Highlights
@GT-IDEA

SMART CITIES

ESG:
ENVIRONMENTAL, SOCIAL, AND GOVERNANCE

INDIANA UNIVERSITY
BLOOMINGTON
Kelley School of Business
O'Neill School of Public and Environmental Affairs
Luddy School of Informatics, Computing, and Engineering

Welcome note

Colleagues,

During the 2019 Spring Semester, Grant Thornton LLP, a leading professional services firm, gifted Indiana University $3 million. This gift established the Grant Thornton Institute for Data Exploration for Risk Assessment and Management (GT-IDEA), an interdisciplinary institute that spans across IU Bloomington's Kelley School of Business, the O'Neill School of Public and Environmental Affairs, and the Luddy School of Informatics, Computing, and Engineering.

GT-IDEA is aligned with the core vision of Grant Thornton's Advisory Services' consulting practice, which is driven by technology and data analytics to help businesses achieve long-term sustainability, create value, and solve problems through innovation. Students who participate in the GT-IDEA program gain experience working on real-world industry issues by utilizing data-driven technologies, engage in case studies and competitions, and benefit from interactions with established risk assessment and management practitioners from Grant Thornton.

This innovative approach to learning is designed to prepare students to become the next generation of even more effective industry leaders. It has also deepened Grant Thornton's relationship with IU, allowing the firm an opportunity to recruit deserving students who are well versed in risk assessment and management.

I personally invite you to join this growing and vibrant GT-IDEA community through our various programming events that will help you prepare to be the business leaders of tomorrow. And, I look forward to seeing you during my next visit to Bloomington!

Sincerely,

David Hazels
National Managing Partner, Advisory Services, Grant Thornton LLP

David R. Hazels
National Managing Partner, Advisory Services
david.hazels@us.gt.com

Deans welcome notes

Ash Soni
Executive Associate Dean for Academic Programs, Professor of Operations & Decision Technologies, The SungKyunKwan Professor
soni@indiana.edu

The GT-IDEA is a new program that brings together three Indiana University professional schools—the Luddy School of Informatics, Computing, and Engineering, the O'Neill School of Public and Environmental Affairs and the Kelley School of Business—to foster ideas and collaboration across a range of areas and topics such as the Internet of Things, Smart Cities, and Environmental, Social, and Corporate Governance (ESG) as the central factors in measuring the sustainability and ethical impact of an investment in a business or organization. In many of these areas, it takes the technical, the business, and the public policy viewpoints together to maximize impact. At the Kelley School, our faculty and students are deeply engaged in business applications of digital technologies and data analytics, which is one of the key driving forces for ESG initiatives in businesses and organizations. That is what makes the GT-IDEA program very unique and exciting.

Travis Brown
Senior Executive Assistant Dean
trabrown@indiana.edu

The Luddy School of Informatics, Computing, and Engineering (SICE) is delighted to participate in the GT-IDEA program. At its core, SICE is a school built on collaboration among disciplines and, at IU, schools. SICE is one of three schools, with the Kelley School of Business and the Maurer School of Law, to offer an innovative, interdisciplinary MS degree in Cybersecurity Risk Management. SICE also houses the Shoemaker Innovation Center, a 3,500-square-foot space dedicated to nurturing innovation and entrepreneurship at IU. The center is available to all IU students, and many Kelley School of Business and O'Neill School of Public and Environmental Affairs students participate in programs at the school. Thus, SICE has the experience and infrastructure to foster cross-disciplinary partnerships, which is one of the primary reasons for the creation of GT-IDEA.

Brad Heim
Professor, Executive Associate Dean
heimb@indiana.edu

In the short time that GT-IDEA has existed at Indiana University, it has worked to develop a sense of community among its constituents at Grant Thornton, the O'Neill School of Public and Environmental Affairs, the Kelley School of Business, and the Luddy School of Informatics, Computing, and Engineering. By bringing together IU faculty and students with Grant Thornton business leaders, cross-disciplinary synergies have improved not just the student experience, but the experience of all involved. Hundreds of participants have gathered at the Bloomington campus for GT-IDEA events, from the faculty banquet for our Grant Thornton Scholars to our conference and case competition. Our case competition winning team comprised members from all three schools; one student remarked that they never would have collaborated without GT-IDEA. We are excited to explore the possibilities for further developing this community as time progresses.

Table of contents

Highlights@GT-IDEA

What Events Does GT-IDEA Support on Campus?

Since its launch in the spring of 2019, GT-IDEA has actively engaged students from the Kelley School of Business, O'Neill School of Public and Environmental Affairs, and the Luddy School of Informatics, Computing, and Engineering. We've held roundtable discussions, case competitions, data jams, and conferences. GT-IDEA engages faculty from the three schools in various student-facing initiatives, as well as networking events with GT business leaders.

Each academic year, there are six roundtable events featuring a business leader from Grant Thornton who engages in a discussion with students from the three schools. Each school hosts one roundtable discussion per semester that provides information relative to the student competitions and additional networking opportunities.

There are also two case competitions and a data jam each academic year. These events encourage students to use an interdisciplinary approach to real-world problems. During the competitions, students have an opportunity to be mentored by Grant Thornton business leaders, as well as Luddy, Kelley, and O'Neill faculty scholars. Each competition culminates in a conference that explores the competition themes.

Faculty workshops are hosted by the Kelley School of Business early in the spring semester each academic year. These provide a great opportunity for GT faculty scholars and GT business leaders to network with each other.

In the coming semesters, GT-IDEA plans to introduce webinars that will allow Luddy, Kelley, and O'Neill faculty to share their research with Grant Thornton in an online and interactive environment.

The coming academic year will be filled with exciting events and opportunities for students, faculty, and Grant Thornton business leaders to connect across disciplines, build relationships, and share expertise. We hope you are looking forward to it as much as we are!

Smarter Cities, and a New Way of Governing

Martin O'Malley, the 61st Governor of Maryland (2007–15), presented at a GT-IDEA roundtable discussion in February 2019, and returned to deliver the keynote for the GT-IDEA Spring 2019 conference on March 29. O'Malley served as the Mayor of Baltimore from 1999 to 2007 and as a councilman in the city's third district from 1991 to 1999.

The only thing wrong with politics today is not enough good people try.

For those of you that may think that that the opportunities are limited in public service, let me disabuse you of that notion. Municipal service—that is, city or county government—is where you can make a huge, huge difference in the lives of other people, and maybe by that leading example, bring the rest of us along with you.

Humanity and our nation have crossed a couple of important thresholds. One of them is that we have now so superheated the atmosphere of the planet that we're breaking all sorts of temperature records, polar ice caps are melting, the water systems of the earth are being disrupted. But we've crossed another really important threshold in the human family on the planet, in 2012: For the first time in recorded history, a majority of us now live in cities.

Perhaps these two things are actually related. Perhaps the only way to save this planet is for us to make our cities more livable places for more people.

We have seen the rise of the Smart City. We say the words "Smart City" and "Smart Cities" so frequently, it's important to do a little check on this new buzzword term. I've traveled all around the globe, and it seems to me the definition of what it means to be a Smart City is this: It's not a noun. It's a verb. Smart Cities take actions to make themselves more inclusive. They take actions that make themselves and their citizens more prosperous, more sustainable and resilient, more educated and skilled, more connected, more mobile, more healthy and clean, more secure.

And to do all of these things. Smart Cities have had to become better at government. In the information age, a couple of really important technologies have come together.

Belief space and the internet of things

"It is from the numberless diverse acts of courage and belief that human history is shaped. Each time a man stands up for others, or strikes out against injustice, he sends forth a tiny ripple of hope."
Robert F. Kennedy

That was true when Robert F. Kennedy said it over 50 years ago, but it's not so true anymore. And why is that? Because the diverse acts of courage and belief are no longer numberless. They can all be numbered. They can be measured. In fact, you can count the number of ripples, measure the number of ripples, and see how many ripples it takes to build up to that wave of change that all of us would agree is positive progress; the sort of progress that makes the Smart City more sustainable and healthy. The type of progress that might even save this planet in time.

The two converging technologies are number one, our ability to model "belief space"—our physical, our natural environment—and the human dynamic that moves across them in real time because of "The Internet of Things."

This is an actual screenshot from my iPad of what was my weekly commute from North Baltimore to Georgetown University on the far side of Washington, D.C. If you ask my neighbors they would say, "oh, you can't get there from here at that time." But I did what all of us do now, I punched the coordinates of Georgetown University into my iPad, and voila! The route would appear. And if there were accidents along the route, or some sort of road closures, my iPad would tell me that a faster route is available now, boom—and I would take it, right?

Now that's belief space. It might be two-dimensional, but the ability to do that in real time, my millennial brothers and sisters—we didn't have that when we were growing up. We didn't have the ability to call Uber and see where the little car is and see that actually, it's three minutes away and took a wrong turn and is coming back. That's what I'm talking about when I say belief space, and the Internet of Things. Increasingly, Smart Cities are using those new technologies in order to get inside the turning radius of dynamic problems.

The changing nature of leadership

Shimon Perez once said to me that in the information age, the people now know more than their leaders. And they usually know it before their leaders. That brings about a big shift. It used to be that smart leadership was to sit high atop this pyramid of "command and control" authority. You control the information, and nobody else can get it until six months later… in that model, things get done on the basis of "because I said so." This new way of governing is fundamentally entrepreneurial. Spare me your ideology—show me whether or not it works, and whether it's working any better this week than last week. It is performance measured. It is relentlessly interactive. And unlike the top-down approach of yesteryears, its here in the center of a collaborative circle, using the authority of the leader to convene people to focus on the latest emerging truth on what works, and to follow the evidence wherever it leads. Things no longer get done on the rule of "Because I said so," it gets done on the rule of "because I can show you it worked."
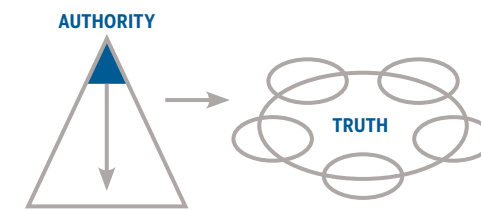
When I was elected mayor of Baltimore in 1999, our city had become the most violent, addicted, and abandoned city in America. We had more population loss in the 30 years leading up to my election than even in Detroit. And it was primarily because of rising violent crime—open air drug markets, these concentrated locations of shootings and murders that made our city the subject of a series of television series, not just one, but a series of TV series, (by the way, I am not the guy in *The Wire*.)

When I ran for office, I said "hope and despair can no longer coexist on our street corners like this. And for us to be able to give our kids a better future, we need to come together and start shutting down these concentrated locations of violent death and within six months, we will close down the first 10 open air drug markets and will make a safer city." We won. And we got right to work.

We were aided by the help of an additional 200 police officers, which the federal government helped us to hire quickly. Then we had a decision to make—where to put those 200 officers. The old way of governing (the likely way, the traditional way, the way we've always done it) would have been to divide the 200 officers by six, bring in the senior council member from each of these districts and said "Congratulations council lady, you have received now one-sixth of 200 police officers." Another way to go would be to look at the last election, see who voted for me in the greatest numbers and deploy the police officers there—kind of a performance managed way of doing it, but not really effective in terms of getting the job done.

The new way of governing

The third way of doing things is what we would call the new way of governing. Let's look at what we already know about where the greatest numbers of our citizens—regardless of race, class, place, or who they voted for in the last election—are being shot, robbed, mugged, and murdered. You know what happens when you put that reality of truth on the map? A picture emerges. And it's concentrated in these two tiny little areas. What does that make up in terms of land area of that big, major American city? It's like 8 percent.

We put the additional 200 officers in those places. And then in community meetings, we were able to show people why. Learning from Jack Maple in New York, we also implemented CompStat, which is the leading edge in this evolutionary development of the new way of governing. We brought police commanders into a room with their citywide command staff on a two-week rotation, district by district, and asked the questions, "What's happening in your district? What are you doing about it?" Tactics and strategies, and timely, accurate information were shared by all with relentless follow up.

Over the course of better information sharing, better clearance rates in solving crimes, more anticipatory deployments, policing the police in a better way through internal affairs—all of those essential things to foster and nurture trust between police and community in a country where law enforcement and race have been intertwined for over 300 brutal and difficult years. We changed the reality. Over the next 10 years, we achieved the biggest reduction of violent crime of any major city in America.

Predictive analysis: bridge safety

Do you remember a number of years ago when in Minneapolis a bridge collapsed, and moms and dads plunged to their death on their morning commute? Shortly thereafter, the nation's governors gathered at a meeting of the National Governors Association. As you might imagine, the talk was the fragility of our infrastructure, and the underfunding of maintaining the infrastructure that our parents and grandparents built for us.
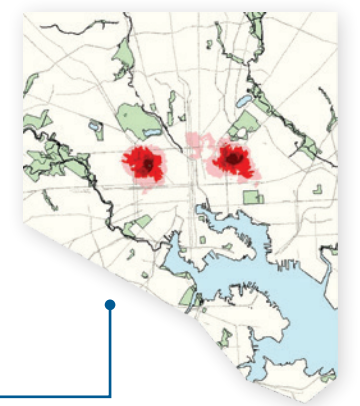
2000 Baltimore City Homicides and Shootings
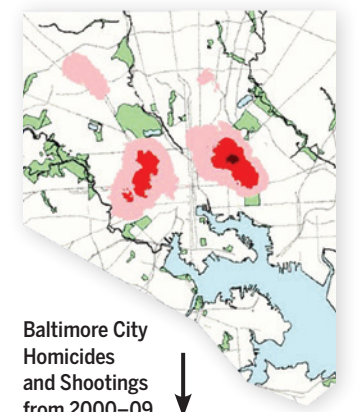
Baltimore City Homicides and Shootings from 2000–09
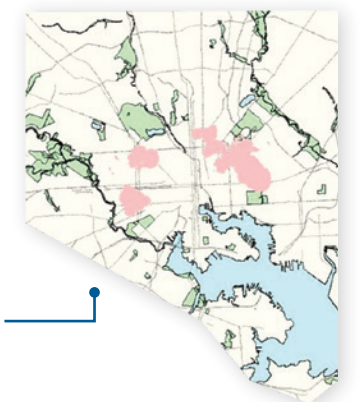
Jack Dangermond, the head of ESRI (Environmental Systems Research Institute, a privately held geographic information systems, or GIS, software company), came up to me and said, "I know that you and your colleague from Pennsylvania, Governor Ed Rendell, care passionately about this issue. I want to show you my new bridge app, created from open source data combined with GIS."

