WEARABLE TECHNOLOGY
A Story About Wearables, Athletics, and Trust

DATA, DISASTERS, AND DECISION-MAKING
Using data for community resilience

LEADING BY EXAMPLE
Mississippi awarded WDQI “supergrant”
Welcome to the Technology Arms Race

The Human Factor and Context in Data Science

Cutting Diamonds: Student Workers Shine at NSPARC

The Need for Integrated Data in Disasters

Department of Labor Features Mississippi as an Example for Others

Data Science + Personal Touch = Employment

Using Data to Communicate Organizational Improvements

NEXUS Q&A with Craig Shorter

Editor-in-Chief:
Laura McPhail

Contributors:
Tori Boatner, Katelynn Bowman, Gregory Ellzey, Laura McPhail, Mariah Stevens

Guest Contributors:
Jonathan Barlow, Reuben Burch, John Forde

Designer:
Femi Sobayo

This magazine was prepared by Mississippi State University’s National Strategic Planning and Analysis Research Center (NSPARC). NSPARC is expanding the boundaries of data science to create knowledge and innovations that drive human progress. Our expertise includes data analytics, predictive analytics, machine learning, artificial intelligence, system of systems, data governance, cybersecurity, cloud technology, and high-performance computing. Known primarily for our work with smart government and more than 50 data innovations, NSPARC has achieved national prominence in the data science field.

For more information, visit nsparc.msstate.edu
Welcome to the TECHNOLOGY ARMS RACE:
A Story About Wearables, Athletics, and Trust
BY REUBEN BURCH, P.H.D. • PHOTOS BY FEMI SOBAYO / NSPARC

We live in a world today where decades of science fiction ideas visualized through movies and television have come to life. As smartphones rampantly spread in global popularity, sensor technologies get smaller and cheaper. As sensors continue this cheaper-smaller-faster progression, wearables become a natural technology byproduct.

Through wearables, we can do almost anything; the biggest limitation is our own imaginations. At the 2014 Consumer Electronics Show in Las Vegas, wearable inventions were on display at levels never before seen, and now the wearable technology industry is expected to be worth between $34 and $40 billion by 2020, including almost $3 billion just from core athletic wearable companies alone.

Why did I grow such a fascination with wearables during my time in industry? A researcher named Kenneth Boff from the Air Force Research Laboratory studying human effectiveness predicted this wearable technology evolution back in 2006. Boff recognized a shift toward “combining what people and machines each do best...into a single entity.” Before the big evolution of mobile technology in 2008 with the Apple iPhone, and long before sensors would ever be small, robust, and economical enough to integrate into bands, straps, shoes, clothes, and glasses, Boff envisioned a time in the near future when the lines would be blurred between where a human ends and where technology begins.

Now in 2019, wearables are a daily part of many people’s lives. With such success, that should be the end of the story, right? Wearables are a multibillion-dollar business. A large percentage of the modern world population is regularly tracking something about themselves or someone else. A culture, and even a specific vocabulary, have been created out of this technology shift (e.g., “How many steps did you get in today?”).

What else is left to do with wearables, you might ask? Aren’t they a proven commodity at this point?

These are valid questions and ones I’m often asked when I tell others about my research work with wearables and collegiate sports teams. But just because the wearable market is booming and this technology has seen complete dispersion into just about every athletic pastime we can think of, that doesn’t mean we are wrapping up this story. In fact, we are still at the beginning.

As those who actively follow sports would suspect, most NCAA Division I sports programs in the Power Five conferences (Atlantic Coast Conference [ACC], Big Ten [B1G], Big 12, Pacific 12 [Pac-12], and Southeastern Conference [SEC]) utilize wearable solutions to collect performance data on their student athletes. Likewise, almost all major professional sports teams—even professional athletes who do not play team sports—utilize wearable solutions to gain any insight that might lead them to a competitive training advantage.

Any team that can afford these highly-priced wearable solutions ($20K to $100K+ per year, per wearable solution, is common) are agreeing to multi-year purchase arrangements with these technology companies. Strength and conditioning coaches, athletic trainers, and even head coaches in some cases are often the people providing the purchase justifications to their financial officers. The motivation for these teams to use wearables is often wrapped in good intentions, such as athlete health and safety first, and competition performance second.

With nearly every major collegiate brand in the world of sports utilizing wearables, one could easily assume that these athletic solutions are meeting the needs of the coaches and trainers…and one would be wrong with this assumption for a single, shared reason throughout the athletic community: trust or, more accurately, a lack of trust.

A common sensor-based component in many wearable technologies is the Inertial Measurement Unit (IMU). Accelerometers, for example, are the most utilized and well-
known IMUs. Accelerometers are used to collect information about movement direction and the wearer’s intensity of movement. Technology companies can take this movement data, and through mathematical equations based on human movement principles, determine what your body is doing. Because the sensor information is limited, the human movement equations may, at times, be little more than “educated guesses” based on what the sensor “thinks” you are doing.

Herein lies one of the biggest issues: all algorithms used by wearable sensors for calculating things like movement, heart rate, distance traveled, intensity, calories burned, etc., are proprietary to the company that made the device. Strength coaches and athletic trainers may want to know exactly where a measurement value came from for a team or a specific player, but that manufacturer generally isn’t willing to share the specifics of the answer for fear of the competition learning their own “secret sauce” to biomechanics and physiology.

This concern is completely understandable, but often results in the wearable sales representative telling the strength coach, “I can’t tell you how we got that number because it’s proprietary. But trust us that it’s right because an engineer back in the office came up with it and he’s smart.”

So here we are. A lack of trust has been shown on the part of the wearable manufacturer to divulge how the technology works, and the athletics staff begins to question what kind of multi-year commitment they just spent a lot of money to get into.

I want to stress that not all companies are this closed off but enough are such that there are a number of well-known athletic programs moving away from wearables. In terms of trust, some companies also do a better job at correctly identifying athlete movement and physiology based on the sensor data captured during practices and games. Other companies, however, leave a lot to be desired.

