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*"Impact Indicators for Research: Multi-dimensional measurements"*

## **TRANSCRIPTION**

It's wonderful to be back here in Paris with people working in the evaluation system, because I've been here many times over the years, and in fact I think I recognize some people in the audience who may have already heard me speak before in this setting.

I understand that the topic of impact indicators is a hot topic in Europe. Many people are interested in it, so I appreciate your all giving up your vacation to come and hear me speak about this. I told the staff here, when we made the arrangements for me to come, that I wanted to talk about this topic because we had a small project in the area. You will see it is indeed a very small project that we are doing for a university client, but in doing that we were led to look through several recent reviews and literature in the area, so I hope that some of the thinking that we have gone through will be helpful for you in whatever tests you are facing in relation to impact indicators.

There we go.

The small project that we are doing is for a client on our own campus, and I'll tell you who that client is, although it's an unexpected one: it's our technology transfer office. We were working together on tests for some innovation, for the campus, and I said quite a while ago we should be thinking about a portfolio of patents, and commercialization in terms of focusing on the areas that have the greatest impact for the State of Georgia, where we are, and for society at large, not just whether they are going to make money.

The head of the office actually took me up on that charge and said: "OK, would you please work with a student this year, and with a member of my staff, to try and develop a way that we can even think about doing that. I don't know how to do that already, so please develop some indicators of impact for the campus, and give us a decision tool that we could use to decide on various investments that the campus might make, if we wanted to try to maximize our impact."

This rang a bell with me, in relation to Georgia Tech issues as they've been articulated by our leadership over several years. A few years ago, our number two person in the University asked all the schools and departments to describe: What kinds of impacts do you have? How can we take these into account in our promotion and tenure process, and in the faculty evaluation process. So, having been given this small project, I thought: "Let's



use this as a chance to think through how the University defines impact, and how we might measure whether we are having any in the world.”

We are going to use this for decisions within the University, and then to compare our performance with other universities – we always like to know that. So what I’m going to do for you today is talk through the structure of that problem, and then the ideas that we have gleaned from the recent reviews that have been done of impact indicators. In relation to each of the areas that we are focusing on, I’m going to give you the story about what we actually have on campus to be able to use, to construct these indicators, which is a limited amount, you will find. Then I’ll talk a little bit about next steps the campus might take, and I’m looking forward to discussion with you about how this fits your context.

First we have to decide what we mean by impact. Of course, with campus audiences, you always have to start from square one, and do all the education, but I’m sure this is familiar to you: the notion that a research activity has inputs, like funding and people, then the research activities themselves happen, and then it has outputs, the immediate, tangible results that are produced from the research process. Somewhere beyond outputs is what we call impacts. I have to get my university people to thinking in terms of anything that comes out of the process, at all.

What do we mean by impact? Well, one of our criteria is that it doesn’t happen on the campus itself, that it is something that happens out, in the world that we are trying to affect. It also should involve a “user” in some way, but of course the users’ activities are quite different too. So for students, we think about where they are going in their jobs, what they are doing for their employers, and how their employers see them. For research, of course, off-campus, even other researchers use our scientific outputs, and we are all very familiar with the set of output indicators there, but research users can be even broader than the scientific community. For our work with outside organizations, there is a “real world” user of some sort, and I have of course put “real world” in quotations, because we are part of that real world on a university campus, but we use this phrase anyway.

The ones that our campus is very used to thinking about are private sector users, or industry users, and part of what we are doing with this exercise is trying to get them to think in terms of other users. I have listed public sector, and non-governmental organizations in particular. And in particular this week, because I’ve just been here on this visit, some of the work that has been going on in Europe that shows that the social sciences and humanities are more likely to have users that are in the public sector or in NGOs, whereas the hard sciences and engineering are more likely to have users in industry. There is some crossover in both directions but if we leave out public sector and non-governmental, we are really underestimating the impact of social sciences, which is definitely not something I want to do at my university.

Where would the issue of impact come in, in terms of the decisions that the university makes? I started out with hiring decisions and thought about what we look for in faculty members but then realized that every hiring decision starts with the notion of: “We have

a faculty position. How do we define that position and where does that fit with the strategy of the university?”