Dangermond flipped up his laptop and with one click of the button, says, "These dots on this map represent every bridge in Minnesota." Second click. "The dots on this map represent—in green light to red light fashion—the structural integrity, or fragility of these bridges." Third click. "Now I have adjusted on this map— based on open data—the size of the dots, depending on how many human souls travel over those bridges every day, so you can see where the greatest number of lives are in the greatest danger from our underfunding and under-maintaining of bridges." With his fourth click, "I want to show you where the federal dollars land to attack this problem." Ed Rendell looked at the map and he said, "None of the dollars are landing on the targets." And Dangermond said, "No. But they're all landing on the map."

It's quite a challenge to actually know what we know and do something about it; to bring people together in a routine and do a better job at how we're doing what we're doing every day to deliver better results for people.

This diagram from Grant Thornton, describes the evolution with regard to predictive analytics. The first step in this evolution is descriptive: "How many accidents occurred last week?" Believe it or

Analytics Maturity Model
What do we mean when we say data analytics?

Business Value

Descriptive
How many accidents occured last week?

Diagnostic
What are the causes of the accidents?

Predictive
How many accidents will occur next week?

Prescriptive
What actions can I take to prevent accidents?

Level of Sophistication
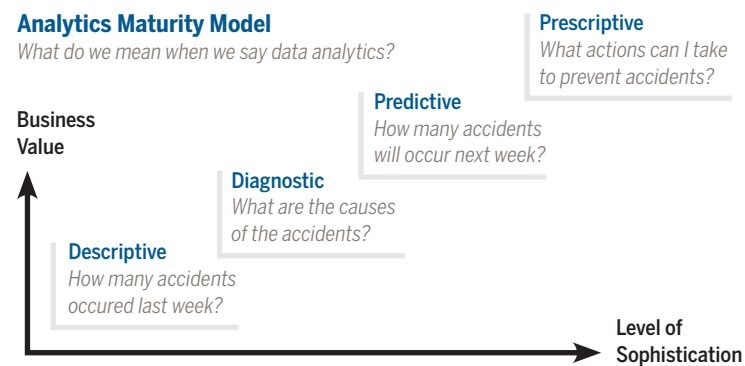
not, there will be something like a bell curve; if you put all the states on it, that would be able to answer that question. The next step, and the question that goes with them in the case of this problem is "how many accidents occurred last

week?" Next step diagnostic: "what are the causes of those accidents?" The next step? Predictive, given what we know about what we already know, "how many accidents are likely to occur next week" And then the fourth and really the most important, the prescriptive. "What actions can I take today to prevent people from dying tomorrow because of those actions?"

Some of those actions can't be completed in one day. Some of them might be a redesign at the curve, or putting in rumble strips or lights. But some of them could be as simple as making sure that your state police are deployed in the places where and the hours when accidents happen.

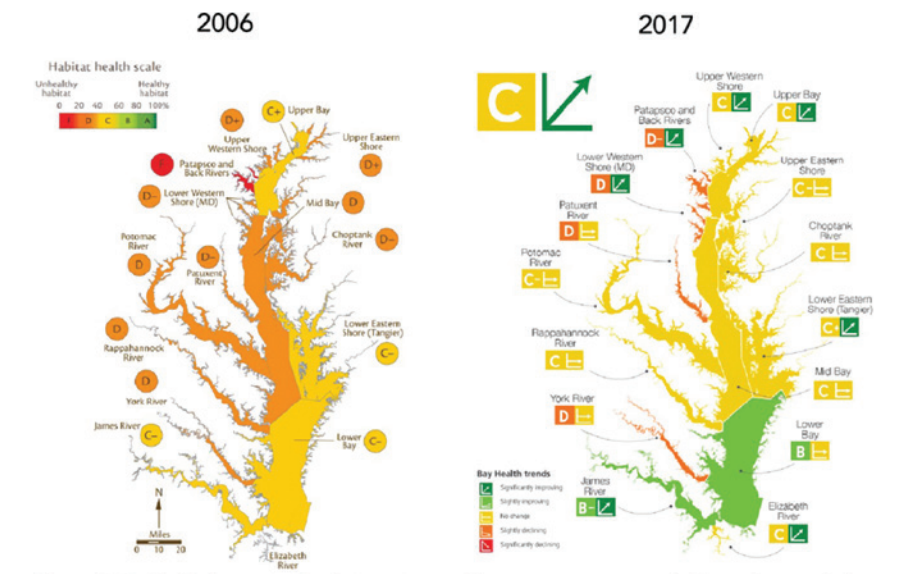## Predictive analysis: restoring the health of the Chesapeake bay

Did you know the Chesapeake Bay watershed goes all the way up to New York? This is a six-state watershed—the largest estuary in North America. For about 350 years, the combination of population growth, the paving of the ground, and heavy-use agriculture—all of the fertilizer we dump on corn and soy to export from this densely populated part of our country to feed hogs in the center of the country—had led to a point where the bay was dying. For 40 years, we did what we thought would work to help save the bay. Still, the bay's health declined. There were lots of occasions when whole beaches would be closed; it just wasn't healthy to be in them because of the water.

When I was elected governor, we applied the same principles and the same management, theory: common platform, GIS, timely, accurate information shared by all. We relentlessly brought together all the departments that had actions to take with regard to helping the bay: The Departments of Environment, Agriculture, Natural Resources, Transportation. Why transportation? They own more blacktop than anybody else in the state. Most of it was built long before people understood the damage that pollution running off the blacktop does to the streams that ultimately feed into the Chesapeake Bay; that create a larger and larger dead zone of epoxy in the middle of it every year.

The other people we brought to the table were scientists, including the head of the University of Maryland Center for Environmental Science, Don Boesch. He's now retired, but he had the academic freedom to call the balls and strikes— not only on the causes of the bay's degradation, but also on the value of the solutions. We set a deadline—not with a 40-year hope of cleaning up

the bay, but with two-year milestones for actions. Once Virginia saw that we were doing it, and using GIS and this new way of governing to get it done, Virginia started doing it too. And once Virginia and Maryland together were doing it, it became the first executive order of President Obama's administration regarding cleaning up a body of water in the United States. The EPA put Chesapeake STAT over the top of its umbrella with us. And we all started taking actions that actually reduced the nitrogen, phosphorus, and sediment that flows into the bay.

This map was where we started. *(2006 map, at right)* This was 2006, a year before I was elected. The method of grading the health of the bay pre-dated my arrival in office. So the Center for Environmental Science would look at six indicators that they blended together to create a grade score. And then they assign the same sort of color schema that we saw on the bridges, that everybody recognizes, and we publish this annually.

I have become a big believer that the difference between a dream and a goal is a deadline. If leaders aren't willing to make themselves vulnerable by sticking out their neck to declare a deadline, there aren't a lot of people in your organization that are going to stretch to achieve more than they thought possible either. I had a meeting with my first environmental secretary early on as we were setting 16 strategic goals for our state across four broad areas, and I said we need a deadline for the Chesapeake Bay.

At what date will we reach the point where the waters of the Chesapeake Bay are all becoming a little healthier every year, instead of a little sicker every year? Let's set a deadline. She says, "Please God don't set a deadline." I said "Why not?" She said, "Because water quality is really hard. It takes a long time. What happens if we don't hit the deadline?" I said, "What happens if we do?"

We set a goal of reaching a healthier a tipping point by 2020. Keep in mind the meetings are happening every month. Are we doing more cover crops this month than we were last month? Are we on track for the capital projects that upgrade the wastewater treatment plants? Are we remediating all of that blacktop with sedimentary ponds adjacent to the highways?

The goal here is to take the orange and make it and get it to green. *(2017 map, above right)* Rather than allow the orange to go dead to red. I could stare at that all day. When I was mayor, if I

Chesapeake Bay health shows a significantly improving trend despite many pressures on the Bay and its watershed. From 2006 to 2017, the overall average grade improved from a D+ to a C. For more information, visit chesapeakebay.ecoreportcard.org.

could have worked on issues that affect vulnerable children and families all day, that would have been a good day. When I was governor, if I could have worked on restoring the life of the Chesapeake Bay all day, that would have been a good day.

Just because you have a lot of data and information doesn't mean you have a whole lot of shared understanding. But we can take that data and present it to the people in charge of the operation—namely citizens and the democracy. Things only get done on the basis of shared understanding—the ability to show these trajectories, where we're headed in the right direction, where we flatline. At the end of the day, it's all about getting things done.

In addition to climate, there's one other big crisis on our planet. And that is the future of democracy itself. Its efficacy, its ability to get things done. You know society's great wealth is not about locking money in a vault. It's about dispersing human solutions to human problems more broadly so all of us can live life more abundantly. And there's a real crisis right now in the world about whether or not democracies are capable of achieving that.

I truly believe, within this room, among many of you that are thinking about throwing your life into this service to others, you have never been born into to a better and more urgently needed time than you are right now. To usher forward, to bring forward, to accelerate forward this new way of governing for the benefit of all of us.

Just because you have a lot of data, and just because you have a lot of information doesn't mean you have a whole lot of shared understanding. But we can take that data and present it to the people in charge of the operation—namely citizens and the democracy.

GT-IDEA Spring Faculty Workshop

February 15, 2019
Held at the Kelley School of Business

THEME: **SMART CITIES**

Bringing together Grant Thornton Business Leaders and Faculty from the Kelley School of Business, the O'Neill School of Public and Environmental Affairs, and the Luddy School of Informatics, Computing, and Engineering.

Above: **Welcome by Ward Melhuish**, Principal, Advisory Services, Grant Thornton LLP Consumer and Industrial Products Industry, Business and Data Analytics

Above: **Welcome from Kelley School of Business Dean Ash Soni**

Left: **Keynote by the Hon. Governor O'Malley** on **Smart Cities and a New Way of Governing**

Haixu Tang and **Jingjing Zhang**, GT-IDEA Faculty Scholars

Owen Wu, GT-IDEA Faculty Scholar with Governor O'Malley

Governor O'Malley, Dean Ash Soni, Vijay Khatri

Chris Lilley and **Owen Wu**, GT-IDEA Faculty Scholar

John Hill, GT-IDEA Faculty Scholar

Roundtable Discussions

February 20, 2019
Held at the Kelley School of Business

THEME: **SMART CITIES**

Roundtables provide an opportunity for Grant Thornton Business Leaders to bring current topics to campus and discuss those with students and faculty.

"The way we can think about the future, and try to anticipate where we are heading, is by coming up with great ideas and collaborating across different disciplines."

—Aurpon Bhattacharya (below), Principal, Financial Management Sector, Advanced Digital Technology and Analytics, Enterprise Technology Strategy and Innovation, for Grant Thornton

Aurpon Bhattacharya (top), Principal—Financial Management, and Bill Slama (above left), Senior Manager, Digital Transformation and Management, speak with the audience following the roundtable.

Roundtable Discussions

February 19th and March 4th, 2020
Held at the Kelley School of Business and O'Neill School of Public and Environmental Affairs

THEME: **ENVIRONMENTAL, SOCIAL, AND GOVERNANCE (ESG)**

Mark Lemon (top left), manager, Geoff Cole (top right), Senior Manager, Strategy and Transformation, and Lisa Carrol (bottom), Director—U.S. Advisory Services, discussing ESG issues during roundtable events in the Spring of 2020.

Rethinking Assets to Drive Value

THEME: **SMART CITIES**

Presented by Bob Hersh—Grant Thornton Business Advisory Services practice partner for the east region, and practice leader for the Metro New York/New England market territory at a GT roundtable in March.

What are the components of a Smart City?

The primary thing that makes up cities is people. You need to make sure that they are getting the services they need, and the health care they need. Everything they need to live needs to be delivered in conjunction with government, businesses, and the people that they serve.

There's so much going on that can define a Smart City. Governance is important. Automated processes. Renewable sustainability. Energy utilities—how you power everything in a sustainable way. Transportation—people, goods, services, the logistics of getting things, getting people things, getting everything around, in and out of a city in the most efficient way. Building and infrastructure are very important. And also resilience—if an earthquake hits, what happens? You've got to be able to survive these things, especially as the population of urban areas keeps growing.

What type of things are needed to support a Smart City?

I live outside of New York City, and it is very disconnected in reality. I take a train in every once in a while—sometimes it works; sometimes it doesn't. There's a lot of variability. It takes forever to get from Midtown to downtown. It shouldn't take as long as it does, but it's old technology and none of it is connected. There is nobody monitoring the real-time demand of subways— they still run on a schedule. This is the type of thing that can change with modern, Smart Cities. We can understand where there's a line in the subway system, make sure that there are more trains in those places to get people in and out faster, and reduce service where there aren't as many people on a real-time basis.

If we're going to do things like that we need consistent data. Right now the sanitation department, the transportation department, and the police department all have separate systems. Some are cloud based, some are not (generally not). I think the cloud aspect of this is incredibly important, because it allows the sharing of information on a real-time basis and it forces a common data model that everybody can understand.

In New York, the infrastructure is old. I would contend that if it's maintained correctly, it's probably okay. But currently, those assets are maintained on an as-failed basis instead of on a proactive basis because they're not collecting the right data around the rolling stock of the subway system.

Process and asset monitoring is understanding what the processes are that need to be supported. The process dimension to me is very important. It's the heart of the analytics, in my opinion. The life cycle of a subway car is 30 to 40 years if you maintain it the right way, and stay on top of it. If you don't, and you let things break down—you keep it going until it fails—then you not only lose a car for a day, you might lose that car forever, because you're not maintaining it correctly, and something catastrophic occurs.

You have to get into a mindset of continual improvement. That happens by understanding the data and managing the process, measuring the process, and being willing to change those processes, even when it might not be politically expedient.

So, let's pick on New York again. It would be great if the police and the transit system, the sanitation department, every department in the city, talked to each other and had a common data model. This is kind of pie in the sky stuff, but if we had that, the city would be able to run so much more efficiently than it does. Common data model process, measured analytics—all of this stuff is what drives a Smart City.

In New York, a lot of the technology that's used to manage those departments right now is legacy technology and there is a great deal of inertia when it comes to upgrading it. How do you overcome that inertia and make progress? One of the valuable things that cloud computing helps with is that you don't have to do it all at once. You can use the technology in the cloud and bring on users in a very incremental way, almost one person at a time. Using a new piece of software and a new system is a very powerful thing because it drives the acceptance and understanding of the data model.

Drilling down on one component of a Smart City

The energy space is all asset-based. If you look at a smart energy company, you start with electricity. You've got to produce it, get it distributed, and get it to users—and you have to monitor all the assets that do that: generating equipment, lines, transformers, the fleet of trucks, the people maintaining all of that infrastructure. It takes a lot of assets to get nuclear energy or natural gas all the way to the plug in your room. If you could monitor all those assets in that sort of value chain real time, with analytics that drive real action on how to better manage those assets? That would be Nirvana. That's where we want to be.