The following three examples are but a few of the stories taken from my experience and those of the many coaches and trainers I work with:

- A football player is recorded by a wearable to have traveled 10 miles over the course of a practice, when he really only traveled about 1.5 miles based on assigned daily drills.
- Every time a basketball player dribbles the ball, the athlete’s step count increases even through he never picked up his feet.
- A volleyball player is in the middle of jumping, and the strength coach looks down to see that her jump counter isn’t increasing.

An athletic trainer observes these discrepancies during a practice and says to the other coaches, “I know that my football player didn’t travel 10 miles so this was clearly a mistake. But does this mean all of my player data is wrong?”

A basketball head coach may want to adjust practice length based on total movement traveled during the week, but the strength coach is worried the numbers are inflated by dribbling. “Does every dribble count as a step or do only some of them count—and how would I know based on this how to adjust practice length?” The volleyball strength coach completely discards her wearable technology because she doesn’t believe any of the numbers anymore and says to the head coach, “If the wearable numbers were at least consistently inaccurate, then they would still be actionable because I’d know how to adjust the totals. But because this wearable is inaccurately consistent, this data is a waste of our time.”

Despite being marketed by companies who may be unwilling to discuss how the technology works, and despite being either inaccurate or inconsistent enough to fully trust, most athletic organizations will still confess to purchasing wearables. In fact, many collegiate athletic technology budgets continue to increase year by year to include even more wearables for more athletes involved in more sports.

Previously, only the sports with the bigger budgets and higher revenue streams would receive the technology, but now all sports, regardless of economic impact, are likely to experience some technology solution. This is partly due to increased collaboration across the sports teams via the strength and conditioning coaches and athletic trainers being more collectively strategic in their budgeting. But as far as why these athletic organizations continue to purchase technology for which they are skeptical, this is a multi-faceted answer that ultimately leads to the last component of athletic wearable trust.

First, athletic organizations understand the golden rule of data: having some data is better than having no data, especially when all of your competition is collecting data. Remember that the goal for everyone in athletics is to keep the athlete healthy and safe. More data about the athletes allows the trainers to baseline human performance while mitigating injuries when possible. If you can afford a new technology, why wouldn’t you try it?

Secondly, organizations may also want to collect data so they can demonstrate to recruits how their sports teams are more advanced than the competition and can provide more customized workout regimens to better prepare recruits for a future in the professional leagues. Athletic facilities and equipment technology now play a significant part in student athlete recruiting. If a prospect sees that you have a more
well-known (read: more expensive) wearable than your competitor, you could sway their commitment over to you.

If your competition has the same wearable but they also have the new best feature, the recruit may be convinced that the other school is willing to spend more than your school on the recruit’s safety and future. That other school may have more wearables with more features and more data but you may have the ultimate secret weapon, the data scientist. This scientist works with the coaching staff on a regular basis and could win over the recruit’s parents, who of course have a major influence on where their child attends college.

This then leads to the third point and the final tie back into trust: many schools recognize the need to bring in an additional resource who is dedicated to doing something with the mountains of data generated by the athletes.

Data scientists understand how to massage and analyze data in ways to find trends and interesting information that the wearable was not designed to display and the strength coach didn’t have time to interpret. These scientists know how to do mathematical modeling, look for trends, create easily readable graphs, and discover statistically significant findings.

Unfortunately, what many of these data scientists don’t understand is the context surrounding how the data was collected.

Many teams have tried to incorporate a data scientist into the coaching staff only to find that the scientist kept going to the head coach directly with “interesting” findings or that the head coach would ask the scientist for a data report. In both cases, the strength and athletic staff would be left out of the discussion. The head coach may not always understand what graphed, raw data is telling them, and due to terminology, the data scientist may not understand what the head coach is really asking for and why they need it.

The strength and conditioning coaches and athletic trainers provide context based on their hands-on experience with both the sport and the athletes. For example, a football lineman spending a lot of time in a higher cardio zone during practice might be normal whereas an elite-level receiver may rarely reach the highest cardio zone. A data scientist looking only at the data might tell the head coach that the receivers are not working as hard as the linemen in practice. Consequently, the head coach adjusts practice to push the receivers harder. Then during the game, the receivers are too exhausted to gain a step on the secondary and the quarterback throws multiple interceptions. The head coach could then assume the receivers are lazy or don’t care and continues to work them even harder in practice because the “data recommended it.” All the while, the strength coach has been left out of the discussion but could have easily added the context that people with extremely different body types should perform differently and that people with a higher mass may have to work harder.

Essentially, data without context is almost as bad as inaccurate data.

The need to win on the field and through recruiting, while keeping athletes healthy over the course of long and multiple seasons, has led to the wearable technology arms race. For many athletic departments at the collegiate and professional levels, trust issues reside with the technology manufacturer, with the technology itself, and with the specialists brought in to analyze the athlete performance data. Yet the wearable solutions continue to grow in popularity, price, and influence.

Personally, I applaud the integration of technology into something I love so much and think that athletics should continue to use wearables. But I also think that the wearable companies need to see and utilize the strength and conditioning coaches and athletic trainers for what they are: researchers.

The strength coach back in the day took more of a “Neanderthal” approach and had a “more weight equals good” mentality. The modern strength coach has multiple degrees in kinesiology or a related field, understands in extreme details how all biomechanical and physiological components of the human body work, and can create training regimens that meet the specific needs of the individual athletes. The wearable companies need to do a better job of respecting the knowledge that the modern coach and trainer have of the workings of the human body. The data scientists need to view the expertise of the strength coach as complimentary and equal to their own capabilities.

Lastly, the wearables themselves should be designed for the needs of the strength coach. The strength coaches and trainers can tell you exactly what they need in a wearable technology and the companies that finally capitalize on the amazing insights that these experts have will finally build the product that athletic organizations can truly trust.
The Human Factor and Context in Data Science

BY JONATHAN BARLOW, P.D.

Reuben Burch’s research in the area of sports wearables illustrates the importance of the “human factor” when working with data in a specialized subject-matter domain (see Welcome to the Technology Arms Race on page 2). Data-driven evidence is not a shortcut to expertise; it is another tool best applied in the hands of an expert. The meaning of data in any field arises in the context of application by an expert. Let’s highlight two of the lessons learned for data science as an emerging field of inquiry.