For instance, if we are trying to hire a set a faculty members in a particular area, something that is called a “cluster hire” in the U.S., first we define what we want from the cluster. Say, energy policy, which is one of the issues we’ve actually done recently. Then we say: “Ok, we are going to have several faculty positions within that, so we start with strategy, even in the faculty hiring process. Then, in terms of individuals, we are looking for people who match the profile, who are doing the kinds of research that we think we need for a cluster of people chosen in part because we want to have impact in the world, in some form.

We don’t expect the junior-highs to have had much impact yet, although by the time they come up for promotion and the tenure decision, then we will look at their impact in their files, we do expect them to have teaching experience, and some publications. For the senior people however, in an area like that, we are looking for the connections they already have in the world. So that’s one place where impact thinking would affect strategic actions on the part of the university. Another is when we allocate internal resources, and we don’t do very much of that, I must say, because we are a State university and we don’t have a lot of money to actually fund research projects, but we do a little of it, and again the question of “Is this going to increase our impact?” could come up there.

The place where it comes up very strongly is when we are thinking about forming a new center, or a collection of centers which we call an institute. Here, we actually really tried to think in terms of broad areas where the university has strengths, and where we will have results in the world. These are relatively temporary structures I must say, because they can be put up and taken down again, as needed in relation to the strategy of the university, and they usually cut across the more permanent units of the university.

The more permanent units of the university, as you all know, are usually formed on a disciplinary basis. Some of ours are interdisciplinary, but they are still just as permanent, because faculty members get used to working in those units. So a particularly strategic moment for a university, in thinking about its impact, might be if it was thinking about a major reorganization of those units. The example I would give of that kind of strategic decision is Arizona State University, led by someone with a degree in science and technology policy, by the way, Michael Crow. When he took over the university, he said: “We want to make a difference in the world. We are not very well organized to do that.” And he started reorganizing all the units in ways that oriented them to problems in the world, so definitely with impact in mind.

As I mentioned, in doing our little project we were blessed with the fact that several other groups had been looking recently at the question of impact for research, not in the university context, but more in the funding program context, but nonetheless, attempts to look broadly over what was out there. One of these was a set of presentations that were done for our Science of Science policy initiative, which is a close cousin of this theme of OST’s Science and Innovation policy. The SOSP is an interagency working group. They were trying to develop

a plan for a huge database, an integrated database that would bring different kinds of data together, for the whole US system, and as background to that, they wanted to really see what was out there in terms of measures in the impact area.

So they put out an open call for short ten-page review papers, in broad areas, and individuals proposed the specific things that they wanted to do. All these reviews are up on line at the website I have listed there, if you

want to go and look at them. They ended up with about 16 to 18 reviews about a pretty broad range of areas. So we checked those. The following spring, again with this notion of the big database in mind, the National Academies held a workshop, and its report is also available through the National Academies' website. Again, it is a broad stretch of people, perhaps more industry experience reported in the academies' workshop.

Then, while we were working on the special issue of research evaluation, on review came out that focused much more on the European experience and particularly on societal impacts rather than economic impacts (September 2011). So we worked with those, and took a look first at the visual representations of models that appeared in them. Remember I'm working, in fact, partly with people who don't think about impact, generally, and the visual presentations are very helpful for them.

Some of them are linear, as in this one. This is the logic model that underlies something called the "payback framework" which I'll talk more about a little later. The payback people claim that it is not linear because it has feedback-loops in it, but that doesn't make it non-linear, unfortunately, it still has a pretty causal chain running through a pre-investment stage, into the inputs/activities/outputs section of the model that I already showed you, with this nice interface called dissemination, and then something they call "secondary outputs", which is something tangible but that occurs outside the research process. Then we've got adoption or use by somebody; final outcomes in this case, because it is a health model, are health outcomes.

You also have lots of feedback-loops, at various stages, changes in strategy at the earlier ones and some of the effects coming from the process rather than through the outputs, so that is a little non-linear, but it's a more sophisticated version of a fairly linear model. Then we have a model that comes from a while ago, that people liked because it showed different kinds of results coming out of university research at the same time, making it a little non-linear, but of course you will notice that there is all these linear portions to it also.