On the distribution side, you have people now that have solar panels on top of their houses that need to be monitored to manage the grid. You've got electric vehicles—all this stuff that didn't exist even 10 years ago that is new to the ecosystem. You need to know what's going on with the transmission lines that go from substations to your house. All of these assets have to be monitored and inspected because if they fail, you could have the entire East Coast go without electricity.

Think about all this as a process, think of all this as a value chain around data. How do you get from the oil and gas to the generation plants, transmission, distribution, customer service? Then there is an analytic element to each one of those things that needs to be on a dashboard somewhere, where someone can adjust that ecosystem, and take real action.

When you start talking about Smart Cities, there's got to be a reason to connect assets—whether that's for an electric utility's reduced downtime/outage management, bettering the transmission, making sure the distribution is reliable, or probably most importantly—making sure customer service is being taken care of. When you start connecting assets, monitoring assets, and running analytics against those assets, you have to have the end in mind and make sure you know what the end goal is: reliability.

Customer experience and asset optimization

Where does demand really come from? It comes from customers. You've probably got a smartphone with your whole life on it—at least mine does. I can pull up pictures, I can show you what's going on in my backyard right now. I control all my thermostats in my house. My wife got home today, and my smart thermostat was down to like 63. The house was freezing cold. Instead of going into turn the thermostat herself, she called me and said, "turn this up."

A lot of these assets have monitoring built into the infrastructure, and they spit out the data. I think there's actually a bigger opportunity in what I call the "middle market" that isn't so sophisticated— where they are running old equipment, and you've got a pump that's been running since World War II. It's still running, but I could put a vibration sensor on it, literally for 50 to 60 bucks. Then I can take that data and send it into the cloud, collected over time. Then I can tell precisely when that asset is going to fail by changes in the patterns and the profiles of data coming off of those machines.

An analytical driven EAM approach

EAM—Enterprise Asset Management—is a system that can monitor assets, record the data coming off assets, manage the asset lifecycle. What has to sit on top of it is the analytics layer. There are systems out there that are cloud based, so we can do the incremental thing and start moving our clients along this journey of monitoring their assets, understanding where they are in their process, understanding where they are in the capital planning and budgeting cycle. Then you can allocate capital and cash flow in the most efficient way to make sure your clients are happy.

Asset instrumentation → **Real-time data analytics** → **Actionable insights** → **Enhance user engagement and experience**

Smart City–Driving Value

Presented by Chris Lilley, National Managing Partner, Business Applications, for Grant Thornton, in March of 2019

The foundation of all of this is getting people to behave differently and think differently

I spend time with our clients every day. And what I want to talk to you about is where technology is versus where our clients are in reality.

The iPhone was introduced in 2007. There have been 18 iterations of the iPhone. New iPhone iterations come out, and we just adopt them. But when you think about the major systems that our clients use to run cities—those systems are, on average, 10 to 15 years old. And they are not connected. That is fundamentally one of the biggest challenges we face.

There is a revolution going on right now with mobility, social media, digitization, and analytics. It is coming at us rapidly, and our clients aren't ready for it. As we try to bring these things to them, we have to get some very basic foundations in place to leverage all this.

What does a Smart City need? It needs to be better for the inhabitants. More efficient. Connected. User-friendly. Safe. And how are cities set up today? Not like that. Cities are set up as autonomous divisions and units. The technology that underlies that—the business processes that underlie that—are siloed. While AI can do a lot of phenomenal things to help cities, until we start to aggregate the foundational elements that cities are built on, they aren't going to change. I sit with a lot of clients where the leadership aspires to that vision and lays out strategy. Then you go down to the department heads who have to execute, and you find that while they believe that's the right answer, their current foundational elements don't allow them to get there. Being a consultant is a phenomenal business to be in because there is a constant need for somebody to come in and try to help you to get there.

When I look at smarter cities, I think about the components of the city. The number one enterprise is that it has to keep the infrastructure to deliver power, water, and services out to the constituents. Transportation has to be factored in—public transportation, private transportation; Uber, Lyft. How they are going to license them, how much they need, has to be understood.

Building an infrastructure, environmental concerns, public and private services. If you look at what is going on in cities right now, there is a tremendous move toward privatization of service. We have to understand how that's going to impact cities and their systems; how we're going to manage that demand and manage that migration.

Governance is the key to make all of this happen. We can have all the great technology in the world, it's how we adapt the government technology and integrate it into the infrastructure, and the day-to-day activities that occur in a city, or in a commercial entity, to leverage everything.

The foundation of all of this is people, changing people, getting people to behave differently and think differently, and making them more productive by giving them better tools. What do people focus on day-to-day in their jobs? They focus on processing a transaction. If you ask them what happens next, after that transaction, or where that transaction came from, or what the impact of that transaction is, a lot of them don't know. Until we move away from the transaction and look at the process, a lot of what we aspire to do is going to be very difficult.

The tools that are out there and available right now allow us to change that behavior, but changing a person's behavior is a huge, huge ask. We've got think about technology and the human implication of making change effective and getting them to understand that they're going to go from the bottom of their license to the top of their license in terms of how they operate. Instead of being a clerk, they're going to be more enriched, they are going to be more empowered, they are going to be more impactful in what they do.

The next elements involve planning and understanding what's going on. We need a holistic plan that asks, "What does this city look like? What's the strategy? How quickly are we going to grow?"

If you're in the commercial sector, in retail, you have done a tremendous job of engaging your customer by personalizing content. That is probably the most advanced integration and understanding of how to deal with your customers or your constituent. Cities have to start to think that way, they have to understand how to engage with the average citizen and communicate with them about what's going on.

When you look at energy supply, there are three elements: you've got to create the energy, you've got to transmit the energy, and you've got to distribute the energy. You've got to figure out how to source that service, you've got to figure out how to get that service out to the user. All of the processing systems have to be connected in order to implement this technology into the real day-to-day operational world.

In the utility world, there is a supply chain. It starts with figuring out where I'm sourcing my energy from. The biggest problem we have on the generating and transmission side is reliability and autonomy. If you look at the severe events and fluctuations going on with our weather, you see more and more outage and downtime, although there is technology out there to help anticipate where those outages are to help pre-position crews, based on weather patterns and historic outages. Then you've got to distribute it and you've got to serve the customer.

The biggest problem is how to engage that constituent. When you engage with your cell phone on any app that you're using on a day-to-day basis, it's a seamless integration. If you call a city, or you call a utility, you are put on hold or get a call back in 57 minutes. When they call you back, it's the wrong person, so they put you on another call with a long hold time. That behavior has to change. Technology is phenomenal, but unless a person can connect with the human element, that's not going to happen.

A linear model of the smarter city starts with whatever we're trying to connect and monitoring it and understanding it. Once we get that data, it's got to be captured someplace, it's got to be analyzed and aggregated, and then a decision has to be made. We have two problems in this model. One, it connects things on an analog, device-by-device, area-by-area basis, and not into an aggregated data structure that understands that connectivity, and where and how problems have to be solved.

The second problem is that this data store is a static data store. With isolated events, we can make a real-time decision. But in the aggregate, we have to build a model that tells us "Hey, wait a minute, we've got a big problem on 75, we have to redirect," and then what we should do to redirect traffic patterns. When databases aren't built to be connected, everything is done in isolation.

> We can have all the great technology in the world, it's how we adapt the government technology and integrate it into the infrastructure, and the day-to-day activities that occur in a city, or in a commercial entity, to leverage everything.

Why do we care? Downtime cost & services impact

Gartner Research shows that average downtime of the system is $540,000 per hour. That's $647 billion a year in lost productivity system outages across the infrastructure. And if you think about it, transportation, energy, and IT all count on infrastructure to survive.

I live in the east, I live in Philadelphia. If we have a little glitch in Amtrak, the entire East Coast shuts down because there are no trains running. You sit at that train station and watch the delays and watch the lines of people pile up until they get those systems back. It's the same at the airport. These are very involved problems to solve, but they have to be solved because the population is demanding reliable infrastructure.

Des Moines, Iowa, went to this model—a much smarter model. They immediately took seven percent savings per hour, by just becoming more efficient in how they monitor and manage their energy. That's why we're doing this.

We are doing this to optimize systems and deliver better performance to the customer. There is phenomenal technology, and you will find when you get into the workforce that we are ill-equipped to holistically realize the benefit of it. When you sit with the folks who do this stuff every day, they know the reality. They know that we build things historically in isolated towers, and that we need to get away from that.

If you go into a relatively new company, they're not dealing with any of this. That's why they are able to advance so quickly. I started my career at GE. I still remember my neighbor saying, "great job, they'll never go out of business." Really? They got so big that they could not adapt. And the majority of the companies that you're going to go work with now are not in the Google, Uber, Amazon line, where they are able to adapt. So, when you think about where you are going to take all this knowledge you have, you really have to think about what you learn and how to address the client.

$540,000 PER HOUR
average energy infrastructure downtime cost

$647 BILLION A YEAR
in lost productivity system outages across the infrastructure

Careers in Consulting

Highlights from a March roundtable discussion that featured Grant Thornton representatives with widely varying levels of experience. They spoke about their work, their backgrounds, and what a career in consulting looks like.

Panel moderator:
Ward Melhuish, Partner and Performance Transformation Leader, Public Sector

Panelists:
Lauren Brumett, Associate, Digital Transformation and Management, Public Sector; IU BS and MBA alum
Bill Slama, Senior Manager, Digital Transformation and Management
Lisa Carrol, Director
Aurpon Bhattacharya, Principal, Financial Management

Ward Melhuish: To begin, would you share a little about what got you into consulting, and what your background was?

Lauren Brumett: I graduated from SPEA (or O'Neill, I should say) in 2017 and from the MPA program in 2018. I focused on public finance and policy analysis. I never thought that I would go into consulting, but what really drew me to it was the wide variety of things you can do.

Bill Slama: I went to DePauw University in Greencastle, Indiana, and I didn't start in professional services or consulting right out of school. I was more of a PMO (Project Management Office), change management guy. I was approached by someone I worked with whose husband owned a professional services firm and they said "Hey, you know, we ever thought about consulting?" I said, "What is consulting?" And that's how I got connected to a small professional services firm—kind of a niche firm—in Naperville, Illinois. I was working on a project, a hospital in Brooklyn, New York, and there was a contingent of about 60 to 100 Grant Thornton folks there. I got the opportunity—and it was the best decision I ever made. That was about five, six years ago.

Lisa Carrol: I went to another school that celebrates red and white on the west coast, where I was a liberal arts major (Stanford University). One of the companies that was interviewing liberal arts majors happened to be Mobil Oil Corporation—they were looking for liberal arts majors because they believed we are able to think and write and are easier to shape. I ended up being there almost 20 years until Exxon purchased them. As an executive, I traveled the world and did some amazing things. The more variety in your life, the better equipped you are to be a consultant,

because of the kinds of situations you're in, the people you meet, and the things you do.

Mobil was very forward-leaning, very culturally advanced. It was a great place to work. I was offered a position at Exxon, didn't really want to work there, and was invited by a colleague who was being courted by a consulting firm—one of the many that served Mobil—and she told them, "No, I don't want to do this, I'm going to go do something else, but you should talk to my friend." You never know who you know, and how your connections work. So, I interviewed with a consulting firm called Fujitsu, and because of the leader of that office's connections with Grant Thornton, on or about the middle of the 2000s, I came to GT.

> The more variety in your life, the better equipped you are to be a consultant, because of the kinds of situations you're in, the people you meet, and the things you do.

Aurpon Bhattacharya: I'm an undergrad from Wabash College, a liberal arts college in Indiana, and my background is in political science and theater. My theater background helps me with consulting a lot. I came directly to SPEA right after, got an MPA in competitive international relations, economic development, and policy analysis. In 2005, Srikant came to IU for a recruiting event for the first time, so I had an interview. The very collaborative approach is what told me that consulting is for me.

Ward Melhuish: How is consulting different than auditing taxes? How are they similar?

Lisa Carrol: I think the main focus is about serving your client, no matter what your discipline is. You've got to take care of that customer, whatever their need is—whether that's from an audit perspective, a tax perspective, or a consulting perspective. No matter what we're trying to do, we want to help that client, and we work together to do that. From a consulting perspective, there are so many things we can do

for our client. We talk often about our consulting practices as a real large portfolio of businesses, but they're really a portfolio of capabilities and different ways that you can help your customer.

Aurpon Bhattacharya: In audit and tax, we look at financial processes. Advisory is about answering questions and facing challenges with a suite of capabilities.

Ward Melhuish: In consulting, we often use the word engagement when we talk about client work. What do we mean by that? And how is that different than doing a project?

Lauren Brumett: As someone who's in the public sector and works on the client side day after day, it's really about collaboration, not only within your own internal team, but with the client there as you're actively listening to what they're saying their problems are. That's why it's called engagement—because you're there collaborating, engaging with them, and trying to find solutions that work for them.

Lisa Carrol: Engagement is about connecting—and it could be connecting over solutions, connecting so that you can actually hear what the issue may be for your client. That connection and that energy around wanting to do the best that you can for that individual is the best feeling.

Bill Slama: We always try to bring the right technical skill sets to a client help solve their problem, but if we miss the people aspect, we miss out on understanding the way that they think and act and why they're doing what they do.

Ward Melhuish: Let's talk about expectations in your role. What does a typical day look like?

Lauren Brumett: GT has really surprised me. Coming from a government and nonprofit background, I thought, "Okay, going into the private sector, you are going to be the rookie, you're going to be the new guy, you're going to have to put up with some stuff before you actually get to do the real work." But that has not been the case for me. I've been given amazing opportunities. I'm the junior-most person but my opinion is valued just as much as anyone else's when we are talking about solutions for the client.

Bill Slama: As a senior manager, I'm responsible for selling additional work to clients or new work to new clients, while at the same time having delivery or utilization goals. So, I need to have XYZ billable hours to a client, on top of being responsible for managing teams and engagements. You learn so many things, and you work your way up the ladder, and before you know it, you're managing people and teams and large engagements and all these dynamic companies.

There really is no typical day as a consultant. You'll find that a client will bring you in the door for A and before you know it, you're doing Z, and Z changes to double-Z and triple-Z. So being agile is a huge part of all of our jobs. That's probably the one constant—I know I'm going to wake up tomorrow and I'm going to be asked to do something that I wasn't asked to do today.

Audience member question: For the people out there who are aspiring to a career in consulting, what qualities or characteristics do you think they should work to cultivate?

Aurpon Bhattacharya: Intellectual curiosity is the first one, and the ability to ask questions, and not to take anything you're talking about at face value; being patient and a very good listener so you can come back with a solution. Asking questions and listening. The soft skills are very important—you can pick up the technical skills in school and on the job.