First, data scientists must rely on expert practitioners in a given field to avoid mindless empiricism. Burch provides the example of the strength-training coach, an expert well versed in exercise science and human physiology. Over time, these coaches gain intuition and expertise. In building a better athlete, the coach accounts for evidence such as the player’s history, recovery from injury, trajectories of performance relating to longer-term career goals, and the player’s role on the team.

The data from a wearable technology cannot be privileged above other inputs for the coach. What expertise means for the strength coach is learning to weigh evidence from logs, scales, calipers, timers, direct observation, and various physiological assessments; information from the interpretation of data from a wearable is yet one new factor in a larger context.

Second, data scientists must pay proper attention to the legitimacy of conclusions drawn from data. Legitimacy has both a formal and a material sense.

The formal sense of legitimacy relates closely to the first lesson. When subject-matter experts concur in the application of data science, and when these applications come in the context of a well-ordered governance structure, the conclusions have a legitimate organizational meaning. Burch describes the erosion of formal legitimacy on a team when tentative conclusions based solely on data analysis are stove-piped past subject-matter experts directly to the head coach.

Proper data governance ensures that stakeholders share a unified perspective on the social meaning and value of data. This moves the advice drawn from data science out of the realm of parochial opinion and into a “team” context, whether that team is a single sports organization, an entire league, a State Longitudinal Data System, or even the federal government.

The material sense of legitimacy relates to the reliability of particular conclusions drawn from the application of data science. Burch describes step counters that erroneously report additional footsteps simply based on stationary player movement such as dribbling a basketball. Because wearables are relatively new and their innerworkings are mysterious, these anomalies raise questions about the value of wearable data for decision-making. If a strength coach were to take three weight measurements of a player and receive three different weights, the scale would be replaced—but the strength coach would not completely discount the value of scales in general.

Wearables are not based on intuitive concepts like weight. Even something as apparently simple as step count data from a sensor passes the raw output of a rudimentary electronic sensor through a chain of interpretation that culminates with the display of a number of steps. The sensors themselves do not record “steps”—they simply react to jostling. Mathematical methods are then used to interpret patterns of jostling as steps.

Data science is an emerging field concerned primarily with advancing our understanding of the application of methods for working with data. Burch is on the front lines of basic science, finding ways to validate the sensors themselves and the mathematics applied to them by comparing sensor results to results from gold-standard laboratory observations. In this way, data science can help to improve results from newer sensors and perhaps save wearables from general suspicion. As with the example of a broken scale, a strength coach may one day doubt a particular wearable, but not wearables in general.

Beyond these two lessons, the example of wearables illustrates the overall importance of data science as a field.

Just as strength coaches gain subject-matter expertise in the world of sports, data scientists gain expertise in the application of statistics, machine learning, and other numerical methods.

Through experience, they learn to pay attention to the origin of data, the way that real-world objects and processes are represented by data, and the appropriateness of applying different methods to different kinds of data. If all fields will be impacted in the coming decade by machine learning, connected devices, and other artifacts of the cybernetic city, we must have a branch of science dedicated to using data well.
It has been said that interns are like uncut diamonds—some have flaws, and some require a bit of work to shape into something valuable, but when it is finally cut and refined, the diamond really sparkles and can become priceless. NSPARC has become known as a place where, through hands-on experience and mentorship, these “diamonds in the rough” learn the skills and workplace etiquette that make them shine brilliantly for potential post-graduation employers.

NSPARC’s student worker program employs more than 20 undergraduate and graduate students. One of NSPARC’s foundational principles is to provide experiential learning opportunities to students from all academic backgrounds so they may learn about the value of data in their fields of study. Though their reasons for coming to NSPARC are varied, more often than not, student workers at NSPARC go on to be hired by successful companies or are accepted into prestigious graduate programs.

A balancing act

One of the most recent and extraordinary examples of an NSPARC student worker finding employment is Katelynn Bowman, a communication major with a concentration in public relations who is graduating in May 2019.

Bowman, an intern at NSPARC’s communication department, decided to get an early start in searching for a job to transition to after graduation, and her work experience at the center caught the attention of Andrea Mayfield, executive director of the Mississippi Community College Board (MCCB). She was offered a position with MCCB to start prior to graduation as an administrative assistant for the $10.62 million PDG B-5 early childhood development grant recently awarded to the state. Although her new work diverges slightly, Bowman acknowledges the experience she gained through her PR work as a key factor in the job offer.

“I have gained a lot of experience not only in PR, but in writing, publishing, interviewing, and working with a diverse group of people. I am so grateful for NSPARC and all the tools and guidance they have given me to help start my career.” – Katelynn Bowman

In her new position, she helps facilitate communication between MCCB, NSPARC’s early childhood development team, and several other partner organizations. She balances her final semester of classwork and this new job assisting in important work for the public sector.

“[NSPARC founder] Dr. Parisi always says ‘data is in everything.’ I think no matter what I’m doing, data will always be a part of it,” Bowman said.

Time for research and study

While Bowman’s pre-graduation employment is exceptional, it is not the norm. Most students prefer to concentrate on their most difficult studies when they are upperclassmen, and NSPARC helps facilitate the goals of students from various academic programs by offering ample time for study and research, while also demonstrating how data touches daily lives in surprising ways.

Mmesoma Okafor’s professionalism and awareness of the importance of data analysis made her a welcome addition to the NSPARC team, where she works as a receptionist in NSPARC’s business department. Originally from Lagos, Nigeria, Okafor came to MSU to study biochemistry. Prior to coming to NSPARC, she worked closely with the director of International Research Development at MSU’s International Institute. She was responsible for gathering grant and funding data from organizations such as the National Institute of Health (NIH) and National Science Foundation (NSF). This data was made available to research faculty at Mississippi State for proposal development. She was recommended to NSPARC when her position at the International Institute was downsized.

“I’m studying biochemistry with a pre-med concentration. My research focuses on mosquitoes and mosquito-borne diseases. I have a personal connection to this work because this disease plagues so many developing countries, including my country, Nigeria.” Okafor said.