When you are looking for effect of something you do, you are going to end up with some causal logic in it. This one I call the Keystone model because research is in the middle. The keystone is the little stone at the top of a fireplace that holds all the rest of the stones together; if you take the keystone out, everything falls apart. So this was drawn to demonstrate that if you took the research out, there were a lot of other things that wouldn't be happening in the world.



Like the previous visual representation, we've got knowledge being produced, and delivered directly into the research front. The inner circle is outputs, the outer circle is more on the outcomes area, at least on intermediate outcomes. So the knowledge goes into a knowledge base and is then drawn on in a couple of different directions, through graduate education – I know that mapping education systems is very complicated, but... people have done four years of college and they go on to graduate work, and often they then move on to professional practice in some form and carry the knowledge they got from their researcher professors. Their researcher professors are also teaching other undergraduates who don't go into professional practice: about half of Americans go to college, and the rest of them are taught by people who went to college, so that is a very important interface in which you are providing what research has to offer to teachers, to parents... They all affect the school environment.

One person who saw this model early said: "Well, we can tell what is broken in the American education system by looking at this, because most of the people who get undergraduate education and most of the people who become teachers don't have researchers in their classroom. They have people who are just teachers. And then we have the long-term kinds of results for society. So again, another way of looking visually at the impacts coming out of research. There are some models that are really not linear. This one is from a European project; it is deliberately multidimensional. There really is no linearity to it.

Having looked through these various models and developed a big list of indicators mentioned in the literature in different places, we settled on using four impact areas, four different ways that Georgia Tech research could pay off for society: An economic area, a set of societal impacts (often, that is just treated as a residual category for the economic category), impacts in the workforce, and finally research impacts.

We tried to take a look at our impacts from campus through that schools' route, and it just turned out to be impossible for us. If any of you have positive experiences on being able to do that, I would be very interested in them, but we dropped that area fairly early in our process of checking the feasibility of indicators. The economic impacts area is the one that the University is very used to thinking about, because we're a technological university; two thirds of our faculty and graduate students are engineers, so we think very easily about

connections to industry. The unit of analysis for thinking about this is usually a fairly broad area of research. It's multiple faculty members, it stretches across department lines, and I've given some examples here.

We are actually the number one program in the U.S. in logistics, and this is tied to a local industry. United Parcel Service (UPS) is based in Atlanta; they are a few miles away from campus, and so our logistics folks, who are mostly located in industrial engineering, are in constant interaction with UPS. We have a very strong group to get across various departments in new media of various sorts, a big concentration of microelectronics, which has connected easily to nanotechnology, although nano has some other application areas too, and we're very active

at the moment in advanced manufacturing, and in particular thinking through light or stronger materials.

So, the university is used to thinking of those strategic areas, and they've got a set of customary indicators – although they don't think of them as indicators they would look for – to see whether things are working in those areas, whether their strategy is working out. They would certainly look for some industry funding, they'd look for interaction with industry in various forms, including some of the centers will have industrial partnership programs, and if those don't sell, then it's a sign that there is less going on there than the university would like. They look for faculty consulting relationships, and that's a kind of word of mouth: our people here are talking to the firms, so they know what the firms want. But then, what is very surprising, even to me as a social scientist, is that they really expect that particular research results will change something that is happening in industry.

I was on a committee at one point, talking about someone's record, and she had a policy element on what she was doing. They said: "Has she changed her policy yet?" In policy, this is a silly idea, because there are so many factors that go into policy one research result isn't going to change anybody's policy. It's like "oh, no, life is much more complicated than that... You don't really expect that her research results would actually change something someone is doing in industry." And they said: "Yes, absolutely! If she develops a new algorithm, a new approach, whatever, there should be a change in industry practice"... So the expectations are very high on that, and very well known and familiar in the industry area.

We looked out in the literature to see whether there was anything new that the research literature had to offer, beyond the model that our decision makers already have in mind, in terms of the economic impacts. I'll just give you a few examples that I mentioned to you earlier.

