a particular department as their home. They are stand-alone degrees that draw on subjects and faculty from many different departments across the Institute.

I worked on curriculum design and development for the -- we did a revamp of the Master of Science in transportation. I also worked on strategy for the PhD in transportation.

INTERVIEWER: It sounds like you get a lot out of the relationship with students. What's it like to teach at MIT?

BARNHART: It's a lot of fun. The students are -- well, they're brilliant. They're usually open and vocal and interactive. So it's always a lot of fun to teach MIT students. I think every time I teach a class, I'm amazed by some of the comments or questions that come because they just reflect how quickly our students absorb things and how smart they are. What's not to like?

INTERVIEWER: Have you had the experience of a question coming up that you didn't know the answer to?

BARNHART: Oh sure. You learn really quickly you do not bluff. You say, huh, that's a really good question. Haven't thought about that. Sometimes we'll have a discussion about it, and by talking about it of a combination of the students and I, might come to the answer. Or maybe we say, hmm, I have no idea. You'll have to research that and find the answer.

INTERVIEWER: You also did work at the Operations Research Center.

BARNHART: So, I have actually served as co-director of the Operations Research Center twice. I stepped down I guess in January of this year because it was a little bit much with working the deans office and also the new Transportation@MIT initiative. The Operations Research Center for me is kind of home, because it is the Center that is responsible for the Masters and PhD in operations research. It is the Center that brings together the faculty across the Institute who do operations research. It's always been a really special place for me, both as a student and as a faculty member. The students are remarkable, and the faculty are great to work with. I've really enjoyed being affiliated with the Center, and also serving as co-director.

INTERVIEWER: When you're involved in work at these various centers, can you talk a little bit about the collaboration and the interdisciplinary activities and the value of that?

BARNHART: So, the collaboration, interdisciplinary activities are really on two fronts, both in research and in education. So the premise of these centers, both CTL, the Center for Transportation and Logistics, and the Operations Research Center, these are degree granting units. They are inter-departmental degrees. So, the idea is that students graduating with these degrees, by their very nature, are taking subjects that stand in different disciplines.

I think that the fact that we've organized operations research and transportation in this way at MIT has been a huge strength for us. So when we compete for students, we compete with top-rated programs. We have an edge I think in that we're structured in the way we are. We're structured recognizing that these are inter-departmental, interdisciplinary programs.

So, a student coming in to, say, operations research. if they happen to have an interest in data mining for cancer research, the Operations Research Center can meet that interest. Because our affiliated faculty is a dynamic group. If we need someone with expertise in data mining or expertise in biology, we have the Institute to draw from. Whereas other programs at other universities, they're departmentally based, and the set of faculty affiliated with the department is much less fluid and dynamic.

So, interdisciplinary is kind of the hallmark of these educational programs, but also the research because of all of our students are doing theses. So their research, again, draws from faculty from across the Institute.

INTERVIEWER: We didn't talk yet about the Transportation@MIT initiative.

BARNHART: Right. So that was launched about 15 months ago, and I serve as the director. Well, it's related to a lot of the things that we were doing in the school in terms of bringing down the barriers, and in terms of providing interdisciplinary education and research on an important societal problem, that of mobility and transportation.

What we're trying to do is to leverage what we have at MIT, to bring together people with expertise relevant to transportation and try to make a difference. So, for me interesting. Interestingly, we did a survey, now about a couple of years ago, asking the faculty here at MIT do you do research that is relevant to transportation? In response to that survey, we identified nearly 250 MIT faculty who said their work was either directly associated with or relevant to transportation.

This was amazing. I've been affiliated with transportation here at MIT the entire time I've been here. I had no idea that we would have such a response. I didn't know most of the people. So, what we learned from that was we'd really not done a good job of taking what we have here at MIT and bringing these people together to address the problem.

So that was kind of our initial job to do is bring this community together and begin to focus this research group and these energies on sustainable transportation.