While her work at NSPARC is not directly related to her chosen academic track, Okafor’s range of skills and knowledge have grown while working there. She asserts the value lies in the opportunity to study and conduct research while working for a center that supports academic research.
Ramon Richardson Jr., a junior in environmental geoscience, agrees and adds that the opportunity to learn new skills and put them into practice is making him a more well-rounded candidate for when the time comes to start job searching.

"Geographic Information Systems (GIS) uses a lot of computers to virtually show what faults are doing or we use it to do land nav and things like that," Richardson explains. "So learning how to work with Python and Linux is actually helping me out with my undergraduate studies since I'll get more hands-on experience with the tech side of the geology field."

Richardson got his position as a student worker with NSPARC's ITS department after meeting NSPARC employees at an MSU career fair. He expresses a reverence for the experience he has gained from ITS work.

"They're showing [me] how to use the command prompt. That's allowing me to learn how to do more things than the average person knows how to do in the geology field. So it gives me a step up when applying for jobs. They're going to see that I have computer skills that most other geology majors don't already have."

Embracing diversity and inclusion

Of course, NSPARC also employs graduate students, who come to the research center from varying academic programs and backgrounds. A good example of this diversity can be found in Aynaz Lotfata, who has developed a knowledge that genuinely transcends boundaries.

Originally from Iran, Lotfata has bachelor's and master's degrees in architectural engineering from the Islamic Azad University. After finishing her master's degree, she completed a doctoral program for urban and regional planning at Middle East Technical University in Istanbul, Turkey.

In 2016, Lotfata was admitted to MSU's geoscience department, studying geoscience and GIS. Shrinidhi Ambinakudige, professor of geoscience and an NSPARC faculty fellow, helped her find employment as a doctoral student with NSPARC. She says her affinity for NSPARC spawns from the center’s “think tank” environment.

"Working with different disciplines here is good… every field adds something better," Lotfata said.

The difficult transition of going from somewhat culturally isolated cultures in southwest Asia to a melting pot of diversity and inclusion at Mississippi State was made easier at NSPARC.

"Here, [in the U.S.] they respect ideas. They accept and invite people who have ideas about technology and science.” —Aynaz Lotfata

Cultural diversity and inclusion are a major part of what made NSPARC a desirable place to work for Tyler Daniel, who is taking graduate courses as he finishes his undergraduate studies in political science with a minor in international studies. His embrace of different cultures through the observation of the political spectrum represents one of NSPARC's needs as a global research center that partners with several government agencies.

"I've always been interested in different nations and different cultures, and more specifically, how to get those people from different backgrounds to interact in a proactive way with one another," Daniel said.

Collaboration is among many of Daniel's specialties, and his resume reflects that. Among many other leadership positions, he is the president of MSU's Hillel, the Jewish Student Association, the Head Council President for the Mississippi Model Security Council, co-secretary general for the Southern Regional Model United Nations, member president for the International Student Advisory Board, mentor for Linking Internationals in the Community, and Parliamentarian for the United Nations Association.

"I enjoy working with the people at NSPARC, who come from a wide array of cultural backgrounds," he said. "Everything in terms of race and religions, to nationality and age—virtually every sense of diversity can be found at NSPARC." —Tyler Daniel

Daniel proofreads, then applies his knowledge of the political field to make information more digestible for state administrators and legislators.

"I come from the same type of background that a lot of these legislators come from," he said. "So when you have someone like our research project..."
managers who are experts in their fields, they may sometimes not explain something thoroughly enough or may over explain something. Part of what I do in proofreading is tell them ‘they won’t know what this means’ or ‘explain this further.’”

Working for the greater good

Through their work experience, a few fortunate students gain a competitive edge and earn full-time positions immediately after graduation. Starkville native Nathan Ansel is an iOS app developer, and it would be an understatement to say that he belongs at NSPARC. As an integral part of the center’s mobile development and programming team, Ansel is a Senior Programmer Analyst who started out as a student worker. He later transitioned to full-time employment after graduating from MSU in 2016 and applying for an open position.

“I was interested in making iOS applications for several years before actually going to college, but I never really knew how to get into it,” Ansel said. “I ended up majoring in computer science. On my own time, I started learning how to make iOS applications.”

Like Richardson, Ansel first learned about NSPARC at an MSU career fair. Seizing the opportunity, he met NSPARC’s director for design and development, and soon started down a path that would eventually lead to full-time employment.

Along with an interest in iOS app development, Ansel’s interest in work that supports public programs and community development in Mississippi made him an even better match for the center.

“arinted to work on projects that had more of a social impact, something that has a more direct impact on people’s lives,” he said. “NSPARC just seemed like the place for me.”

A Place to Shine

NSPARC has found itself in the diamond-cutting business. Though they come from various backgrounds and interests, NSPARC has excellent student workers who gain new knowledge and skills during their time there that propels them toward successful post-graduation careers. By providing hands-on experience and new learning opportunities, NSPARC shines with the help of its students.

Join the growing list of employers developing their talent pools through partnership with our Experiential Learning Programs.

PROGRAM OPTIONS

Co-op Program

Students work full time for a company by alternating work and school semesters. Other rotations are acceptable as long as the student completes three work semesters. Hiring two co-ops to alternate terms will fill one position for two years.

Internships

Students take on an 8-20 week practical experience directed towards their course of study or career interest. Internships may be paid or unpaid according to U.S. Department of Labor guidelines.

What are the responsibilities of employers?

• Provide planned and progressive work experience related to major
• Offer regular supervision and feedback during the work term
• Complete an online evaluation at the end of each work term

What are the benefits to employers?

• Gain fresh insight from the classroom
• Fulfill short-term human resource needs
• Build a talent pipeline for long-term hiring needs

How do I register?

www.coop.msstate.edu/employers/

Contact us today!