One of the approaches is based on econometric methods, particularly in agriculture, because they've been doing this for a really long time. There is a very nice paper at the SOSP workshop that was based on a review of almost 300 studies and a whole lot of econometric estimates of the extent of influence of funding in agriculture, on changing agricultural productivity. Big methods questions about how long should you lag, exactly what kind of econometric modeling should you do, but the fact is you can do it in the end, and it's quite plausible, because you can count up the funding reasonably well, and you have a very long time series in terms of productivity changes that have also been measured. There's a big statistical system behind that, which has been done for quite a long time.

Now, scaling that down to our university level was hard for us to picture. In the areas in which our impact as a university would be so big in relation to a field, that you would be able to apply this kind of approach to it... We would have to have done something... either we were virtually alone on the field, or we did something that you could track its

particular impacts, but then it's more at a technology level rather than quite what the econometricians are doing with this kind of series.

Some of the examples that were out there in the literature used more complicated techniques and once it had been very well worked down in relation to biotechnologies, Zucker and Darby had built a big dataset following people, firms, and the relationship between them, for biotechnology. They have now made a similar database in nanotechnologies, and they make the argument that the impacts of research really come from people who are in the research activity, going into firms. Once you have the people/firm connection, you can track that idea, but it really requires a specialized database.

The kind of thing that you can do with that data once you've got it, which is very appealing to the policy world in particular, and could be appealing for a university as well. They have star scientists, really eminent scientists, that they have identified, in this case in nanotechnology, and the blue dots indicate where a star scientist was involved in a startup activity. That's what the firm entry means. The bigger blue dots with the bigger yellow

stars indicate more firms in an area. So you just can see visually where the activity is concentrated: in the North- East corridor, on the West Coast, in the Seattle and Portland areas, and then of course Atlanta, where I'm from. Maybe we could find the Georgia Tech portion of their dataset, but building their dataset has been quite an

expensive proposition, and over a long period of time, so there are some interesting ideas there. We would need a study to follow through all of them; it's not something that is instantly available.

In the economic area, we also looked at what the Association of University Technology Managers does. They are actually a US association. I think they are more international now, and you might know them better as AUTM. They have actually taken this diagram from their vice-president, who is a technology transfer officer at the University of Glasgow. It is in several of their publications. It is their logic model on which they have based a long list of indicators that they are recommending to universities to gather, in order to benchmark their technology transfer results against each other.

It's got a familiar structure. We have the research activities going on over there, and the outputs on the left. We then have the knowledge transfer activities, the things universities actually do try to get the knowledge out of the laboratory and into use for someone. Those are the activities, and then the transfer itself comes up here, with income flowing in and knowledge flowing in both directions. Then we got economic activity; you may recall

that secondary product section of the payback framework. This is stuff that is tangible, measurable; it is outside the university, it's beyond just the activities of transferring, but there are some things that you can watch.

Getting to impact is then the next very difficult stage in this, with jobs, new products and services, profits... You are often in survey territory, by the time you get there, but anyway... We were working for the Technology transfer office, and they were very



familiar with AUTM, they were involved in this discussion. I looked at the set of indicators until there was no way we could do all this. So we compared the set of AUTM indicators with what we really had available, through the office – it was actually wonderful working with them because they had very good access to the data – and we sorted out a couple of underlying concepts that we had data to construct indicators of.

The faculty consulting turns out to be relatively easy to get to, for an odd reason: it is because of our conflict of interest rules. The faculties actually have to report – which they now do on an online database – every year, who they are doing consulting with, so that Georgia Tech can monitor that kind of conflicts of interest, and that database sits right in the same office that we were working with. The data concerning faculty-consulting relationships is therefore quite accessible, and then we would realize: “Wow, this is not just industry, we can find out who else faculties are consulting with”. So we can look for the private sector, we can look for the NGOs.