Clockwise from top left: A scene from the audience; Lisa Carrol, Director—U.S. Advisory Services, speaks with students; a question from Alex Lopes, Kelley GT-IDEA Faculty Scholar; Governor O'Malley speaks with audience members.

Student Case Competition

March 28 and 29, 2019
Held at the Kelley School of Business

THEME: **SMART CITIES**

The first GT-IDEA case competition took place in March of 2019, with finalists presenting during the GT-IDEA Smart Cities conference. Each team comprised students from the Kelley School of Business, the O'Neill School of Public and Environmental Affairs, and the School of Informatics, Computing, and Engineering. Each team shared its research and ideas about how to help cities like Bloomington—home to Indiana University—develop into Smart Cities.

Consumption and Performance

Jingjing Zhang
Kelley GT-IDEA Faculty Scholar,
Associate Professor
Kelley School of Business
Indiana University

Summary with excerpts from "Consumption and Performance: Understanding Longitudinal Dynamics of Recommender Systems via an Agent-Based Simulation Framework," by Jingjing Zhang, Gediminas Adomavicius, Alok Gupta, and Wolfgang Ketter.

This paper is forthcoming in Information Systems Research.

Understanding Longitudinal Dynamics of Recommender Systems via an Agent-Based Simulation Framework

The importance of recommender systems in the electronic marketplace

Recommender systems are commonplace in the electronic marketplace. They provide personalized suggestions to individual consumers to help them discover information and items that are most relevant to their interests and needs. Such systems are especially valuable in complex electronic commerce markets that often involve millions of products to choose from. In practice, recommender systems have demonstrated strong influence on both consumers and retailers. It has been reported that recommendations could account for 35 percent of product sales at Amazon.com. Netflix, the Internet television and movie streaming/rental company, has reported that about 75 percent of the content watched by its subscribers is suggested by its recommendation system.

Underexplored aspects of recommender systems

Much research in the area of recommender systems has focused on developing and improving personalization techniques for making accurate predictions of user preference ratings for individual items. A vast number of studies in the recommender systems literature have used existing offline datasets collected from real-world systems for assessing the performance of algorithms. Such datasets typically represent a one-time snapshot of the system and can help make best design choices (e.g., find the best performing algorithm) for that specific situation.

However, it remains unclear how these design choices will affect users' consumption of items and interactions with the system, which in turn will influence the future performance of the system. In prior literature, the nature of long-term consumer-recommender interactions, i.e., temporal dynamics of recommender systems, has been underexplored. Additionally, the static datasets only contain the actually observed interactions between users and items in a fixed system setting and, therefore, we do not know the evolution possibilities and longitudinal dynamics of the system under alternative settings. There are many "what-ifs" to be explored in a system, e.g., what might happen in the long run, if systems rank the recommended items differently? What if users rely more heavily on the system for their item selections? To answer these questions, we need to analyze and understand the longitudinal dynamics of recommender systems.

In addition, real-world recommender systems implementations have not only to focus on recommendation accuracy, but also to balance a number of objectives, including accuracy, diversity, relevance, novelty, popularity, scalability, adaptability, awareness, and social values. In other words, most real-world recommender systems inevitably have to navigate various trade-offs in order to balance many (often conflicting) goals. Thus, understanding longitudinal performance trade-offs that are inherent in the interactions between the users and the system constitutes an important and practical research topic. Such understanding would enable designers to anticipate the temporal changes in the system, make strategic design choices, and maximize the long-term value of the recommender system.

In this research, we demonstrate that consumption strategies (based on different degrees of users' reliance on recommendations when choosing which items to consume) turn out to have a major influence on some of these trade-offs and, more generally, on the longitudinal performance dynamics of the system. Thus, understanding the impact of consumption strategies (and some of the underlying reasons behind it) represents an important contribution of this work.

Understanding the longitudinal dynamics of recommender systems

An ideal approach for studying recommender systems' longitudinal dynamics would be to perform large-scale longitudinal field experiments in real-world settings. Depending on the research question, such live experiments may need to isolate or control for the effects of numerous (potentially confounding) factors, such as the composition of user and item populations (e.g., user population heterogeneity, distribution of item popularity), users' "lifecycle" characteristics (e.g., users' consumption frequency), users' consumption strategies (e.g., how users choose items), and so on. Controlling for some of these effects may be difficult in real-world settings; thus, conducting such field experiments may not be feasible or could be prohibitively expensive. Therefore, we propose and develop an agent-based modeling and simulation approach to investigate the temporal dynamics of recommender systems.

Agent-based modeling methodology allows for creating computational models that simulate the simultaneous actions and interactions of artificial agents, which typically represent individual entities (e.g., users), in an attempt to re-create and predict the appearance of complex phenomena. In the recommender systems context, agent-based simulation is typically much cheaper and faster than large-scale field experiments with real users and systems. Besides, simulation can provide a rich environment for exploration, allowing for numerous experiments under a variety of settings, which makes it possible to identify, explore, and separate effects of different factors.

Simulation can uncover key insights that could then be further analyzed using additional methodologies (i.e., more targeted field experiments and econometric analyses) and, thus, can be used in conjunction with other methods such as field experiments and analytical modeling. These characteristics of agent-based simulation make it well-suited for our exploration of longitudinal dynamics of recommender systems.

Our research

Building upon prior studies that demonstrated the usefulness of simulation to examine some specific recommender-systems-related research questions, we introduce (and advocate for) a general-purpose, comprehensive, low-cost, and risk-free simulation framework that can be used to explore various emerging phenomena resulting from user-recommender interactions by allowing researchers and practitioners to manipulate all the different aspects of recommender systems as well as simulate various canonical user consumption behaviors.

Getty Images

We use the simulation framework to study how users' consumption strategies (specifically, with respect to the level of users' reliance on recommendations) influence the longitudinal performance dynamics of the system. The user's inherent consumption strategy is not something that can be controlled by companies using field experiments; thus, agent-based modeling provides a useful tool for researchers to study the impact of consumption strategies.

In our paper, we demonstrate an interesting paradox that users' high reliance on the recommender system actually provides highly suboptimal performance outcomes (i.e., smaller benefits for the system's performance) in the long run. The simulation framework allows us to perform a more in-depth investigation of all the process-oriented metrics to provide an in-depth understanding of why and how this performance paradox occurs. Our analysis suggests that the different consumption strategies (e.g., select items randomly instead of based on recommendations) lead to fundamental changes in the structural and value distributions of the rating data, which subsequently serve as inputs for the recommendation algorithms, and therefore affect the future performance of the recommender systems. The theoretical understanding of the longitudinal nature of recommender systems represents a major contribution of this work.

Lastly, we provide explorations of several additional factors about user populations and types of recommender systems (e.g., popularity-based recommendations, non-homogeneous user populations, top-N recommendations). Our exploration reveals some highly interesting patterns. For example, the hybrid consumption strategy based on personalized and popularity-based recommendations offers a unique combination that is able to substantially improve the relevance of selected/consumed items over time. It is because recommender systems can discover and popularize the "good quality" items that are appealing to a significant number of people (but that are not popular at this time), thus, helping these items climb up in the popularity rank list. This results in a general increase of item quality in the list of most popular items (and, hence, consumption relevance) over time. In other words, in hybrid consumption settings, recommendation algorithms facilitate the general "quality-rises-to-the-top" phenomenon, which is not present in pure popularity-based consumption; this is another important finding facilitated by the simulation-based approach. In addition to discussing a number of key performance patterns, the paper also analyzes and provides insights into the underlying factors that drive these patterns.

Improving the Predictive Ability of Intelligent Driving Systems

THEME: **SMART CITIES**

SICE RESEARCH SPOTLIGHT
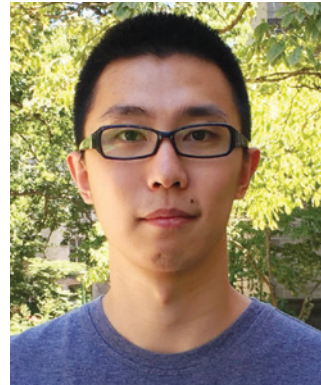
Mingze Xu
Ph.D. candidate
Luddy School of Informatics,
Computing, and Engineering,
Indiana University

Summarized from the paper "Egocentric Vision-based Future Vehicle Localization for Intelligent Driving Assistance Systems," by Yu Yao, Mingze Xu, Chiho Choi, David J. Crandall, Ella M. Atkins, and Behzad Darius

Egocentric Vision-based Future Vehicle Localization for Intelligent Driving Assistance Systems

Safe driving requires not just accurately identifying and locating nearby objects like cars and pedestrians, but also predicting their *future* locations and actions so that there is enough time to avoid collisions. Precise prediction of nearby vehicles' future locations is thus essential for both autonomous and semi-autonomous driving systems. Research has been conducted on predicting vehicles' future actions and trajectories using static overhead (bird's-eye view) observations. But obtaining overhead views requires overhead traffic cameras or aerial imagery that must be transferred to the vehicle over a network connection.

A much more natural approach is to use forward-facing cameras that record the car's "first-person" or "egocentric" perspective. In addition to being easier to collect, the first-person perspective captures richer information about the relationships and interactions between the vehicle and objects in the environment. Due to these advantages, egocentric videos have been used in applications such as action recognition, navigation, and end-to-end autonomous driving. For trajectory prediction, some work has simulated bird's-eye views by projecting egocentric video frames onto the ground plane, but these projections can be incorrect due to road irregularities or other sources of distortion, which prevent accurate vehicle position prediction.

A novel approach to predicting future locations in Intelligent Driving Assistance Systems

Predicting relative future locations and scales of nearby vehicles within the field of view of a vehicle's egocentric camera is challenging. Our approach uses a multi-stream recurrent neural network (RNN) with an encoder-decoder (ED) architecture that separately captures both object location and scale and pixel-level observations. Incorporating dense optical flow, or the movement of each pixel from frame to frame, improves prediction results significantly since it captures information about motion as well as appearance change. Unlike other

work that has addressed prediction in simple scenarios such as freeways, we consider urban driving scenarios such as interactions with a variety of multi-vehicle behaviors. Our work presents a novel perspective for intelligent driving systems to predict vehicles' future location from egocentric views and under challenging driving scenarios, such as intersections. The multi-stream RNN-ED architecture improves temporal modeling by explicitly capturing vehicles' motion as well as appearance information, improving prediction accuracy, which could be especially beneficial in intelligent and automated vehicles that have motion planning capability.

We've published a new first-person video dataset—the Honda Egocentric View-Intersection (HEV-I) dataset—which was collected in a variety of scenarios involving road intersections. These scenarios consist of particularly challenging moments for prediction because vehicle trajectories are diverse and dynamic. This dataset includes over 2,400 vehicles (after filtering) in 230 videos. When we evaluated our approach on this new proposed dataset, we achieved state-of-the-art results.

Traditional approaches

An egocentric camera view is often the most natural perspective for observing an ego-vehicle environment, but it introduces additional challenges due to its narrow field of view and the fact that the camera itself is moving. The literature in egocentric visual perception has typically focused on activity recognition, object detection, person identification, video summarization, and gaze anticipation.

Previous work on vehicle trajectory prediction has used motion features and probabilistic models. The probability of specific motions (e.g., lane change) is first estimated, and the future trajectory is predicted using Kalman filtering. Deep learning techniques achieved convincing results on many problems and have been recently investigated for trajectory prediction. However, these methods model trajectories and context

Getty Images
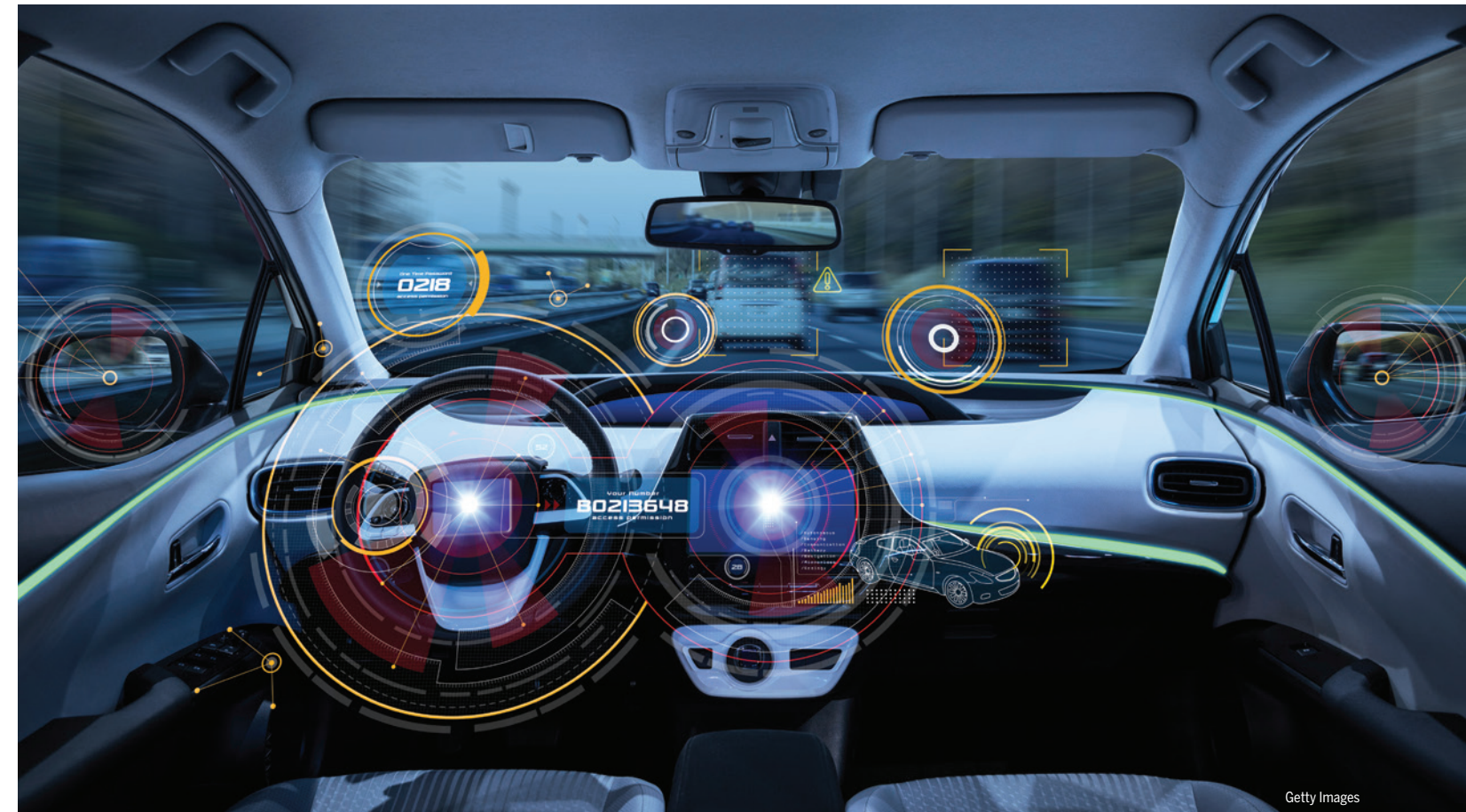
information from a bird's-eye view in a static camera setting, which significantly simplifies the challenge of measuring distance from visual features and of understanding the motion patterns of objects, since the camera itself is not moving. In contrast, in monocular first-person views, physical distance can be estimated only indirectly, through scaling and observations of participant vehicles, and the environment changes dynamically due to the motion of the camera. Consequently, previous work cannot be directly applied to first-person videos. On the other hand, the first-person view provides higher quality object appearance information compared to bird's-eye view images, in which objects are seen only from the top. This paper encodes past location, scale, and corresponding optical flow fields of target vehicles to predict their future locations, and we further improve prediction performance by incorporating future ego-motion.