MSU Career Center
Cooperative Education & Internship Program
333 McCain Engineering, Mississippi State, MS 39762
www.coop.msstate.edu • 662-325-3823
Residents in Butte County, California, had no idea as they started their early morning activities on Thursday, Nov. 8, 2018, that the deadliest and most destructive wildfire in California history was about to lay waste to their communities. A perfect storm of weather and geographic conditions made the area a tinderbox for the fire dubbed “Camp Fire” (named after the road where the fire started). By the time the fire was extinguished on November 25, it had scorched 153,336 acres, destroyed 18,804 structures, displaced nearly 52,000 residents, killed untold numbers of wildlife, and killed 85 people.

And yet, scientists in the Bagley College of Engineering at Mississippi State University believe that part of the loss caused by Camp Fire could have been mitigated through the use of an integrated data system. This was the subject of a letter by NSPARC faculty fellow Farshid Vahedifard, Alireza Ermagun, Kimia Morezaei, and Amir AghaKouchak published in Science magazine on January 10. The team has been researching infrastructure resiliency data and quantifying the impact of what they call “extreme events.”

According to Vahedifard, an associate professor in civil and environmental engineering and a Civil and Environmental Engineering (CEE) Advisory Board Endowed Professor, research on exploiting the power of big data toward enhancing the community resilience against extreme events can assist decisionmakers and stakeholders in four critical areas: (1) how to anticipate the event, (2) how to prepare for the event, (3) how to respond to the event, and (4) how to recover from the event. The importance of this research is underscored by the fact that it is part of “Harnessing the Data Revolution,” which is recognized by the National Science Foundation as one of 10 Big Ideas for future investments.

Vahedifard’s team says that an integrated framework for identifying, harnessing, synthesizing, and communicating pertinent data can help decision-making in multiple sectors before, during, and after an extreme event. From healthcare to transportation, data communicated in a timely and consistent manner can be utilized to mitigate the impacts of an impending disaster. They use Camp Fire as just one example.

“In several cases, data was not communicated in a timely
manner, if at all,” Vahedifard said. Reporting by James Rainey of NBC News supports this as many survivors he interviewed questioned why warnings and evacuation notices were belatedly communicated. Some residents said they never received a notice—delivered via text, phone and email—about the fire, even as it was approaching their area. Destroyed cell phone towers, limited access into and out of the mountainous region, and lack of navigation all contributed to the loss incurred by Camp Fire.

“It is possible the fire won’t be the only factor in the devastation of that area,” said Ermagun, an assistant professor of transportation systems engineering. “Wildfires are getting larger in terms of activity, size, and intensity. They usually happen in barren areas. After the fire, without grass and trees, we get increased probability of mudslides and landslides. They cause roads to close, cutting off access to people in need. Each event cascades in a ‘downstream’ effect. We want to lower the consequences of such events.”

The research team is looking at the ability to create an integrated data framework for the Southeast U.S., which is no stranger to extreme weather and other events. Hurricane Katrina is perhaps the most memorable example of the need for coordinated, timely preparation, and evacuation across multiple states, which resulted in a mix of successes and devastating failures.

“The fire would have been an optimal weapon against Katrina. Information moved to the right people at the right place at the right time. Information moved within agencies and across departments. And information moved across jurisdictions of government as well. Seamlessly. Securely. Efficiently,” Chairman Tom Davis said in his opening statement at the 2005 hearing by the State of Alabama to investigate the preparation for and response to Hurricane Katrina. “Unfortunately, no government does these things well, especially big governments.

“We spend $150 billion a year on information technology. You’d think we could share information by now.”

With aging infrastructure and the current and future effects of climate change exacerbating precarious conditions, Vahedifard stresses that each sector should be resilient on its own and all involved sectors should communicate and work together. “It sounds easy, but it’s not,” he said.

“In several cases, education and information can help convince decision makers of the value of a resiliency data center. If we can bridge the gap between agencies and between key players, then we can begin to translate their data into something the public can use.”—Farshid Vahedifard

This means creating a multi-level system by engaging stakeholders from the local level all the way to the federal level. The team recommends a bottom-up approach and they say that community engagement is the key to success. The need for data sharing is obvious for urban areas, but according to Ermagun, states with more open areas have a long way to go.

“Mississippi needs a lot of work,” Ermagun said, referring to its physical infrastructure.

“Rural areas are more likely to have a lack of access to cell phone networks, internet connection, and even roads for evacuation. We are working on a proposal to study the needs of rural and disadvantaged communities for an integrated data system.”

In a region where climate change is a hotly contested issue, this can be a challenge.

“Don’t underestimate the value of education,” Vahedifard said. “It doesn’t matter if you believe in climate change or not. I’m not here to be a champion for climate change. What I am saying is let’s look at the numbers. If the numbers show there is an impact, we should adapt.”
I t sometimes seems like Mississippians have waited a long time to see their state topping “best of” lists, but now that wait is over. Move over, music, hospitality, and food—Mississippi is becoming known for being the “best of” in a new category. According to the U.S. Department of Labor (DOL), Mississippi’s data game is on point. In fact, the DOL is using Mississippi as an example of how data can be used efficiently, effectively, and with cross-agency cooperation for positive impacts on its citizens.

In 2010, the U.S. Department of Labor (DOL) launched round one of the Workforce Data Quality Initiative (WDQI), a portion of funds made available from the DOL appropriation for Training and Employment Services, to fund the development of state workforce longitudinal administrative databases. These state longitudinal databases would, at a minimum, include information on programs that provide training and employment services and would be linked longitudinally i.e., over a long period of time, at the individual level. Collecting these and other data sources longitudinally provide a comprehensive picture of workers’ earnings throughout their careers. Through analysis, this data demonstrates the relationship between education and training programs, as well as other employment services.

While agencies and lawmakers were excited for the 2016 award for round four, they were blown away in 2018 when Mississippi was one of only two states to be awarded $2.7 million for WDQI with what is being referred to as a “super grant.” Representatives from DOL visited NSPARC in September 2018 to create a video using Mississippi as an example of how a state’s WDQI should work.

“We knew and had confidence that people would be able to explain what NSPARC is doing, and how it will help them serve Mississippi residents more effectively—it will improve education systems, workforce systems, the ability to collaborate, shared strategies for collaboration and talent development, and economic development,” Wolff said. “We wanted to provide a platform for people to be able to explain, in their own words, what difference they hoped it would make or what difference it’s making now. Mississippi is far enough along to do that, and has a huge range of stakeholders.”