INTERVIEWER: As you work on these very complex issues and challenges, it seems to me that actually affecting change, you have to rely on consumers and governments and politicians and policymakers. It's a very complex set of interactions that have to happen. A lot of those groups don't function well together -- they don't cooperate very well. When you look toward the future at solving some of these transportation issues, how are the solutions going to come about? What's going to be the catalyst to actually force substantive change?

BARNHART: Well, that's an interesting question because it's something that we are grappling with now. As I said earlier, our team on the Singapore project is a multi-disciplinary team in which there are faculty who work on technology, faculty who work on vehicles, faculty who work on optimization systems, and faculty who work on public policy. What's interesting when you bring these faculty together, not surprisingly, is that we all speak a different language. We in some ways have different value systems, too.

So that is part of the challenge. What I think we all recognize is to effect change we need all those elements -- that technology alone won't do it. And policy alone, without having some way to inform policy, isn't useful either. So that's part of what we're working to do. We had a meeting yesterday, actually, and what we were talking about was we would like to be the first university that comes to mind when Congress is debating some transportation policy issue. With 250 faculty members having expertise on something element, we'd like to be there saying this is what we have learned, this would be the consequence of doing that, while that would be the consequence of doing this.

So we would like to be the ones that are part of the debate that provide information. I think that that's a critical link to moving from developing things in our lab and testing them out. Assessing them in our laboratory versus having it be used in practice and be adopted or transformed into new transportation policies at a national scale.

INTERVIEWER: So what effort is being made to make MIT a resource for government?

BARNHART: Well, I think part of what we needed to do is first make it clear to our Washington office we are interested in being a resource. Because many faculty at MIT aren't interested in that particular aspect, but certainly in transportation there are a number of us who are interested in that. So sharing first just with our MIT people, we have this expertise and this interest and these sets of analyses that could affect and impact and inform policy. I think that is a critical first step. So we're beginning that process now.

But I think there's also, I'm not sure if it's something that's changing. I kind of suspect it is. But what we clearly see now and hear now when we have groups of us meet and talk about what it is we're trying to accomplish, many, many researchers are motivated by making a change, making a difference, having an impact. So I think the combination of that motivation and interest on the part of our faculty, together with getting that information to the people who need that information. I think once the information is there and we have more opportunities to showcase our analyses, then we'll find we're called a lot. Certainly, already this goes on, but I think we'd like to see it at a much larger scale.

INTERVIEWER: Something else that you're working on that I don't want to miss asking about is the optimization based data mining. Can you talk a little about that project and its potential applications?

BARNHART: This is a really different project for me out of the mainstream. But I guess it reflects optimization and operations research. It's really a methodology that can be applied in many, many, many different domains.

So this is an effort, a project, with Professor Dimitris Bertsimas. He and I were co-directors of the OR Center up until January, and he continues to co-direct the Center. He's a faculty member in Sloan and an operations researcher.

So what we are doing is building on some work that he has done related to different drug regimens for the treatment of cancer. So, we have worked to build a database of the different drug regimens that have been used for different types of cancers and recorded different statistics, like the toxicity, which is like a proxy for quality of life. And the longevity, how long people survive under the different drug treatments.

In this database that we have amassed, we then apply these data mining techniques that are optimization techniques. So we use our optimization background to try to mine the data to get some insights about effectiveness of these treatments. Because our goal is to recommend which drugs should be combined for future treatments.

Now this is a different approach than a biologist would take, because it really isn't about modeling the biology. It's about looking historically at drug treatments and their effectiveness and trying to glean from that experience information that would be useful for future drug treatment.

So that's ongoing work. Unfortunately, at this point the results we have are in some ways negative results. What they show is that we should have known before conducting the study that the drug treatment wouldn't be more effective than the average treatment. So we're continuing to push that work to see if we can find something more positive in the results.

INTERVIEWER: Just to make sure I understand. The combining of drug treatments is not working out to make each one more effective because they're in combination?