What makes our approach different

Our method for predicting future bounding boxes of vehicles in first-person view differs from traditional trajectory prediction because the distances of object motion in perspective images

do not correspond to physical distances directly, and because the motion of the camera (ego-motion) induces additional apparent motion on nearby objects.

We propose a multi-stream RNN-ED model to encode temporal information of past observations and decode future bounding boxes. The past bounding box trajectory is encoded to provide location and scale information, while dense optical flow is encoded to provide pixel-level information about vehicle scale, motion, and appearance changes. Our decoder can also consider information about future ego-motion, which could be available from the planner of an intelligent vehicle. The decoder generates hypothesized future bounding boxes by temporally updating from the encoded hidden state.

Next steps

Our future work may incorporate evidence from scene context such as traffic signs/signals, depth data, and other vehicle-environment interactions. Social relationships such as vehicle-to-vehicle and vehicle-to-pedestrian interactions could also be considered.

> The first-person view provides higher quality object appearance information compared to bird's-eye view images, in which objects are seen only from the top.

Adaptation, Culture, and the Energy Transition in American Coal Country

THEME: **SMART CITIES**

SPEA RESEARCH SPOTLIGHT

Sanya Carley
O'Neill School of Public and Environmental Affairs

David M. Konisky
O'Neill School of Public and Environmental Affairs

An excerpt/summary of "Adaptation, culture, and the energy transition in American coal country"

The United States is shifting from dependence on carbon-intensive energy resources to lower-carbon alternatives. While historic energy transitions have often taken up to a century to unfold,¹ the current U.S. transition is evolving at a relatively rapid pace.

The coal industry has been one of the primary sectors affected adversely by this transition. Early signs of coal industry transition and decline emerged as recently as two decades ago due to advanced mechanization, declining mining productivity, and environmental regulations. As domestic electricity demand has declined and market substitutes such as natural gas, wind, and solar have dropped in price over the past decade, the coal industry decline has become precipitous.

Within his first three months in office, President Trump signed a bill to repeal a regulation protecting streams from coal mining waste and an executive order to rescind limits on greenhouse gas (GHG) emissions from existing coal power plants (i.e., the Clean Power Plan), lift potential restrictions on coal mining on federal lands, and remove the mandate to include the social cost of carbon in regulatory benefit-cost analyses. These and other actions were to fulfill campaign promises he made to bring back U.S. coal jobs.

It is unlikely, however, that these policy changes will drastically affect the country's current energy transition. While environmental regulations have been an important factor in the energy transition, they are not the primary reason for the recent decline of the coal industry. Proposed efforts to remove environmental regulations, all else constant, will not change the near- or long-term economic trajectories for coal communities.

We gathered insights from focus groups in Appalachian coal mining communities and interviews with professionals working within these communities in the summer of 2016. Through this research, we found that many within Appalachian coal communities understand that coal is a declining industry, and that it is important to seek out new economic opportunities. Significant efforts are already underway on both a community and individual level to adapt to these changes.

Signaling that coal should remain an important part of the U.S. fabric can impede momentum.

Our research stresses the importance of asking questions about the distribution of benefits and burdens resulting from the U.S. energy transition and contributes to growing literature on the "just" transition—one that is experienced equitably across groups and communities. Our research also underscores the importance of understanding what is transpiring in declining communities, and the manner in which such communities approach or perceive the energy transition.

Background: the decline of the U.S. coal industry and economic vulnerability

Coal production is declining, as are U.S. coal mining and electricity production jobs. Coal mining jobs have decreased approximately 71% since 1985: from an estimated 170,500 jobs in January 1985 to 50,000 in January 2017. Coal production peaked in 2011 and has dropped dramatically since. Appalachia, the focus of this research, was one of the hardest hit regions.

These declining trends are due to a confluence of factors. Among the earlier contributors were rising prices for coal due to declining mining productivity, the need to dig deeper for usable coal deposits, and rising costs of sub-surface coal mining. The mechanization of coal mining and technological improvements have led to higher worker productivity and fewer jobs, even as production has expanded. Environmental regulations—especially the sulfur dioxide limits in the Clean Air Act of 1990 and the subsequent decline in demand for Appalachia's high-sulfur coal—also contributed, although a recent analysis argued that the role has been quite modest relative to other factors. This study estimated that recent environmental regulations only accounted for about 3.5 percent of the total 33 percent decline in U.S coal production.

Three additional trends have played a particularly important role over the past decade. First, U.S. demand for electricity has been relatively flat since falling drastically at the end of the last decade during the Great Recession. Forecasts suggest that it is not expected to appreciably increase for

decades to come. Second, the price of market substitutes has fallen considerably. As a result of the U.S. shale gas revolution, natural gas prices are well below the price per unit of coal across most of the country. The cost of wind and solar generation has also declined significantly due to technological improvements and there is little to suggest that these price trends will change considerably in the future. Third, many countries are adopting low-carbon alternatives and have committed to the Paris Climate Agreement. Although President Trump has declared his intention to withdraw the United States from the agreement, many U.S. state and local governments have noted their continued commitment to renewable energy development and GHG abatement.

These trends suggest a bleak long-term forecast for coal as a market commodity, regardless of retrenchment of relevant U.S. environmental regulations. Moreover, coal communities are particularly vulnerable in the face of an evolving energy transition. Due to the historic nature of economic development within coal mining communities, they are especially prone to economic hardship in boom to bust periods. U.S. coal communities are marked by a dependence or resource curse, which is defined as a tendency for communities that rely heavily on certain extractive resources to become "addicted" to these resources and to develop overly dependent or specialized economies.

Many coal regions have had mono-industry economies for over a century. The nature of coal mining jobs, which are highly unionized and high paying, tends to reinforce this dependency and provide little incentive for regions with coal resources to diversify their economies and employment opportunities, or foster entrepreneurship. Mono-industry economies make it more difficult for communities to adapt to shocks due to a lack of alternative labor market options and a consistent underinvestment in education. When coal extraction declines, it also affects the entire community, since local governments rely on severance taxes to support education and other public services.

Not only do these communities offer a dearth of economic opportunities, but

individuals within these communities may limit their own educational attainment. The allure of a low-skilled, high-paying profession often results in coal miners beginning their careers before completing high school. Lower levels of educational attainment across coal miners and their families further render them susceptible to shocks and limit the potential for adaptability in the face of economic decline.

Local perceptions of the energy transition

Interviews and focus groups conducted within Appalachia revealed important insights about how communities are adapting in the current energy transition. These results highlight the importance of culture, shifting mindsets, and community efforts. They also underscore just how potentially damaging it is to make promises about reviving the coal industry.

Coal as culture

Mining employment in many coal regions dates back over a century. Many of the respondents that participated in this study noted that their grandfathers and great-grandfathers both worked in the mining industry, so it was a natural decision for them also to become a miner. This history and personal identity make it difficult to accept change. As one focus group respondent noted, "People don't like change, especially around here; they been doing the same thing for 150 years, why would they change now?"

The historic roots of coal not only steer individuals toward the profession but also shape the broader culture within these communities. Scholars have identified previously that a strong sense of identity among extractive industries is common, and we found significant evidence of coal culture in Appalachia. Coal was frequently framed as the common bond—or identity—that held the entire community together. This sense of identity is amplified by strong attachments to location, landscape, and personal networks, which not only makes it challenging for individuals to generate a conception of self that transcends coal, but also makes it particularly difficult psychologically for individuals that need to leave Appalachia for new employment opportunities.

Shifting mindsets and seeking new opportunities

Many respondents discussed how a primary component of an individual's or a community's ability to adapt is to embrace the move away from a culture of coal rooted in dependence to one focused on new opportunities and community engagement. For many study participants, this vision highlighted the importance of rebuilding with new objectives. One respondent articulated this vision by explaining, "I think longer term, it is an opportunity despite all the pain that people feel to finally diversify our economy, to be healthier, and diversify how we create energy ourselves, to be a kind of a healthier, more vibrant place."

Getty Images

The varied accounts we collected underscored that significant change is already underway in Appalachian coal communities. As many come to terms with the future prospects for coal, the tenor has, at least for some, turned from anger to excitement, and the result has been important momentum toward individual and community adaptation.

The way forward

As the coal industry continues to decline, it is important to consider how best to support the communities that have traditionally relied on coal jobs for their livelihoods. Promising coal communities a return of their jobs has the potential to fill them with false hope, which can threaten the very progress that has been made to date as individuals and communities work to redefine their collective identity and create new, dynamic, and promising opportunities for their future.

Long-Termism: Thinking Sustainably about Work and Life

THEME: **ESG**

Presented by Geoff Cole, senior manager for strategy and transformation at Grant Thornton, with questions from undergraduate students representing the Kelley School of Business; the Luddy School of Informatics, Computing, and Engineering; and the O'Neill School of Public and Environmental Affairs

"Long-termism" is about getting off the treadmill of only thinking about what needs to get done this week, this month, or this year and—as a society—considering our big-picture sustainability challenges. How do we address climate change, malnutrition, workers' rights, and other macro issues that the world is trying to solve in ways that are fundamentally sustainable?

I've come to love the diversity of experience and the platform we're given in consulting, both as individuals and teams. We get to explore new ideas and challenge each other.

Grant Thornton is working to show leaders that adapting business to the Environmental, Social, and Governance (ESG) criteria for sustainability shouldn't be separate from everything else. It must be part and parcel of everything we do, whether it's helping clients with their tax returns and audits or fundamentally changing the direction and scope of their business.

It's taken me 15-plus years in my career in the commercial world to get to a point where consulting companies themselves are the platforms that are affecting the kind of change that's needed for sustainability. As you think about your career, consulting can be an environment that allows you to have a long-term impact.

We're very active in the ESG risk management and analytics space. We have an opportunity to tell a different story in the marketplace and invest time in things like the GT-IDEA partnership to tap into the brain power here at Indiana University and excite the next generation of consulting talent. Part of our recent effort has been to develop a framework to help leaders think about this new mentality of long-termism—which isn't about trying to beat the S&P 500 Index like most traditional businesses.

At this year's World Economic Forum, the whole world was talking about sustainability. The CEOs of Goldman Sachs and BlackRock and foundations and nonprofits are saying that it needs to be at the core of everything.

Sustainability can sometimes be a buzzword or shorthand for addressing climate change, but it's much bigger than that. There are also social and societal dynamics that we need to consider.

Business is not just about shareholders anymore. Employees and consumers are a big part of that trend. Think about how we engage with brands that do sustainability well and don't do it well, and how that affects our brand affinity or willingness to spend, consume, or attend events sponsored or not sponsored by an entity.

As students, how has your perspective on ESG and sustainability changed since getting involved with GT-IDEA or as the topic has become more mainstream?

Student: Now more than ever, we're seeing effects of climate change. With events like the Jakarta flooding and wildfires in Australia, climate change has been shoved to the forefront of world news. Companies like Microsoft and Amazon are almost competing for who can be more sustainable.

Geoff: We each need to apply our own criteria for whether we think companies' efforts are authentic and genuine or if it's just marketing spin and PR. For a long time, companies put out corporate social responsibility reports or associated themselves with certain charitable organizations. To me, it didn't feel authentic.

Adopting long-termism means getting off the treadmill of Wall Street expectations about quarterly earnings and how much headcount you laid off and how many businesses you moved offshore. Sustainability can mean many different things for you as a business—the environment, diversity in your workforce, or access to education and training, for example. If you do it right, it will drive better business performance, excite your client base, and open up new markets.

Student: As a consumer, I'm looking more closely at the companies I support or the brands I buy. I'm also looking at the companies I want to work for in the future. If they don't have beliefs that line up with mine—especially in the realm of sustainability—then I don't want to work for them.

Geoff: You should feel empowered to ask interviewers about sustainability and the topics you care about. In January 2020, Grant Thornton put out our first corporate responsibility report. You can all take a look at it and consider what it means for a company like ours to get something out there publicly. We certainly have a long way to go to be more authentic and transparent and to address issues that are relevant to you as students. But if we're going to be in the marketplace talking to companies about how they're going to be more sustainable if they infuse long-termism into their decision-making processes and business strategies, we need to take steps in that direction as well.

Many of the actions that can be taken to impact sustainability do have a short-term feel and require short-term sacrifices. But businesses are starting to prove that the long-term gains are there. The question is how we start getting more action and alignment around long-term goals instead of short-term goals.

Student: You touched on authenticity. Something I've seen since I've been doing GT-IDEA case competitions is that the millennial generation cares about where they're getting their products and what those companies are doing. It's obvious that a lot of companies are moving this direction because they know it's only going to become more prevalent. **In your opinion, is most of this sustainability effort just marketing? How do you know it's authentic? And are there going to be purity tests in the future?**

Geoff: This is where data analytics comes into play. How do we do more than take a company's word for it? What other data points would we want to gather be able to validate that what a company says is reality? We'll see data analytics come more into the ESG space. There's no shortage of data providers out there that are charging a lot of money for the data they gather. But each assessment is based on different criteria. There's a whole evolution out there beyond the investment community: How do consumers and businesses express their desire for sustainability with their purchasing decisions? Some will be in dollars, and some will be through other means—but I do think there will be more transparency in general. New measurements of performance will become more widely available, and there won't be anything for companies to hide behind anymore.

We get calls from companies saying, "I'm worried we're going to be asked about any one of these issues. Can you come help tick the box and say I did the ESG thing?" This is not a box-ticking exercise and step one is realizing. You can gather the data and put out the report, but if you think you're done there, you're grossly mistaken.