Wolff asserts that there are a few distinct things that made Mississippi stand out to the DOL. First, Mississippi is a rare rural state, meaning there are more people living in non-urban areas than urban areas.

“To be a public steward, a policy maker, or a leader in Mississippi, you’re obligated to think about the distribution of resources in a different way,” Wolff said. “Often if you’re a state that has a lot of cities in it, the city is the flywheel. The city creates a lot of jobs and attracts a lot of people to move to the city, and the spillover affects neighboring counties, that sort of thing.

“But where populations are more dispersed, which also has it benefits—not only in terms of sustainability but in terms of not needing to import so much—it just means a different level of intention to all parts of the state,” Wolff explained. “That creates incentive for Mississippi to want to do something like this, because the context really demands a high level of data analysis in order to serve people well.”

The second reason Wolff believes Mississippi to be so far ahead lies in Mississippi’s small population relative to other states.

“Mississippi is a smaller state and has fewer institutions of higher education, fewer think tanks, and fewer entities who are competing with smaller data projects,” Wolff said. “So it’s more of an incentive for everyone to pull their resources together and do a great data project, as opposed to everybody trying a little one that can’t be sustained. I think that has something to do with [Mississippi’s success as well].”

Wolff credits vision and a commitment to the long-term for Mississippi’s successful use of data.

“Across several different institutional leadership changes, at the governor level and the state agencies, Mississippi has managed to hold the idea and the vision that it can be a secure holder of data and intelligence. Holding that idea and committing for the long-term is also a really important thing because these projects are not quick, and they aren’t simple.”
Finally, Wolff sees the unique role of NSPARC as a university entity as a key to Mississippi’s WDQI success.

“I think Mississippi’s arrangement is interesting,” Wolff said. “Mississippi was one of the first to affiliate with a university, and that model is becoming more common and of greater interest to more partners. I think [Mississippi] was kind of ahead on that front.”

She goes on to say that many people in many different locations are interested in the idea of connecting WDQI projects and longitudinal data projects more generally with universities.

“State agencies go there [NSPARC] routinely for meetings, and what that means is that when state agencies come together and meet at NSPARC, they’re on neutral territory and they are collectively participating in a data project,” Wolff said. “That really does change the dynamics from one agency giving data to another agency, because [exchanging data from one agency to another] can often be a little bit fraught. They’re not sure about security, and what happens if [the data] gets used incorrectly, so there’s a lot of worry.”

Wolff notes that NSPARC serves as a neutral player, “with a huge amount of depth and sophistication, both in technology and also in data management.” She went on to say the state’s relationship with Mississippi State University came with a built-in infrastructure, which is supported by public dollars that are combined with publicly supported agencies that contributed to the enterprise.

“It just makes it more affordable for everyone,” she said.

Wolff emphasizes the importance of the partner organizations. “The community colleges and the schools, and other institutions for higher education—even if they aren’t all involved with it to the same degree, they’re all involved. Economic development—that’s the other thing—is just the range of public players that are engaged in Mississippi’s project is amazing, and it’s impressive.”

The WDQI video will be published in summer 2019. With so many states working to build so many similar, yet different, data systems for so many different stakeholders that share data across education and workforce, it becomes hard to communicate how the data project is structured. Wolff and DOL hope the video will help states understand how Mississippi is running its data system as an example of best practices and an approach that is inclusive of a variety of stakeholders and the general public.

Mimmo Parisi was featured in the video

Kristin Wolff and video producer Aleixo Goncalves
Fannon Martin and Janet Borchert can attest to the fact that job searching can be difficult and stressful, and many times it can seem like there is nothing out there suited to your qualifications and experience. In fact, there are currently more than 39,000 jobs available in the state of Mississippi, but Martin and Borchert found themselves frustrated by questions familiar to most job seekers. Where do you go to find these jobs? What is the best way to sift through the thousands of open jobs to find the one right for you? How does one even start to apply to these jobs, or even decide which jobs would best suit them?

Fortunately, the state of Mississippi had a set of tools that helped Martin, Borchert, and thousands of other people searching for employment in the state. The Mississippi Works web portal and app and the Workforce Investment Network (WIN) Job Centers combine data, technology, and personalized help—for free!—to get people on the path to employment.

Mississippi Works was a technology solution built to answer Governor Phil Bryant’s call to build a stronger, more competitive Mississippi. As he said in his 2012 inaugural address, “My first job is to make sure that every Mississippian has a job.” To help achieve this goal, NSPARC, the Mississippi Department of Employment Security (MDES), and a committee of state business leaders teamed together to create a website where Mississippi employers in the public and private sectors could easily post job openings, and job seekers could easily search for open jobs.

MississippiWorks.org is a user-friendly website for those seeking employment within the state of Mississippi. After the job seeker creates a profile, the website is able to match the person with real-time job listings based on real job transitions in Mississippi. However, what makes Mississippi Works distinctly unique when compared to job search engines like Indeed.com or Monster.com, is after clicking on a recommended job, the website utilizes the user data in the job seeker’s profile to see how well they match up with the job in the “How do I measure up?” section on the side of the page.

Job seekers also have the ability to upload documents like resumes, military discharge papers, diplomas, etc., and maintain a personal repository of documents that may be attached to job applications. Finally, if there are gaps in experience or credentials necessary for the job, Mississippi Works will identify those gaps and provide recommended resources and agencies available to help fill any skills gaps to make the job seeker a more viable candidate.

In 2014, a mobile version of Mississippi Works was created for job seekers on the go. The Mississippi Works mobile app, which is available to download for free for Apple and Android devices, is a true mobile application with core native functions like job search, in-app applications, registration, profile building, gap analysis, and job center search. Users can maintain a list of favorite jobs and even browse downloaded jobs offline when Internet access is unavailable.