We have lots of indicators of their relationships with firms, and what we decided we wanted to do is put those together, look at them over time, in relation with the firms, and see something about the richness and continuity in the relationship, that was beyond the specific mechanism that we were using to interact with them. We can definitely get new companies that are launched out of Georgia Tech, it's just finding out what happens with them. A few years down the line, it was difficult, but then another very easy measure turned out to be royalties, because after we've licensed technology, if somebody is actually using it in the world, if there are sales, we get the royalties, so that is a relatively good indicator of whether somebody is using a technology even beyond the firm that we are dealing with. That's again an easy one to capture in our systems. So those are the concepts we are going to be looking at.

Let me move on to the societal area. The literature reviews in this area, on the US side, were very, very thin. I was one of the participants in a SOSP workshop in a kind of miscellaneous impacts area, and I was very disappointed at the kinds of things we were presented. They weren't really indicators oriented, they were using old methods... It's really not strong on the US side. But we did a paper you might find interesting about policy impacts, basically saying: because people have started, in the U.S., to track citations to research results into policy types of literature, into regulatory literature you can trace them, to some extent, in our legislative documents. I'm very worried about that, because I think most of the influence that researchers have is not reflected in those citations, and nobody has a theory about it.

We did a review on the mismatch between concepts of policy impact and what is actually being measured in agencies. It ended up recommending measuring participation in policy networks. We are now of course experimenting with that, and it's hard too, but at least it will be more realistic if we could get there, and maybe we could get there through data mining and text analysis methods.

There was a very nice review done of the health impacts literature by Sampat and Azoulay; it was a background paper for the National Academy's report, so it's available

there. One of the things that they noticed is that there is very little literature on the health outcomes themselves, but that most of the literature tracking impacts looks a

lot like the economic impacts literature; it focuses on research and development in firms, using a lot of the same techniques, including surveys of firms about how much they've used research. That's the Mansfield style.

So here is their logic model. It looks familiar. We've got the publicly funded R&D on the left-hand side, going through a number of different kinds of knowledge, and then the big stream in which they found the studies was really true private sector R&D producing drugs and devices. Over here, you have health outcomes, somehow. That whole part of the map is basically just the same as the economic impacts, until you try to get to this. This is the more interesting part in some ways, but they said there weren't many studies in the connection between research knowledge and proved clinical practice for better health behaviors. I love the fact that they've got a two-way arrow with the doctors and the researchers, but only a one-way arrow with the public; I guess the researchers never learned anything from the public about changing health behavior. But again, as they admit here, in their note, it is too stylized, simple, and linear.

The Payback Framework that I mentioned earlier was originally developed for health services research, but they think it is a general enough approach at this point to be used in other areas, and they really present it as a research tool. It is not a measurement system. Their framework can be filled with quantitative information, if that happens to be available, or you can use it to collect qualitative information, but in a way that is comparable across cases, which can be quite useful, under certain circumstances. It provides a common structure for gathering data and facilitates cross-case analysis, by providing two things: another logic model, and some categories to classify the paybacks. It is also multidimensional, as we've seen in some of the models so far.

So here is that model again, that we looked at before. Now you can think of it as a research tool. If you're going to do a case study of a health innovation area, this is a framework that you could use, for asking questions if you're doing interviews, for queering documents if you are looking at, for instance, news accounts, or accounts in the trade journals about the technology. You would say: "OK, which step is this about? What information do I have on the dissemination techniques?" Then you would be trying to link it, in the end, to changes in health outcomes and health statuses, with a complicated set of feedback loops that we talked about before.

That is a European approach that was developed by the RAND evaluation group in the U.K., and SIAMPI is an FP7-supported project. SIAMPI, for those of you who had been wondering about it, stands for Social Impact Assessment Methods related to Productive Interactions. Obviously "Productive interactions" is the big keyword there. A key difference in this is not only... We already saw that this is not a causal model; it doesn't have the boxes and the arrows that a lot of the models use. It has this spider framework for presenting things, and that is in part because the goal is not evaluating the outcomes or the impacts, but learning about them, and learning about how they are produced, and

displaying them, leaving the judgment part of it to the decision makers who use this framework.