Student: Thinking about what you were saying about drivers of change, **where do you think the most efficient drivers of change exist? With employees? Or does it start at the top to make change most effective and efficient?**

Geoff: It has to be a little bit of both. There have been examples like the employee walkout at Google around internal sexual misconduct and harassment issues with their leadership. Employees have a voice and platforms to get their message out. Companies can't ignore their employee base. But change also needs to come from the top down. We need to see that a company has taken action and that the board has formed a committee and mandate for ESG. That direction should trickle down to the next level. The CEO and senior management team should be communicating that ESG is important at every level. It needs to be backed by the proper investment and reallocation of time and resources. And it requires companies to take a step back and ask what's best for stakeholders—not just shareholders—long term.

Student: Internationally, sustainability is a goal across the board. **How do we reach markets that are more isolated and less developed and be culturally aware of the differences?**

Geoff: In most cases, less development presents an opportunity. There are examples of economies that don't have a history of investing in tremendous infrastructure—like telephone systems and fiber optic cables. They went to mobile first. Not having legacy infrastructure has actually enabled better access in some less-developed countries. Countries themselves, through the United Nations and the UN Sustainable Development Goals, have signed up to meet goals of sustainable development by 2030. Those that are still investing, growing, and attracting foreign capital recognize that they can redirect. They don't have to feed a legacy infrastructure and can actually position themselves more nimbly.

On a personal level, I would challenge you to think about what you want for your career. How will you optimize for long-term impact in your own work? And how will you apply your own story to the global narrative around sustainability?

> Many of the actions that can be taken to impact sustainability do have a short-term feel and require short-term sacrifices. But businesses are starting to prove that the long-term gains are there.

Integrating Sustainability into the Core Business Model of Grant Thornton

Presented by Mark Lemon, manager at Grant Thornton

My background in sustainability and environmental policy has played an instrumental role in addressing some of the internal challenges faced by Grant Thornton as the demand for environmental, social, and governance (ESG) standards increases.

During my undergraduate studies in political science and environmental studies at Kenyon College, I became interested in politics and took a semester to work on the 2000 presidential campaign. I also garnered an interest in the environment and environmental policy.

After graduating, I spent three years on the "frontlines" of the environmental movement. During this time, I worked as a community organizer, a campus organizer, and an advocate for environmental policies. Then I decided to enhance my quantitative analytic skillset and enroll in the Master of Public Administration program at the O'Neill School of Public and Environmental Affairs.

During my time at O'Neill, I completed concentrations in environmental policy and natural resource management and policy analysis. I also worked as a Service Corps Fellow, performing a greenhouse gas inventory for the City of Bloomington. After earning that degree, I took a job at Grant Thornton, where I've now worked for 11 years. I currently lead the Higher Education Cost and Revenue Analytics Program, which helps institutions understand how activities, courses, programs, and other outputs consume financial resources. I also help guide the direction of the firm's corporate social responsibility initiatives.

In the United States, there are no regulatory mechanisms that require reporting on an organization's ESG footprint. To fill the void, a number of nongovernmental organizations (NGOs) have put forth their own standards, one of which is the Global Reporting Initiative. As a nonmandatory reporting method, the Global Reporting Initiative encourages firms to consider the impact of their operations and communicate key criteria to stakeholders.

To implement an effective corporate social responsibility (CSR) program, leadership and other key decision makers within the organization must integrate those efforts with an overarching strategy. Historically, there has been a tendency for company c-suite leadership teams to create a separate environmental group or corporate citizenship team that is not fully integrated into core business decisions. They use sustainability efforts as a marketing tool, rather than integrating CSR into the central decision-making of the organization. This will not be sufficient as the demand for ESG standards increases.

Grant Thornton has initiated a journey to integrate corporate citizenship efforts into everything we do. Historically, Grant Thornton has largely focused CSR efforts on local community engagement. Some of Grant Thornton's more recent CSR campaigns include Purple Paladins, Grant Thornton United, and IMPACT2030. As a founding member for IMPACT2030, we have encouraged and incentivized organizations to activate corporate citizenship in their communities in order to contribute to the UN Sustainable Development Goals.

The Purple Paladins program identifies and rewards community members who are making a positive impact. Organizations can apply for grants through the program, and if selected, they can also receive pro bono consulting work from the firm. Grant Thornton emphasizes targeting local organizations, and the first-ever recipient was a small organization called Coming Up Rosies that provides head scarves to children with conditions causing hair loss. The financial support given through Purple Paladins essentially doubled the organization's capacity.

Grant Thornton United serves as an internal, online forum the firm uses across its U.S. offices. This helps us celebrate and encourage community engagement from city to city.

In addition to community engagement initiatives, I've admired Grant Thornton's recent increased focus on diversity and inclusion efforts, given our industry's reputation for a lack thereof. At a national leadership conference for the firm last year, the CEO and leadership team bluntly expressed an urgent desire for more women in leadership positions.

While our focus on local community involvement was in line with our client and community expectations, our firm has started to face growing pressure to reevaluate what it means to be a good corporate citizen. This is consistent with the ESG's evolution in the past decade. This comes, in part, from increased pressure from investors and stakeholders, and this pressure is felt especially by business-to-consumer businesses.

There is also an increasing demand for quality ESG data and reporting. Investors want to know what they're buying and understand what companies are doing in regard to ESG.

For Grant Thornton specifically, potential clients are asking for internal ESG reporting, even in bidding for work. In a bid to perform an audit, for example, a client will consider the service and the cost, but they might also ask for Grant Thornton's top three ESG practices and their Carbon Disclosure Project (CDP) score. Transparency is increasingly important as existing customers also expect compliance.

Historically, the firm has not prioritized greenhouse gas emissions. In all honesty, this comes as a result of multiple factors, including:

- A lack of regulatory requirements and conflicting guidelines from the U.S. federal government
- Limited use of fuel because the industry does not manufacture or mass produce products
- Decentralized responsibility
- Challenges in tracking 58 leased offices' energy consumption

In 2019, a large client prompted Grant Thornton not only to update our CDP reporting, but also to think about how we integrate future CSR strategy into our core business model. Through the process of performing this analysis, we hope to establish guidelines that can become an industry standard.

I'm incredibly enthusiastic about the future integration of CSR into Grant Thornton's prioritized business strategies. At such a large company, sometimes all it takes is a bit of external pressure to spark consideration of sustainable corporate citizenship as integral to success and sustainability. Ultimately, if you want to be doing business in the U.S., you need to be prioritizing ESG.

GT-IDEA Spring Faculty Workshop

January 24, 2020
Held at the Kelley School of Business

THEME: **ESG**

Bringing together Grant Thornton business leaders and faculty from the Kelley School of Business, the O'Neill School of Public and Environmental Affairs, and the Luddy School of Informatics, Computing, and Engineering.

"We knew we had something special going on in Indiana. This year, we have 70 students committed to come work at Grant Thornton across the country. When I go to our offices, people tell me, 'Those Indiana students are awesome. They're so prepared. They're not afraid to speak or talk to clients. They do great presentations.' That's something that's really important to us."

—**Mark Sullivan,** Principal, Advisory Practice Leader for the Central Region, Grant Thornton

"The project that we're undertaking is exposing students to consulting as a career and the practical considerations that enable them to contextualize the education they're receiving. We've done a lot in a year, and I look forward to facilitating connections between IU's faculty and the Grant Thornton team to come up with new projects, programs, and opportunities for collaboration."

—**Travis Brown,** Senior Executive Assistant Dean, Luddy School of Informatics, Computing, and Engineering

"The amount that has been accomplished in a year with GT-IDEA doesn't happen very often in academia. There were an impressive number of events associated with this initiative: three interdisciplinary conferences, two case competitions, and six roundtables. Eleven major events is a lot, and it's brought Luddy, O'Neill, and Kelley together. And I think we're doing a lot more things together now than we were before."

—**Ash Soni,** SungKyunKwan Professor and Executive Associate Dean for Academic Programs, Kelley School of Business

"It's been great to see how GT-IDEA has evolved over the past year, and how participation and engagement of our faculty and students has grown. Our undergraduate students in particular have taken a greater interest in consulting as a career, and our finance faculty has said that students are asking for more resources in this area. It's wonderful to see a project like this being so successful."

—**Bradley Heim,** Executive Associate Dean, Paul H. O'Neill School of Public and Environmental Affairs

Other interactions with IU and GT

April, 2020
Held at the Kelley School of Business

THEME: **ESG**

April 2020 guest speakers from Grant Thornton presented to two different courses at Indiana University's Kelley School of Business.

Guest speaker on Digital Enterprise Business Technologies

Is the Cloud Right for You?

Bill Slama, Senior Manager Digital Transformation & Technology

Bill's discussion covered evaluating a company's cloud readiness, criteria for successful cloud adoptions, and choosing the best cloud technology solution.

Guest speaker on Digital Enterprise Business Technologies

Innovators Agenda

Malcolm Silberman, Blockchain and AI Practice Lead at Grant Thornton LLP

Malcolm's discussion discussed innovation and digital transformation with blockchain technology.

Guest speaker on Business Applications of AI

Implementation of AI

Nate Regimbal, Senior Manager at Grant Thornton LLP

Nate's discussion focused on the value of and implementation of AI in business.

GT-IDEA Spring Faculty Workshop

January 24, 2020
Held at the Kelley School of Business

THEME: **ESG**

Bringing together Grant Thornton business leaders and faculty from the Kelley School of Business, the O'Neill School of Public and Environmental Affairs, and the Luddy School of Informatics, Computing, and Engineering.

Top: **Mark Norrell**, O'Neill GT-IDEA Faculty Scholar
Above: **Jingjing Zhang**, Associate Professor Kelley School of Business and Kelley GT-IDEA Faculty Scholar, discussing recommender systems at the 2020 Spring Faculty Workshop.

Below: **Alex Lopes**, Kelley GT-IDEA Faculty Scholar and **Mark Sullivan**, Grant Thornton

Business leaders from Grant Thornton and faculty from Indiana University's Kelley School of Business, O'Neill School of Public and Environmental Affairs, and Luddy School of Informatics, Computing, and Engineering interact during the 2020 Spring Faculty Workshop.

Life Sciences and Health Care Trends: Disruption with an Eye toward Opportunities and Risks

THEME: **ESG**

Presented by:

Lisa Walkush, National Managing Principal–Industry, Grant Thornton

Erik Shannon, Health Care Sector Leader for Strategy and Performance, Grant Thornton

Sharif Ambrose, Principal, Public Sector for Health Care, Grant Thornton

Trends in health care and life sciences

Lisa Walkush, National Managing Principal–Industry, Grant Thornton

Our life sciences sector at Grant Thornton is focused on connecting people and professionals who work in the industry, not only in our advisory practice, but also across tax and audit. We are focused on helping our clients support patients, provide better solutions and better therapies, and run their businesses more efficiently. To do this, we look at the life sciences industry across the value chain and work with clients in various functional areas including research and development, clinical development, regulatory, quality, manufacturing and supply chain, and commercial.

Aging population

An aging population is creating a larger patient base for the life sciences industry, and the demand for products and therapies is growing. The 65-and-older population will continue to increase by 3.3 percent through 2024, and the amount of medication people take when they reach age 65 to 75 increases dramatically. With the therapies on the market today, people are living longer, and baby boomers are aging. There are more people who will need medication. This is driving revenue in the industry. The pharmaceutical industry alone is expected to reach $1.4 trillion. From a consulting perspective, there is a significant opportunity to help clients develop their products.

Patent cliffs

There is a patent cliff coming that has the potential to make a $200 billion impact on the industry. Most of the products involved are large-molecule or biologics. Humira is the highest-selling product on the market today. Its patent expiration is being extended a little bit, but when that happens, products that are called biosimilars—which are the generic version of biologics—will become available.

The U.S. Food and Drug Administration has an accelerated pathway to get biosimilars to market, but adoption in the U.S. has not been as high as in other parts of the world. This is partly because some of these products are being litigated before they get to market. Since biosimilars are less expensive than biologics, patients would benefit. We're hoping that as this new patent cliff hits, we will see more of an uptick in adoption.

Restructuring to drive down cost

Life sciences is a big industry, and it's very mature. There is not a lot of revenue concentration. There are a number of big players in the space and they tend to focus on different therapeutic areas, but there is some competition. There is also a decrease in margins coming from pricing pressures. Our clients are always looking for ways to grow their businesses and save anything they can from an expense and cost structure standpoint. We're seeing this a lot in R&D. We recently worked on a feasibility study for a client that looks at different ways the procurement group could leverage existing group purchasing organizations (GPOs), buying groups, and consortiums. It was a one percent savings— we did a ton of research. They're trying to save anything they can, especially in generics.

Regulatory environment

The global regulatory environment in this industry is extremely complex. We speak with the FDA and watch guidance documents that come out, but things tend to change quickly. We're trying to help our clients leverage artificial intelligence and machine learning to manage questions from different health authorities around the globe, pull that information in, and get it out to the right people in the business so they can get submissions in and make better decisions faster.

Drug pricing

Drug pricing tends to be one of the top issues in the industry. The current administration has issued a blueprint with certain suggestions to get controls in place in the U.S. One of these suggestions is to look at pricing for certain products domestically and internationally to see if something can be done to align them. Other initiatives are being proposed, but because this is an election year, everything is on hold.

Immunotherapies

Gene therapy and CAR T cell therapy will lead the way and push new business models, including pricing. We work with a number of clients that have drugs on the market to treat cancer. Immunotherapies are truly helping patients, but there are struggles with pricing and reimbursement. Right now, these technologies are available, but private payers tend to make them a third line of treatment—even if they're more effective—because they're more costly. Hopefully that will change.

Trade negotiations with China

A number of our clients are targeting China as a top growth market for 2020, so we're watching the tariffs and trade negotiations. Phase one of trade negotiations affected agriculture the most. Phase two may impact the pharmaceutical industry more, because a significant amount of active pharmaceutical ingredients come from China.

New molecular entities (NMEs)

A record number of NMEs were approved by the FDA in 2018, and there was a similarly high number in 2019. We're watching what happens in 2020, because NMEs are an indicator of innovation.

Health care disruption and innovation

Erik Shannon, Health care Sector Leader for Strategy and Performance, Grant Thornton

We'd like to talk about the disruptions and key innovation areas in health care today. We see healthcare as inclusive of delivery, management, and financing—of hospitals, physicians, and any way of providing health care and health plans.

Author Thales Teixeira wrote, "Disruption starts with unhappy customers, not technology." It's all about solving problems for the customer. Sometimes you don't know you have a problem, and an innovation emerges. I didn't know I needed a really thin mobile device for all of my music, for example. Other times, you just know you have a problem.

The higher the percentage of people—or customers—who say, "this is a real problem for me," the more likely it is that there will be disruption.