In January 2019, a counselor at the Picayune WIN Job Center suggested that Borchert start utilizing the Mississippi Works mobile app on her smartphone. Soon after updating her profile with employment preferences and skills, Borchert started receiving alerts from the app. At the time, she was willing to take any job to get back on her feet, and when a job alert for a poultry worker position came to her phone, Borchert immediately contacted the Picayune WIN Job Center to inquire about the job. She was hired at Southern Hen in Moselle, Mississippi in January 2019.

“The app was very useful and easy to navigate,” Borchert said of Mississippi Works.

Mississippi Works desktop and mobile apps
Along with Mississippi Works, the state provides another useful resource for Mississippians looking for employment: WIN Job Centers.

WIN Job Centers are service centers that offer programs and resources geared toward job seeking and claim needs and are partners in the American Job Center Network. The experts at WIN Job Centers are valuable employment counselors who provide job placement assistance, job and skills training, priority services for veterans, career counseling, and referrals to many other valuable services.

The process is easy and free. People seeking employment can register in person at their nearest WIN Job Center or online at mdes.ms.gov/win-job-centers. The next step is to go to the nearest WIN Job Center and search for jobs on the computers located in the resource center, or search from any computer with internet access.

Combining federal, state, and community workforce programs and services, WIN in Mississippi creates a system that is both convenient and user-friendly. As with Mississippi Works, WIN Job Centers use data and technology to make it possible for people to connect to jobs that are suitable for their interests, experience, skills, knowledge, and credentials—whether the job seeker just graduated from high school or college, or is making a mid-career change.

This strategic system to match job seekers with employers based on the job seeker’s skills, interests, and region has many success stories. In addition to using the app, Borchert went to her local WIN Job Center periodically to check on job fairs and other employment events. Fanon Martin can also attest to the benefits of WIN Job Centers and Mississippi Works as successful tools for his career change.

Martin had several years of experience within the furniture manufacturing industry and decided it was time for a career change in mid-2017. Despite trying his hand in the automotive industry and even commercial truck driving in 2018, his efforts were not as successful as he had initially hoped. Seeking higher pay, but lacking in experience, Martin was intrigued.

After about a month of applying to recommended jobs, Martin discovered a new company that piqued his interest: Williams Sonoma-Sutter Street. The company was a featured employer on the Mississippi Works website, and due to his previous furniture manufacturing experience, Martin was intrigued. He was encouraged by MDES staff to attend the recruitment fair that the company was holding at Itawamba Community College. He applied for a position, and in January 2019, he received a job offer he could not refuse. Martin is now a production team member of the Williams Sonoma-Sutter Street family, which he says exceeds his greatest expectations.

“I was grateful for the encouragement of the MDES staff because I didn’t think I would get the job,” Martin said. “I am grateful for finding a company that will allow me to create a lasting career.”

In March 2018, MDES reported that Mississippi’s unemployment rate had fallen to 4.6 percent in January of that year, which was “the lowest level of unemployment ever recorded in Mississippi.” In more than a year since then, the unemployment rate has only increased two tenths of a percent. In fact, as of March 2019, the unemployment rate has now been at 4.8 percent or lower for 11 months in a row and the number of unemployed Mississippians is down by 1,500 people since this time last year. Thanks to resources like WIN Job Centers and Mississippi Works, data science, technology, and personal assistance are putting Mississippians to work.

REAL TIME TRIAGE

“Should I do the following to find a job in MS?”

“Do more than the basic things on this list. Find and apply for jobs, join or create a network of other job seekers, follow up after your job application is submitted.”

“Go For It!
Use your good work ethic and apply now.”

Interested?
You are in the 90% of people who have already applied.

GAP ANALYSIS

“What is the distance between my qualifications and the qualifications required by this job opening?”

“The Mississippi Works Model”

LABOR MARKET INFORMATION

“Is there a future for me in this career? If so, where?”

“Pipefitters and Steamfitters” In Mississippi

<table>
<thead>
<tr>
<th>Entry Level</th>
<th>Average</th>
<th>Expert</th>
</tr>
</thead>
<tbody>
<tr>
<td>$29,780</td>
<td>$45,340</td>
<td>$61,250</td>
</tr>
</tbody>
</table>

2018 AVERAGE ANNUAL SALARY

$45,340

$21.90/HR

By 2026, Mississippi will need 44% more “Pipefitters and Steamfitters”

Hinds County

2018

4015

46%

People currently have this job in MS

5511

55%

People are expected to have this job in 2026

People are expected to have this job in 2026

37%
USING DATA TO COMMUNICATE ORGANIZATIONAL IMPROVEMENTS

BY JOHN FORDE, APR, PH.D

NSPARC focuses on helping organizations improve through research to help the state of Mississippi. What attracted me to serve with NSPARC was the applicability of the research and the emphasis on working with diverse clients to truly assist them to communicate better and enhance their operations through data science methods.

My background is in public relations, and often those not in the field have trouble understanding what the profession fully entails. Public relations is about working with people, but it involves managing communication between an organization and its publics through two-way communication.

Often when people think of public relations, they focus on the media aspect or sending out information through various channels, now including social media. This is still very important, but the two-way dialogue between a group and its key groups is critical. If leaders don’t care to listen, then success will be much more challenging to achieve.

Public relations also includes relationship-building and determining actions that will help clients. This relates back to enhancing communication within and between organizations.

Public relations additionally focuses on scientific endeavor through conducting research and reviewing studies of others, but there are additional elements that could be considered more artistic. We should base our major communication strategies on appropriate data to indicate goals, strategies, and tactics. The “artistic” focus comes into play when we choose certain detailed messages, specific words, and even colors in design elements.

Another major element of the broad field of public relations is a focus on mutually beneficial relationships or determining actions that help as many parties as possible. I have seen this at NSPARC while working with various outside professionals. We become a team with them and part of their organization for a time to help them see objectively and often adjust their direction. Clients will come back if they are pleased with the results and they recognize this helping attitude.

Public relations also includes counseling or advising clients. Being proactive whenever possible is much better than simply reacting to a situation. Again, research comes into play here. It is much better to reduce a small problem or avoid some problems completely than to go back and try to alleviate major situations that have become extremely detrimental.

I’ve often said that if organizations manage issues well, then there will be fewer crises. To avoid major problems, we have to know what is in the minds of our important stakeholders.