So the main thing that they are trying to track is productive interactions, which involve people talking to each other, interaction through texts which can be something that is published or something that is mentioned; and then we have money flowing. Those are actually quite familiar categories at this point, but they are used in a little unfamiliar way in the SIAMPI approach. What do they mean by productive? These are all interactions. The productive part means that some stakeholder in the area of research has actually used the results.

They claim – and their case studies support this – that this is a pretty general approach, that doesn't have to be limited to industry. They have some industry-oriented cases in the case studies that they've done, and they also have some that are a little more social science and humanities oriented. So again, they are trying and develop a framework that you can use to think about a lot of different kinds of impacts.

Here is their diagram again; we can talk this through a little more, now. The lines in the spider diagram refer to different groups within a health research institution. How far out the lines are, where the point is for each group, is the share of total output of research projects, as viewed via the Internet, by audiences in a particular social domain. They have really used the Internet tools that are available quite a lot in this approach, to try to sort out the different dimensions on which this particular institute is interacting with its various audiences. The actual labeling of the five points in the spider diagram are set in relation to the institute that they are evaluating. It is not the same categories for absolutely everybody. It's a very customized approach.

OK, so our heads are now swimming with lots of ideas about what we might be able to do around social impacts, most of which turned out to be pretty well beyond the resources of our small project, though one thing we are trying to do is to track those policy appearances in the Congressional Record, which is available textually. Because Georgia Tech has a set of peer institutions that it likes to compare itself to, we're trying to compare our

appearances in that policy literature to the other institutions, because they are relatively easy to track. Georgia Tech is actually one of the harder ones...

We are trying to compare public events, which is one of the SIAMPI interaction indicators, using our university events, calendar, and doing a little categorization of the outside groups that we are interacting with. Since other university calendars are also available on the Web, and we want to do this unobtrusively in relation to the other universities, we can look at a little of their data. Then, we had a twinkle in our eye and thought perhaps we could do profiles of the different universities in how much of their effort addresses grand challenges, through their literature, so we may be able to sort out energy, for instance, or health literature. But this is something we would definitely want to do with the SIAMPI spider diagram, because we don't know what the right

answer is to “How much energy research in university should be done?” There is no absolute reference point on that, so we will be experimenting with that.

We threw out the notion of using media coverage because when we started looking up our University, it turned out most of the times it is mentioned in the media, it has nothing to do with research. Number one use is probably sports (we have a basketball team, we have a football team...); number two is tuition issues, parents complaining that we are charging too much for tuition, none of which really helps us very much... Now we would love to do case studies of outcomes using some of these more complex methods and, maybe for next year someone will give us some money to do that. We certainly need to have a way of finding cases that don’t just involve what is patented, and what goes to through the technology transfer offices. Then the consulting data that I mentioned might be a good source of “relationships” data with some other organizations, and we are going to experiment with that too.

Workforce. I will do this very quickly. In the U.S. context, when you talk about workforce, there is a lot data. The further up you go in the degree ladder you go, the more data there is. Lots of data on doctoral researchers, some on masters, some on people who got what we call “bachelor’s degree”, or “college degree”. That data is done with big sample surveys, NFS pays for it, there is a lot of analysis that you can do with it. 44’28

What everybody knows, at this point, is that there is a lot of information available on individuals on the Internet or in big proprietary data sets, that could be put together with this, or could be analyzed on its own, and is not being analyzed. So one of the big, big issues that this big database project in the U.S. is dealing with is how to mine that data and particularly the discussion around unique identifiers for researchers. It gets attached when people come through their early education periods, as soon as they start getting some government funding, and then carries through so you can really track their careers, unobtrusively, through what is unfortunately called “web- scraping”: just gathering data without ever asking them for it at all. That larger-scale vision is there, but the implementation is not there yet, although there is lots of analysis going on with the survey data...

Interestingly, since people are one of our main outputs from our university, we have remarkably little data on what they do after they leave the university, that we gather ourselves. We know who our alumni are, our development office is the fundraising office, so it stays in touché with our alumni very effectively because they want to be informed of the contributions and who is making a lot of money, so they can ask them for big money. They don’t want to talk to anybody about what’s in that dataset, and they don’t gather information on the full population about what they are doing, so... The development office is not in the business of tracking university impact. We do alumni surveys. All they ask is: “We taught you this at Georgia Tech; was it useful, or wasn’t it?” That’s about it, so we can’t get much about where they are working, what they are doing, whether they’ve risen to high-level positions, or any of that, from our alumni surveys as they currently stand.