BARNHART: Yes. So, it's very important to look at drug combinations, because you can't predict the effectiveness of a combination of drugs by looking at each drug individually and somehow adding together the individual effectiveness. So because there is this combinatorial nature, there are many, many, many different ways you can combine these drugs for future drug tests. So we're trying to use the historical data to inform that process of designing the future of drug combinations.

INTERVIEWER: That does sound interesting.

BARNHART: Very different. Nothing to do with transportation.

INTERVIEWER: No. Part of the magic of MIT. You're also involved on the new faculty task force to examine tenure, is that correct?

BARNHART: Right.

INTERVIEWER: What are the issues that you're looking at in that committee?

BARNHART: Well, that committee has already issued its report. So essentially, it was looking to understand the policies, the procedures, processes for the tenure process in different departments, different schools. What we learned was there's a pretty high degree of variability. So the notion then was to look at what are the effective practices, the best practices, and to catalog these as recommendations for the president and provost as they think about structuring these processes more Institute-wide.

INTERVIEWER: Can you name some of the best practices?

BARNHART: One thing that's interesting is that different disciplines are really different. And so the processes and the tenure process are just different, and should be, I guess. So the metric by which you evaluate faculty different.

Now, some of the things that we saw though that maybe don't have to be different, even though there should be differences, some of the things we identified were in terms of how we go about selecting letter writers for theses, for example. What input does the faculty member who's being evaluated have? What is the process by which other names are identified?

Why this is important is because the letters received for a tenure case are really carefully considered and can make a big difference. So careful selection of letter writers is really important. So there were different processes for doing that. Best practices were compiled and used as a guideline of how all the different departments might want to do it.

INTERVIEWER: And these are not just letters from the MIT community.

BARNHART: Right. So these are most importantly from outside the MIT community.

INTERVIEWER: So you almost have to know who the tenure committee would be most impressed by ahead of time.

BARNHART: Yeah, and there are different processes in terms of tenure committees, also. So some departments have all senior faculty involved in the process, others have smaller promotion and tenure executive committees. So we examined these different practices. In some cases, different practices were the right thing to do, it seemed. In other cases, maybe a more common or uniform approach would be more appropriate.

INTERVIEWER: I'd like to spend a little time talking about MIT generally. What do you think makes the Institute unique when compared with other prestigious universities?

BARNHART: I guess it's a combination of things that create this uniqueness. So, necessary elements would be really smart students and really smart faculty. Those are necessary. I think another really important element is back to the barriers, your point raised earlier. I think that MIT has done a tremendous job at allowing interactions, research interactions in particular, across disciplines. Very, very fluid boundaries along the research front. I think the ability to respond quite rapidly to opportunities. In part that's because there aren't barriers, and in part it's because of the type of people who are here. They're excited about opportunities and they identify these opportunities maybe more quickly than others.

I have to say, though, I think that it's getting harder and harder to distinguish ourselves. I think that we have to continue to work really hard to maintain our position. Other universities have gotten also very good at these things. So, I think we have to continue to innovate and continue to find ways to distinguish ourselves to remain unique and to be preeminent, as we are.

INTERVIEWER: Do you have a description of not so much a typical MIT success person, but what does it take to be a success here?

BARNHART: So, I'll give you one model, because I think probably there are different attributes of people that can combine to create success. But I think some of the necessary elements are a passion for your research. A passion to innovate, to discover. I think that you have to be hard working.

In my case, I feel that organizations and discipline were really critical. Not sure it's necessary for everybody to be organized and disciplined, but for me it was a critical factor. Otherwise it could have been too stressful, too overwhelming. But I think being structured and organized worked for me.

Another element that was, I think, important for me is really enjoying collaboration. For me, that collaboration -- first, you learn a lot from it because you learn from others. Secondly, I think I was more productive, because I had more things going on when you have many collaborators than certainly you would have if you were alone. Going back to the first thing, a passion for what you're doing, loving what you're doing is a hallmark of MIT faculty, and I think makes a really big difference in our ability to accomplish things.