When a client comes to NSPARC and asks for our help, they are genuinely trying to improve their business model, including communication. This all relates to having the proper research available to help organizations make good decisions that will positively impact those who are affected by decisions.

We have conducted focus groups with various clients and confidentially asked different groups how their company, association, or non-profit could improve. Then we provide reports to management for them to better understand attitudes and opinions of these important publics.

With a recent client, we conducted in-person surveys in six separate sessions where employees confidentially chose answers to close-ended questions. Then we discussed major areas of concern in depth in an open forum, including challenging areas and positive perceptions. This example of using quantitative and qualitative information is designed to help the company retain their quality employees and determine what types of new hires would be the best fit for the company. If their turnover rate can be reduced and productivity increased through enhanced communication and better practices overall, then the local economy will be positively impacted.

One of the best feelings with this type of research with NSPARC is how thankful all of the research groups (or respondents) have been to have the opportunity to express their opinions openly in a safe setting. Many excellent ideas were derived from these sessions by just encouraging people to talk about whatever they felt was important. So many organizational challenges relate to the fact that many people don’t communicate as openly and effectively as they should. Therefore, they misunderstand what is important to their co-workers and others.

Another major factor in today’s connected world is that relationships with one group now often impact an organization’s potential influence with other groups. For example, if employees with a certain company are not happy, then most likely many people outside of the organization will know about it relatively quickly because there are so many direct communication channels now available.

As more people have access to increasing amounts of information, credibility of the sources becomes even more important. Just because it’s “out there” does not mean it is necessarily true. This has been evident with many scams that continue to fool smart people into making bad decisions. Before acting on broad information or specific research, leaders should understand how the data were collected and analyzed in the first place.

Working with colleagues at NSPARC to benefit other organizations continues to be very fulfilling for me. Most of us have heard that the best way to determine what people think is to ask them! NSPARC is focused on finding more ways to gather information that will in turn help organizations serve their clients—and society—more beneficially.
When you’re a leader, people watch to see what you’ll do next. Nobody knows that better than Mississippi State University. For years we’ve been leaders in the world of aerospace engineering. MSU now serves as the national lead university for the Federal Aviation Administration’s Center of Excellence of Unmanned Aircraft Systems, putting us on the cutting edge of this new era of research, development and integration into the nation’s airspace. We’re driven to lead the way. Keep watching as we soar to new heights. RESEARCH.MSSTATE.EDU

What is the top security concern for NSPARC?

A lot of times people talk about security, protection, data and access control, but what we’re really talking about is risk management because everything is a risk. The only way to not have any risk is to not be in business. What we have to do is determine what the acceptable risks are.

How has NSPARC used its resources to make sure security threats are minimal?

What we’re building here is one that we hope will be a world-class program. NSPARC’s investment in security has allowed me to put in place the tools and protocols for what we have to protect, but that’s always changing. We partner and leverage resources from many places. Of course, we use as much of the university resources and/or state and government resources that are available to us, and we also use outside resources all of the time from vendor programs to contract workers, to outside seminars, and training sessions. We are NIST 800 171 certified through a partnership organization, and we have a couple of options that are on the table right now that will take us to some new levels of data security.

How does NSPARC ensure that data security is progressing?

A part of anybody’s job at NSPARC is to stay abreast of current technology; there are a number of ways that we do that. I do a lot of reading, tied to a lot of security resources that feed information in almost real time. I have reports that come in daily for things like brand protection. We use a service that is watching out for our name, key words, or any mention of our executives in social media or the dark web. They monitor 24/7.

We leverage information from an organization called SANS (System Administration, Audit, Network and Security). This is one of the top organizations in dealing with cyber events, cyber-crimes, analysis and forensics. We leverage MS-ISAC, a federal organization put in place specifically for state, local, territories and satellite countries that fall under the federal government’s jurisdiction. They have a fairly complete security program for monitoring and alerting vulnerabilities. They have ties to NSA (National Security Agency) and the U.S. Department of Homeland Security so that we can be made aware of the latest threats that might be seen in our environment and networks. We leverage the campus ITS, as well as the state ITS for information sharing and general administration. Again, we are pretty much all over the place all of the time gathering information to try to stay abreast of the latest and greatest.

On which aspect of data security does NSPARC place the most emphasis?

If you were going to take one thing away about NSPARC’s data security, it would be our emphasis on risk intelligence. Risk intelligence allows us to have the conversation about managing risk appropriately and appropriately. It typically means having an established risk tolerance for an established organization. The risk management methodology that we use is STRIDE, which is an acronym for spoofing, tampering, non-repudiation, information disclosure, denial of service, and elevation of privileges. One of the big ones that we see in any attack is elevation of privileges.
ABOUT NSPARC

Known primarily for our work in support of smart government, NSPARC has achieved national prominence with its use of data science (the field of study that examines new methods for the use of data) in economic development, workforce development, education, and delivery of human services at all levels of government.

NSPARC has extensive experience in the application of data science in every major area of enterprise software development, data security, and IT infrastructure, including:

**INNOVATION THROUGH DATA SCIENCE**
We use data science with a focus on data analytics, predictive analytics, machine learning, artificial intelligence, system of systems, data governance, cybersecurity, cloud technology, and high-performance computing to develop innovations that further human progress.

**EXPERIENTIAL LEARNING**
We provide students from all academic backgrounds the opportunity to learn about the value of data in their fields of study.

**TRANSDISCIPLINARY RESEARCH**
We provide opportunities for transdisciplinary research to improve the use of data in multiple fields of study.

**NATIONWIDE LEADERSHIP IN THE FIELD OF DATA SCIENCE**
We provide a model for public universities to become places where the public and private sectors come for data innovation.

Imagine a world where sustainable energy powers our daily commute and where our nation is safe from cyber-attacks. Imagine a world where food shortages are replaced with food abundance and where the flu is something our children will read about in history books. Imagine a world where the spark of an idea can grow into a solution that molds the future. Imagine a world where inspiration gives birth to innovation. We are, at Mississippi State University, where we ring true. MSSTATE.EDU