The best that we actually found, and it’s not very good, is the study we do on students who just graduated, to find out whether they got a job or not. So we asked them, and we have a little bit of information about what industries they go into, and what their entry-

level job is, not where they're gone a little bit later. So we are going to mine this a little bit, but it's really weak in terms of the contact that we maintain with our alumni. This is an area that certainly should be considered, since we're doing the surveys anyway, if we just asked them a few more questions, I think we could get a lot more information. I'll see if I can sell that idea on campus.

Finally, research impact. Late in the year, we said: "Wait! Maybe we should have some indicators of the scientific impact of the university!" It is symptomatic, and it's a good symptom, that we didn't put that in earlier, because that literature that we were reviewing really assumes that we know how to measure this stuff. We skipped right over it and went to the things that were harder to measure; that's why we only went back to it at a very late stage. Since we were doing that, and since we have some of the world's experts on these measures sitting on our campus, we simply asked one of our local experts for some recommendations, and she recommended (perhaps interestingly to you) the Leiden rankings, public and freely available ranking sets using

normalized citation score and the proportion of the top 10% of publications. Georgia Tech shows up pretty well on those; I think 14 and 15 is pretty good, if we didn't have a few of our main competitors further up in the list, that would make people unhappy.

Then there is this research benchmarking work which is coming from a UNU information institute, which is rather strange, but it does have some broad fields that we were active in. When we look up the kind of combination of the indicators in those, we come out fairly strongly in fields where we think we are strong – although number 7 in engineering is not going to make my colleagues happy... Anyway, that is such a well-studied area, there are so many versions of these indicators out there, that we think that is the easiest part of the whole problem to address. We need to have that dimension into our model.

In summary, what we end up with, as a realistic set of things that we can do from our campus, are more in the economic and societal area: the consulting, multiple indicators about the relationships with firms, forming new companies, paying royalties back, some information about societal interactions, through publically available datasets, that can be benchmarked with other areas. The consulting, by the way, as well as the royalties, are ones that may be hard to benchmark with other universities, unless the AUTM collection of universities does it. Then there's also our little graduation survey and citation measures.

So this is not a bad list, actually. This is from one master student who is working on trying to gather this stuff up for a report he had to submit at the end of the month. Can we, can the University use these indicators prospectively, in some form? As I've said, the benchmarking is an exercise that would capture the imagination of our management at Georgia Tech. They always want to know where we stand in relation to our peer institutions, and they want to know things that we can do to break through, to the next level. So they will be very interested in the benchmarking, and then in the logic models of how to create impact, to go beyond that.



We think that this could have an impact on campus by making obvious a few of the simpler things that we can do to increase our information base, like the survey questions, and finding some examples to do some case studies. It happens that all the reports of people who are going to be promoted, in which they are supposed to specify their impact, are going to be coming through my new office, so we may be able to mine those for examples to look at prospectively. I think that the big impact of the impact indicators, if we have an impact on campus, will be in thinking at a more sophisticated level about what impacts are.

Clearly, with our multidimensional approach, which comes right out of the literature, we'd be broadening beyond the discussion of just scientific impact, citations, that sort of thing. We would even be broadening beyond the area of patents and commercialization, which is so easy and so measurable from campus that attention tends to focus there; and even beyond industry, because the approaches that are being developed are generic enough. So we may be able even to help our engineering leadership to think about other places for us to change things in the world, and make lives better, places that don't go through industry R&D, which is the easier way to think about it.

What I really hope is that by using the framework one can come up with a few well worked-through concrete examples of new investment areas that Georgia Tech leadership is not thinking about yet, to demonstrate that the overall approach of adding measurement to intuition, may actually pay off at the end of university. Thank you very much for your attention, and I'll welcome your comments and share experiences of trying to use impact data in other areas.