INTERVIEWER: I'm wondering if you'd like to talk a little bit about what you see as both the strengths of your department and the strengths of your school?

BARNHART: OK. Let's think about the school first. Everybody says it doesn't matter, but in the end I suppose it does. That is, if you look at the ratings of the departments in the School of Engineering, many are top ranked. I think collectively -- well certainly, the school collectively is top ranked. I think collectively the School of Engineering faculty are just, at this moment without fear, and that is the big strength. We have, again, tremendous faculty and tremendous students.

I think that what keeps us there is this constant innovation and sort of re-definition of what departments do. When I first sat on engineering council as the associate dean, the very first time, I was involved in the promotion process. So we have our casebook of cases for faculty who are being considered for promotion. Associated with each faculty there's CV and letters of reference and lots of information and research papers. I was absolutely first, amazed by the fascinating and exciting things people were doing.

Secondly, I was really struck by the fact that if I covered the department name on the title page for a candidate, in many cases I would not have guessed right about in which department they were housed.

So that, I think, is one of the things that is really exciting about MIT. Once you're here, you are given the freedom to do whatever is of interest and exciting to you. As a result, faculty are doing really cutting edge work, but it doesn't necessarily fall within the boundaries of what you would think computer science or mechanical engineering or electrical engineering, or civil engineering, how we maybe have traditionally defined it. So I think this interdisciplinarity and this dynamic adapting of what we are, is what has kept us where we are.

INTERVIEWER: You've talked about mentors. Are there colleagues that you've worked with that you might want to say something about, and I was sort of thinking of Bill Mitchell in particular.

BARNHART: Bill Mitchell. I actually met him for the first time when we were beginning to form the proposal for the Singapore project. He was the first person I met with to talk about that project. He came with this idea of the CityCar, and a mobility on-demand concept that was about the traveller, the passengers -- thinking about what makes it easier for people to get around. But at the same time it fits with future urban systems and the tremendous demands that will be placed on them. He had this vision of which he was totally passionate.

It was really fun to talk to him, because although I know nothing about folding cars or very little about electric vehicles, the vision he had was one that was easily understood and it was really clear to me where, as an optimizer, my skills could play a role in designing the system. I think that was one of the real strengths of Bill.

When he talked to me or he talked to my colleagues in autonomous vehicles or my colleagues in networked computing and control, and described his vision, they saw where they had a place to fit and how they could impact that system and improve it. He was just really great at painting this vision that was compelling and easy to understand. It's very sad that he won't be here to see the vision through, but he had a number of postdocs and students who have worked with him who are committed to this vision. We continue to work with them.

INTERVIEWER: Are there changes that you've seen at MIT that you think are notable in the time you've been here?

BARNHART: Yeah. It's interesting. There are changes and there are things that stay the same. So, one of the things that has changed is there are more women now, not everywhere, but more women now in many departments than there were when I started.

So, for example, when I began, I was the only woman in the Operations Research Center on the Faculty. Now there's a handful of us.

When I began in civil and environmental engineering, I think we had the same number of women that we had a couple of years ago. It's improved in the last couple of years. But that what it points out is that although there are tremendous efforts to increase diversity here, it is a really hard problem. We have advances and successes, but it's also kind of easy to lose ground. So it's just something that will be an ongoing struggle.

Other things that I think have changed somewhat, again, were already evident when I came here, but I think have increased. Is in civil and environmental engineering, when I started, I guess at that time there was one biologist who was part of the civil and environmental engineering faculty, Penny Chisholm. I think because she said it, she felt like she was sort of a fish out of water. But she knew that she fit there, but she was not typical -- she didn't have the typical profile of a civil and environmental engineering faculty member.