As of August 2019, the pharmaceutical industry scored a net -31 percent in a Gallup poll that asked participants whether their overall view was positive, somewhat positive, neutral, somewhat negative or very negative for business sectors across the U.S. Health care scored net -10 percent. The pharmaceutical and health care industries were among the three worst-scoring business segments in terms of public opinion.

Given these numbers, people want change in health care. So what's changing now that would potentially be a reason for true disruption?

Complexity

If someone buys a Starbucks coffee, that person is making the decision about where to go, what coffee to order, and how much they want to pay for it. In health care, a highly skilled physician tells you where to go have your surgery, and what medicine to take. At least three different organizations pay for these things, which muddies the waters.

Provider fragmentation

If you look at concentration levels of different industries—with the exception of health plans— health care providers are extremely fragmented. Part of that is due to the existence of nonprofit hospital systems. There is a cultural barrier against merging from a financing perspective.

Proprietary/closed systems

If we look at proprietary/closed systems, we have to ask ourselves: How transparent is the data? How free-flowing is the information around that?

Regulation

It's a highly regulated industry, and that certainly puts rules in place that create limitations. There are a number of game changers that may disrupt health care.

Patient financial responsibility

There's a significant move toward consumerism in health care. As patients pay a much higher percentage for their health care through their insurance premium, coinsurance, and rising deductibles, they are more empowered. Health care organizations are moving toward the how-and-when-we-want-it approach.

Consolidation

There's been rapid consolidation that has meant large health care systems are now considered medium-to-small.

Standards and interoperability

Regulations are a wild card. But if people are

$1.4 TRILLION
expected reach of the pharmaceutical industry by 2024

$50 BILLION
amount the government health care systems are investing to replace the health record innovations made 40 years ago

38 | Highlights@GT-IDEA

Highlights@GT-IDEA | **39**

unhappy with legislation made by our regulators, they're going to try to experiment and push more.

Nontraditional entrants into health care
Another catalyst for potential health care disruption is that some of the world's largest technology players have entered the digital health care market. Apple, Facebook, Amazon, Google, and Walgreens are among the players who are already communicating with millions of users annually and developing apps to guide care.

Health innovation funding. Where's the money in healthcare?
Private equity entered the health care space during the financial crisis because of good returns, and the fact that it doesn't matter what the economy is doing—there's always a need for health care. Investments today center around digital health and patient empowerment (helping people navigate health care). Firms are investing in smaller companies and ideas. One hot industry is autism clinics—every state has regulation saying that autism care is a required benefit. Because there is funding, there's a race to build clinics.

CEOs and COOs are coming from retail and applying ideas to the retail of health care, including how to digitally interact with customers.

Innovation in government health care

Sharif Ambrose, Principal, Public Sector for Health care, Grant Thornton

The best way to talk about the innovation that government health care has contributed to the industry in the last quarter century is to give a few examples:

- 70 years ago, the National Institutes of Health (NIH) pioneered clinical trials to test new drugs.
- In 1958, a couple of doctors from the Buffalo VA Hospital invented the first transportable pacemaker.
- In 1984, government health care invented the smoking cessation patch.
- In the 1970s, the Department of Veterans Affairs—the largest provider in the U.S. with over 1,000 points of care—collaborated on what was then the most sophisticated enterprise-wide electronic health care record, later to be known as VistA. They developed the core medical record, applications for the specialties, and then, when the technology became available, the integrated imaging.
- In 2000, the federal government recognized its purchasing power from a pharmaceutical standpoint. A million patients spent an excess of $100 billion a year on care for those in active military duty and their families. The federal government negotiated very large contracts with two of the larger pharmaceutical suppliers—McKesson and Cardinal Health—to provide pharmaceuticals to their patients, greatly decreasing the cost of medication and cost of care for those cohorts.
- In 2010, engineers and physicians at the Indianapolis Medical Center invented the first vertically standing wheelchair, which allows patients more mobility and dignity—an example of consumer-focused problem solving.
- In 2012, the Centers for Medicare and Medicaid Services (CMS) developed a pilot program called Accountable Care Organization (ACO). This is one model that helps with care costs in the U.S.—providers and hospitals base their reimbursement on health outcomes when a patient's treatment is finished, not on the services they provide. It started as a government health Medicare program, but there are some commercial health plans that are in the pilot phase of this innovative approach to efficiently managing care.
- In 2014, government health care providers began providing telehealth services to patients to address rural care and access issues in a meaningful way. It is now the foremost provider of telehealth services.

If you're wondering if there's innovation in government and government health care, we hope this convinces you that there certainly has been.

So, what's happening now and what's going to happen in the near future? Federal health care is facing some of the same trends that were discussed earlier, and leveraging technology to overcome those challenges.

Customer focus
There's a laser focus on solving problems with patients at the center—not the provider, not the pharmacist. Consultancies like Grant Thornton have developed entire practices around customer-centric approaches and methods to help solve problems.

Patient access and readiness
Government health care providers are somewhat different than commercial health care providers in that they are mandated to provide care in every corner of the U.S., no matter where, and regardless of the population. This creates tremendous challenges. Military Health and the VA have begun to rely more on private sector providers and contracting with networks to provide the same care.

About 10 years ago, this represented about 10 percent of care—now it's 35 percent and growing. That policy shift began toward the end of the Obama administration and has accelerated under this administration. One day, the majority of care for these patient cohorts will not be provided in military or VA hospitals, but in other settings.

High Reliability Organizations (HRO)
HROs are somewhat unique to federal health care. They are organizations that experience fewer than anticipated accidents or events despite operating in highly complex, high-risk environments. Health care fits that bill. When you think about these enterprise organizations, the quality is high in terms of customer service, administration, and clinical care, but the consistency of quality and effectiveness isn't always there. HROs are meant to create the consistent, high-quality organization that federal health care really embraces.

Learning health care system
The government wants to evaluate ongoing transformations and make iterative changes to improve through a learning health care system model.

What will foster new disruptions in health care?

Integrated electronic health record (EHR)
Every community and major health system is using the integrated EHR, and almost every clinical practice. Today, government health care systems are investing $50 billion to replace the health record innovations they made 40 years ago. The EHR is a great innovation from a workflow and interface standpoint for clinicians.

Sophistication of wearables
We used to think it was cool that we could check our pulse on our watch. Now the sophistication of wearables is increasing exponentially. Pacemakers can provide information about the state of your heart. Home health devices can help manage chronic conditions and transmit data to a clinician 100 miles away. Federal health care providers are embracing this as part of their telehealth strategy.

Internet of Things (IoT) and 5G
IoT and 5G are all over the news right now and will certainly have a big impact on health care. By 2022, IoT will be a $410 billion market for health care alone. Devices will communicate with each other, not just the enterprise system, to help better manage chronic conditions, diagnose ailments, and help doctors understand how treatments are working.

Focus on adoption and customer experience
As a consulting firm, and as a business and technology consultancy, we advise clients that they have to have an adoption strategy. None of the technology matters if they don't have a strategy to adopt the change. Each one of the things we've discussed is a solution that solves a problem today, but it has to be part of an integrated solution over the long haul.

The complications in health care are many. We all play a role and there are many levers to pull. The important thing is that consumers are at the center of the model. We, as individuals and organizations, must think about what our role will be in helping health care transform to reduce costs, improve outcomes, and increase patient safety and effectiveness of the treatments available.

At the end of the day, our work at Grant Thornton is all about patients, and the students we're working with through the GT-IDEA program are working on real-world problems like these for clients. We look forward to continued collaboration.

Fall 2019 Case Competition and Data Jam

2019 Fall Semester
Held at the O'Neill School for Public and Environmental Affairs and the Luddy School of Informatics, Computing, and Engineering.

THEME: ESG

During the 2019 fall semester students competed in two different competitions under the theme of ESG. With team members coming from all three schools for these events, the first event, a case competition, took place in the O'Neill School of Public and Environmental Affairs. The second event, a data jam, took place in the Luddy School of Informatics, Computing, and Engineering.

From top: **Olly Dennison**, Managing Director, Regulatory and Compliance Solutions, Judge at O'Neill Case Competition. Students enjoying peer presentations at O'Neill Case Competition. **Andrew Chupp**, Senior Lecturer, Judge at O'Neill Case Competition.

Participants in the Luddy Data Jam during the 2019 fall semester.

Students working on their projects during the Luddy Data Jam.

Blaine Nashold, Director, Enterprise Transformation, working with students during the Luddy Data Jam.

Tom Char, Senior Manager, Digital Transformation and Management, Public Sector, working with a team of students at the Luddy Data Jam.

GT-IDEA Faculty Scholars

Indiana University Faculty

Kelley School of Business
Luddy School of Informatics, Computing, and Engineering (SICE)
O'Neill School of Public and Environmental Affairs (SPEA)

Sanya Carley
Associate Professor
Chair, Policy Analysis and Public Finance
O'Neill GT-IDEA Scholar

Dr. Sanya Carley is an associate professor and chair of the policy analysis and public finance faculty at SPEA. Her research focuses on electricity and transportation policy, energy justice and a just transition, energy-based economic development, and public perceptions of energy infrastructure and technologies. She is a co-editor of the *Journal of Policy Analysis and Management*. Dr. Carley has extensive consulting experience with the World Bank, RTI International, and the EPA, among others.

David Crandall
Associate Professor of Informatics and Computing
Director of Graduate Studies for Computer Science
Luddy GT-IDEA Scholar

David Crandall is an associate professor at SICE, where he is a member of the computer science, informatics, cognitive science, and data science programs, and adjunct faculty in statistics. He is director of graduate students for the computer science PhD and MS programs and a member of the Center for Algorithms and Machine Learning, the Digital Science Center, and the Center for Complex Networks and Systems. He obtained his PhD in computer science from Cornell University in 2008, where he was a Postdoctoral Research Associate from 2008–10. He received BS and MS degrees in computer science and engineering from Pennsylvania State University in 2001. He is an associate editor of the *IEEE Transactions on Pattern Analysis and Machine Intelligence* and the *IEEE Transactions on Multimedia,* and the recipient of an NSF CAREER award, a Google Faculty Research Award, and an IU Trustees Teaching Award.

Jonathan Helm
Associate Professor
Kelley GT-IDEA Scholar and Co-Director, Life Sciences Faculty Research Fellows, Center for Business of Life Sciences

Jonathan Helm joined Indiana University in 2012. Formerly, he held operations management and supply chain roles at GE Healthcare and Mayo Clinic. He is a three-year National Science Foundation Fellow. His research aims to improve the delivery of health care at three levels: the system level, the organizational level, and the individual patient level. Specific interests focus on patient flow, readmissions, and disease monitoring and treatment. He won the 2018 Pierskalla Award for Best Healthcare Paper at INFORMS and was a finalist for the 2018 POMS Most Influential Paper award for 2015–16. He was selected to give a Showcase Presentation at the 2014, 2015, and 2018 POMS College of Healthcare Operations Management (CHOM) Conference for implementation of three different research projects in hospitals and nonprofit organizations. He founded an interdisciplinary research group encompassing business, engineering, and surgical faculty at Indiana University, University of Michigan, and University of Pittsburgh and has collaborated closely with Mayo Clinic, National University Hospital (Singapore), and the MESH Healthcare Coalition in Indianapolis.

Diane Henshel
Associate Professor
O'Neill GT-IDEA Scholar

Dr. Diane Henshel is an internationally known systems-based risk assessor working across diverse systems and disciplines. Her research addresses the multidimensional problem of integrating disparate metrics across the many dimensions of multilevel systems. Her main research foci encompasses the fields of environment, health, and cybersecurity, which have begun to overlap in ways that will increasingly impact global security as climate change causes stresses in both natural and anthropogenic (and joint) systems. She is an associate professor at SPEA specializing in risk and resilience assessment, cybersecurity risk modeling, risk communication, and toxicology. She spent a year as the executive director of the Risk Assessment Forum at the EPA. She is also the principal and owner of Henshel EnviroComm, a consulting firm specializing in supporting both government agencies and communities addressing chemical contamination.

John Hill
Clinical Associate Professor, Co-Director, Digital Logistics and Transportation Workshop
Kelley GT-IDEA Scholar

John Hill has been a faculty member with the Kelley School of Business in the Department of Operations and Decision Technologies for six years. He was previously an assistant professor of mechanical engineering at Michigan Technological University. His industry background includes positions as engineering manager for R&D at Eaton Corporation and product development engineer for General Motors. John received his bachelor's in mechanical engineering from Michigan Technological University, a master's in Engineering from Purdue University, and both a PhD in industrial engineering and MBA from the University of Iowa. He teaches courses in operations management and business analytics for the full-time and online MBA programs. He is co-director of the MBA Supply Chain Academy and has received multiple teaching awards.

Bryce Himebaugh
Clinical Assistant Professor of Engineering
Luddy GT-IDEA Scholar

Bryce Himebaugh's career has centered around embedded systems design and leadership. His work history includes positions at Intel (four-term co-op), Cummins Engine Company, Indiana University, and Analog Computing Solutions. He has held technical leadership positions at Cummins (heavy-duty controls hardware lead), Indiana University (SICE director of information technology), and Analog Computing Solutions (chief technology officer and co-founder of this startup). He began teaching for IU's Department of Computer Science as clinical assistant professor in 2013, and moved to the Department of Engineering in 2018. He has taught undergraduate and graduate level classes on topics such as computer structures, embedded systems, C programming, operating systems, computer architecture, analog circuits, and cyber-physical systems.

Antino Kim
Assistant Professor of Information Systems
Kelley GT-IDEA Scholar

Antino Kim is an assistant professor of information systems at the Kelley School of Business. Antino earned his PhD in information systems from the Foster School of Business at the University of Washington, Seattle, and a master's degree in computer science and engineering from the University of Michigan, Ann Arbor. His research interests include misinformation and social media, supply chain of information goods, digital piracy and policy implications, and IT and worker displacement. Antino's papers have appeared in the *Journal of Management Information Systems*, *Management Science*, and *MIS Quarterly*, among other outlets.

Apu Kapadia
Associate Professor of Computer Science
Luddy GT-IDEA Scholar

Dr. Apu Kapadia is an Associate Professor of Computer Science and the Associate Director of the Security Program at the Luddy School of Informatics, Computing, and Engineering. His primary research interests are computer security and privacy with a focus on usable security and HCI in the context of pervasive computing, cameras, wearables, and IoT. Dr. Kapadia has received eight NSF grants, including an NSF CAREER award in 2013, and two Google Research Awards in 2014 and 2020. He was also a recipient of the Indiana University Trustees Teaching Award in 2013 and a Distinguished Alumni Educator Award from the Department of Computer Science at the University of Illinois at Urbana-Champaign in 2015.