Now, there are a group of faculty who share her background, her expertise, and with whom she collaborates in civil and environmental engineering with chemists and biologists, material scientists. So, the backgrounds of the faculty in civil and environmental engineering are very diverse. But the commonality is the domain and the problems on which they work.

So again, I think I'm reminded when we were doing a search for a department head in civil and environmental engineering. This was now probably eight years ago. There was a firm that was brought in to help with the search. I was one of the members of the committee, and they were asking us, OK, so what is that you're looking for. Then at one point as we're going through this, I remember the person saying to us wait a minute, you didn't say that the person had to be a civil or environmental engineer. We're like oh no, that doesn't matter.

That was an interesting discussion because the person was like but, this will be the head of your department. We're like right, that doesn't matter, we don't need to have a civil or environmental engineer. We just need someone who's interested in leading our department to the vision we've set out. It doesn't have to be someone who has a civil or environmental engineering background. I think that this was something new for the person who had conducted, helped conduct searches in many other universities. We don't make those kinds of distinctions.

I see it in my job as associate dean, because being sort of in a position of seeing every search because of my role in trying to increase diversity, I was really surprised a few years back when I first saw the data. And realized that multiple searches in multiple departments in the school, and even outside of the school, were interviewing the same people. So one person might be interviewed by Mechanical Engineering, same person interviewed by Aero and Astro Engineering, and maybe even by Materials Science.

So it really does show that these departmental boundaries are really blurry. And MIT just has no need to make these boundaries and silos. It's fine. The person might fit here, there, or maybe in both places.

INTERVIEWER: You know it almost sounds from our whole discussion that the historical model of the departmental structure is kind of like just a holdover, and that it really isn't how MIT is organized anymore.

BARNHART: It's interesting, because we've had these discussions. You know the life of departments is pretty long. We don't kill off departments, very rarely or very often. And we don't actually create new ones very much. But you need some sort of organizational structure, if for no other reason than to figure out where is a person's office, where do they park? The mundane things maybe. But you need some sort of structure to make sure that delivery of our degree, different degrees, is achieved.

So I think departments play an important role, but maybe not the role we maybe thought 50 years ago. Because they play a role but really part of their role is to ensure visibility into the other departments about the activities going on there so that we can share teaching when it makes sense, we can collaborate in research when it makes sense. So it's interesting. It's a function, a structure that we need, I guess. Certainly we're not going to get rid of real quickly. But we've adapted it so that it is adaptable and allows this kind of flexibility.

INTERVIEWER: I think we've covered most of the things that I wanted to ask you about. I'm wondering what we haven't covered that you think would be important to talk about.

BARNHART: I can't imagine. I honestly can't think of anything.

INTERVIEWER: You talked about your future hopes for MIT. Are there big challenges ahead that you personally think that you're going to start getting interested in?

BARNHART: On the research side or on the--?

INTERVIEWER: Both.

BARNHART: One challenge that I think is important in my mind for MIT, it's going back to what I think we started with the new flexible degree, which I actually should say ME started with what is now the flexible degree. I think that at MIT we train -- so I have, of course, the engineering perspective -- we train superb engineers. And I said that what we see with students today is an interest in making a difference.

I think that we can do -- we, MIT -- can do a better job at helping students make a difference. I think we have to think some about what are the skills that our students need to actually be in positions to make a difference. Certainly our students make a difference now. They go on and they do great things. But I think that we could do more to facilitate that, even at the undergraduate level. So I think that you have to think about that.

INTERVIEWER: What kinds of things are you thinking about?

BARNHART: Well, I think as a first step, giving them more flexibility in their degree is a really important first step. We've talked about things like leadership and what should we do, what do we do, what can we do to help develop future leaders -- MIT grads as future leaders. We've talked about the whole idea of the global economy and the role of an MIT engineer in this global world. Should they have more exposure, more international experiences? So there are a host of different questions like that.

INTERVIEWER: Anything else?

BARNHART: I don't think so.