Antung Liu
Assistant Professor
O'Neill GT-IDEA Scholar

Antung Liu is an assistant professor at SPEA. His research interests include climate change policy and environment issues in developing countries. His recent work addresses carbon taxes and the unique properties that could make them attractive components of modern tax systems. He is also interested in pollution issues and the interactions between the environment and the economy in China, and he has studied transportation issues in Beijing extensively. His work on China's environment has been published in journals such as *The Journal of Development Economics* and the *Journal of Environmental Economics and Management*. Previously, Professor Liu was a visiting assistant professor of economics at the Cheung Kong Graduate School of Business in China and a fellow at Resources for the Future in Washington, D.C.

Alex Barsi Lopes
Clinical Professor of Information Systems
Kelley GT-IDEA Scholar

Alex Barsi Lopes is a clinical professor of information systems at the Kelley School of Business, where he teaches process modeling, systems analysis and design, data warehousing and visualization, big data, applications of artificial intelligence, and technology consulting management. He has served as director of the Technology Consulting Workshop since its creation in 2016 and has been responsible for GLOBASE and AGILE consulting projects in Guatemala, India, and Thailand. His research focuses on online information goods, collaboration technologies, face-to-face and online social networks, and IS educational initiatives, with his work appearing in journals such as *Information Systems Research*, *Journal of Management Information Systems*, and *Communications of the ACM*. Passionate about international education, Dr. Barsi Lopes has taken students to Thailand, China, India, Brazil, Guatemala, Mexico, and Canada. Before joining Kelley, he was the director of the MS-IS Program at the University of Cincinnati.

Antonette McCaster
Senior Lecturer
O'Neill GT-IDEA Scholar

Antonette McCaster is a licensed CPA in both Virginia and Indiana and holds the certified government financial manager (CGFM) designation. She is currently ABD (all but dissertation) at the Indiana University School of Education focusing in instructional systems technology and adult education. She holds her MBA from DePaul University and BS in accounting from Indiana University South Bend. She has served as an NTT faculty member at Indiana University since 2011. Prior to coming to work with SPEA, Ms. McCaster served as assistant controller for the Virginia Department of Transportation; controller for Richmond, Virginia; finance director for Bolingbrook, Illinois; CFO/treasurer for Inland Real Estate Group; and experienced auditor for Deloitte. Ms. McCaster has recently published an online text, *Elements of Accounting for Business, Not for Profit, and Governmental Organizations* and serves as the faculty advisor for the student chapter of the Association of Government Accountants at IU.

Jill Nicholson-Crotty
Associate Professor
O'Neill GT-IDEA Scholar

Jill Nicholson-Crotty is an associate professor at SPEA. She received her PhD in political science from Texas A&M University in 2005 and was previously on the faculty at the Truman School

of Public Affairs at the University of Missouri. Her research on the nonprofit sector focuses on the conditions under which nonprofit organizations choose to engage in advocacy activities. Her public sector agency research focuses on how the demographic compositions of organizations affects the implementation of public programs and how this influences outcomes for clients. Her most current research explores these questions as well as the decision-making process of bureaucrats using experimental methods.

Frank Nierzwicki
Clinical Assistant Professor
O'Neill GT-IDEA Scholar

An urban studies practitioner as well as an educator, Nierzwicki has worked in policy development and implementation at the state and local governmental levels for more than 30 years. He has served on state, regional, and local boards on intergovernmental affairs and community development. A certified planner (AICP), he has been involved with economic and community development projects at the Indiana Department of Transportation, and in coordination with the Kentucky Transportation Cabinet in Southern Indiana and the Louisville metropolitan area. Nierzwicki has also worked as a manager of a Metropolitan Planning Organization (Bloomington, Indiana) and as a director of planning services (Ellettsville, Indiana). He is currently the lead instructor in the Urban Problems and Solutions class, an undergraduate gateway class for SPEA, and has led graduate capstone classes. His students have won statewide recognition for the Best Indiana Student Planning Project by the Indiana Chapter of the American Planning Association in 2014 (Bedford/Lawrence County—Community Development and Planning).

Mark Norrell
Senior Lecturer
O'Neill GT-IDEA Scholar

Mark A. Norrell teaches in the undergraduate program in health care management and policy at SPEA. He served in senior leadership positions at hospitals and health systems prior to coming to Indiana University. From 1987 to 1993, he served as director of strategic planning for a four-hospital system in Florida, where he was responsible for legislative and regulatory affairs and competitive positioning. From 1993 to 2002, he served as vice president of a 200-bed community hospital in southeastern Idaho, where he guided strategic development, operations, and competitive positioning, leading to acquisition of a local competitor. From 2002 to 2008, he served as executive vice president and chief operating officer for a 250-bed not-for-profit community hospital in central Kansas. Norrell holds master's degrees in health administration and business administration, as well as a bachelor's degree in medical technology from the University of Florida. He currently serves as chairperson of the Monroe County (Indiana) Board of Health. He is a Fellow of the American College of Healthcare Executives and is a licensed nursing home administrator. Norrell teaches courses in hospital administration, health care reimbursement, strategic planning for health care organizations, health management ethics, and U.S. health care systems overview.

Charles Pope
Senior Lecturer
Assistant Chair, Computer Science
Luddy GT-IDEA Scholar

Charles Pope prepared profit and loss statements for the operations director, special accounts division for the largest wholesaler of wireless equipment before working at CompuCom, Dallas, TX, where he held various positions in call center management, including special projects, metrics and reporting programs for Fortune 500 companies outsourcing help desk operations. He was a major accounts manager for a highly specialized network operations center in Austin, TX before moving to Indiana in 2001 to work for a telecommunications aggregator. In late 2003, he began teaching real-world productivity applications to IU students majoring outside of computer science. He has authored materials for one textbook by Hayden-McNeil, and two textbooks from Pearson Education. He currently serves as senior lecturer and assistant chairperson of computer science.

Dan Richert
Senior Lecturer
Luddy GT-IDEA Scholar

Dan Richert is a senior lecturer for SICE in the Department of Informatics, who is currently teaching Undergrad Capstone Project/Internships, Database Design, and HCI Methods courses. Dan previously worked in the IT industry, as the chief information officer for REL-TEK Systems, which provided a custom software package for federal financial management systems. He also operated his own consulting company later in his career. He currently is focused on increasing his knowledge in pedagogy with regards to active learning, team-based learning, and classroom design. During his time at IU he has been part of the Mosaic Initiative, and received the IU Trustees Teaching Award. He participates in SICE Living Learning Center and Undergraduate Program Committee.

Justin Ross
Associate Professor
O'Neill GT-IDEA Scholar

Justin Ross is an associate professor of public finance and economics. He has been at SPEA since 2008, and holds a doctorate in economics from West Virginia University. His research expertise is in state and local public economics, and his research appears regularly in journals with policy and practitioner-relevant policy implications. In Indiana, he has provided testimony to the state legislature and consulting assistance to local governments on the implications for property tax cap impacts emanating from tax policy decisions on local income tax adoption and tax increment financing. His project, *A Fiscal History of Indiana Local Governments*, will be published this legislative session by the Indiana Fiscal Policy Institute. He lives in Bloomington, where he teaches graduate-level courses in public finance, benefit-cost analysis, and economics.

Sagar Samtani
Assistant Professor of Information Systems
Kelley GT-IDEA Scholar

Sagar Samtani is an assistant professor of information systems at the Kelley School of Business. Samtani's research focuses on

Artificial Intelligence for Cybersecurity applications, including smart vulnerability assessment, Dark Web analytics, scientific cyberinfrastructure security, and cyber threat intelligence (CTI). His research initiatives have garnered nearly $1.5M in prestigious funding, including the National Science Foundation (NSF) CISE Research Initiation Initiative (CRII), NSF Cybersecurity Innovation for Cyber Infrastructure (CICI), and others. He has published over two dozen peer-reviewed articles in venues such as *MIS Quarterly, Journal of Management Information Systems, IEEE Intelligent Systems, Computers & Security*, and others. He serves as a Program Committee member or Program Chair of leading AI for cybersecurity and CTI conferences and workshops, including IEEE Security and Privacy Deep Learning Workshop, USENIX ScAINet, IEEE Intelligence and Security Informatics, and others. Samtani has won several awards for his research and teaching efforts, including the ACM SIGMIS Doctoral Dissertation Award and Nunamaker-Chen Dissertation Award (runner-up). His research has been cited in media outlets such as the Miami Herald, Science Magazine, AAAS, and Fox.

Martin Swany
Chair, Intelligent Systems Engineering
Professor
Luddy GT-IDEA Scholar

Martin Swany is chair and professor in the Department of Intelligent Systems Engineering at SICE. His research interests include embedded systems and reconfigurable computing as well as high-performance parallel and distributed computing and networking. Swany is a member of the IEEE and ACM.

Haixu Tang
Professor of Informatics and Computing
Adjunct Professor of Biology

Director, Data Science Academic Programs
Luddy GT-IDEA Scholar

Dr. Haixu Tang is a professor and a Grant Thornton Scholar in the Department of Computer Science and the director of Data Science Academic Programs at SICE. He received his PhD from Shanghai Institute of Biochemistry, Chinese Academy of Sciences, in 1998, and conducted postdoctoral research at the University of Southern California and University of California, San Diego, before joining Indiana University in 2004, where he was promoted to professor in 2015. He was a recipient of the NSF CAREER Award in 2007 and the Outstanding Junior Faculty Award from Indiana University in 2009. His research interests include bioinformatics, data mining, and data privacy.

Donald S. Williamson
Assistant Professor, Computer Science
Luddy GT-IDEA Scholar

Donald S. Williamson is an assistant professor in the Department of Computer Science. He develops algorithms that analyze and extract meaningful information from auditory scenes using machine learning, signal processing, and statistics-based techniques. At IU, he has taught graduate and undergraduate courses on machine learning. He completed his PhD in the

computer science and engineering department at The Ohio State University. Prior to that, he was a member of the engineering staff at Lockheed Martin.

Owen Wu
Associate Professor of Operations Management
Kelley GT-IDEA Scholar

Owen Wu is an associate professor of operations management at the Kelley School of Business. His research focuses on the operations of conventional and renewable energy supply chains and their interfaces with energy markets. He has published articles on a variety of topics related to sustainable energy systems, such as integrating renewable energy resources, upgrading conventional resources, building energy storage facilities, investing in energy efficiency, and managing energy demand. He collaborates with industry practitioners and has advised sustainability projects at Cummins, BorgWarner, Boeing, DTE Energy, 3M, Graham Partners, Delphi, Dow, and UPS. Professor Wu received the Paul Kleindorfer Award in Sustainability in 2017 from the Production and Operations Management Society. His teaching excellence has been recognized multiple times.

Lu (Lucy) Yan
Associate Professor of Information Systems
Kelley GT-IDEA Scholar

Lu (Lucy) Yan is an assistant professor of information systems at the Kelley School of Business. She holds a PhD in business administration from the Foster School of Business, University of Washington. Her research interests include social media, social networking, and patient-centric health care models. Her recent studies investigate the impact brought by social media to health care, especially for patients with social diseases. She has published in *Information Systems Research*, *Production and Operations Management*, *Journal of Operations Management*, and *Journal of Management Information Systems*, among others. She is a member of the editorial review board of *IEEE Transactions on Engineering Management*.

Jingjing Zhang
Associate Professor of Information Systems
Kelley GT-IDEA Scholar

Jingjing Zhang is an assistant professor of information systems at the Kelley School of Business. She received her PhD in business administration from the Carlson School of Management, University of Minnesota, in 2012. Jingjing's research interests include personalization techniques, recommender systems, data mining, and human-computer interactions. Her research has been published in multiple leading academic journals, including *Information Systems Research*, *IEEE Transaction on Knowledge and Data Engineering*, *INFORMS Journal on Computing*, and *ACM Transactions on Information Systems*. Jingjing has received multiple awards, including the Inaugural INFORMS ISS Nunamaker-Chen Dissertation Award, 3M Pre-Tenure Faculty Award, and the IU Trustees Teaching Award. She was recently named to the "Top 50 Undergraduate Business Professors" by *Poets & Quants*.

What is GT-IDEA?

The Grant Thornton Institute for Data Exploration for Risk Assessment and Management (GT-IDEA) is an interdisciplinary institute that spans Indiana University's Kelley School of Business, O'Neill School of Public and Environmental Affairs, and the Luddy School of Informatics, Computing, and Engineering. With a focus on assessing risk both in terms of service delivery exposure and/or client risk, the mission of GT-IDEA is to leverage disruptive technology and unlock innovation in the market by integrating leading-edge technology with business and policy.

GT-IDEA

GT-IDEA Co-Directors

Eric Kinser
Eric Kinser is a senior lecturer in the Department of Operations and Decision Technologies at the Indiana University Kelley School of Business. At Kelley, Eric has won multiple teaching awards and currently teaches both graduate and undergraduate courses. His course topics include spreadsheet modeling, visualizing data with Excel and Microsoft's Power BI suite, cloud-based analytics, and Visual Basic for Applications. In addition to serving as co-director for the Grant Thornton Institute for Data Exploration for Risk Assessment and Management (GT-IDEA), he is a faculty sponsor for the Business Analytics Club and is a co-author on the *Your Office* textbook series. Prior to joining Kelley, he worked in the medical field and in higher education as a technology and decision support specialist.

Andrew Chupp
B. Andrew Chupp is a senior lecturer in the O'Neill School of Public and Environmental Affairs and is the faculty co-director of GT-IDEA for SPEA. He completed his PhD in economics from the Andrew Young School of Policy Studies at Georgia State University in 2009. Prior to joining Indiana University in 2018, Andrew held positions at the Georgia Institute of Technology and Illinois State University. He has conducted research on environmental policy and politics, with articles appearing in the *Journal of Public Economics*, *Public Choice*, and the *Journal of Environmental Economics & Management*, among others.

Travis Brown
As the senior executive assistant dean, Dr. Brown built and serves as the academic director of the Innovation and Entrepreneurship Program and Cross-Curricular Education, the executive director of the Shoemaker Innovation Center, and the point of contact for strategic discussions related to the commercialization of faculty research. Dr. Brown also holds a special academic appointment as an HCI/d Core faculty member, which entails teaching design strategy and strategic design and serving as a faculty advisor for the HCI/d master's degree students, as well as the co-director of the Grant Thornton Institute for Data Exploration for Risk Assessment and Management. In addition, he is the faculty advisor for the Ideation and Creation Entrepreneurs (ICE), the Shoemaker Scholars, the Collegiate Entrepreneurs' Organization (CEO), and the Product Management Club. Prior to returning to Indiana University to pursue his doctoral degree, Dr. Brown spent his career within the intersection of business and technology, focusing on performance management, entrepreneurship, corporate innovation, business analytics, software development, and interaction design in corporate and small business settings.