IASP International Association of Science Parks and Areas of Innovation

32nd IASP World Conference on
Science Parks and Areas of Innovation 2015

Beijing, China

Automotive Research: A Magnet for Innovative Community and Industry Development

Parallel Session 1 :

The impact of technology - Embracing innovation

Author :

Vanessa Cornell

Hosted by:

中关村 Z-Park ZHONGGUANCUN SCIENCE PARK

Automotive Research: A Magnet for Innovative Community and Industry Development

Executive Summary

It is predicted that global vehicle production will increase fourfold by 2021. This growth brings a variety of opportunities to the related companies, advanced technologies and education of the workforce associated with the automotive companies. It also positions automotive headquarters and their related facilities and campuses to become areas of innovation that stimulate economic growth and enhance the total research cycle. Furthermore, with the proper infrastructure in place, they become magnets for public private collaborations, suppliers and ultimately become innovation hubs.

However, each area of automotive innovation must adapt to its own unique appeal. Some may capitalize on a specific concentration of expertise, others on geographic advantages. Building on this individualistic core, the new area of innovation will be one that fosters collaborative economic growth, and sets the stage for the next phase of evolution.

In this paper, three case studies describe how automotive research is a magnet for innovative communities and industry developments.

Image 1: Chrysler World Headquarters in Auburn Hills, Michigan

Introduction

It is predicted that global vehicle production will increase fourfold by 2021. This significant growth brings a variety of opportunities to the related companies, advanced technologies and education of the workforce associated with the automotive companies. This positions automotive headquarters, manufacturing sites and their related R&D facilities and campuses to become areas of innovation that stimulate economic growth and enhance the total research cycle. Furthermore, with the proper infrastructure in place, they become magnets for public private collaborations, suppliers and ultimately become innovation hubs.

Suppliers:
Automotive suppliers tend to locate themselves near their customers to shorten lines of communications and material turnaround. For example, following BMW's announcement that it would build an automobile manufacturing plant in upstate South Carolina, United States, many supplier companies began seriously considering locating operations in the Southeast.

In addition to providing efficient and flexible manufacturing, the addition of new supplier operations has increased the economic vitality of the entire Southeast region. About forty BMW suppliers are now located in South Carolina within a few hours drive of the plant, creating more than 20,000 jobs and dramatically multiplying the economic impact of the plant to the region[1].

Education:
Collaborations with regional universities enhance the research enterprise by completing the total research cycle from basic to applied research and into commercialization in the automotive market. Educational involvement can also provide opportunities for the corporation to sponsor university-based programs that can help with the recruitment of "work-ready" graduates. This is the case with the Campbell Graduate Engineering Center at Clemson University's International Center for Automotive Research, sponsored by BMW and others, and the Chrysler Learning and Innovation Center for Sheet Metal Forming at Oakland University (see case studies below).

Total Research Cycle:
Areas of innovation serve as true economic engines when they provide a place that allows for research to be conducted and applied to the market. This applied research operates at a different scale and requires different facilities than the basic research conducted at universities. Testing, prototyping and first generation production are the areas where industry seeks university help, and areas of innovation can play a critical role in this stage. A strong applied research component that encourages university scientists and post-doc students to develop their own research can create an ecosystem of innovation, where startups more easily make the transition from the incubator stage to successful businesses.

Incubators or Accelerator Programs:
Areas of innovation can also provide more business incubation and accelerator programs. The value of incubator space is the ability to grow firms in place. Firms with strong local ties are less likely to relocate as they gain traction and grow. This model requires that these areas provide more extensive networking and technical support than before. As an example, university research/science parks can differentiate as facilitators of research partnerships between public and private interests. This can be a particularly powerful advantage as corporations increasingly look to invest in broader and more innovative portfolios.

1. https://www.bmwusfactory.com/suppliers-portal/supplier-information/supplier-network/

Smart Master Planning and Architecture:
Master planners and architects can play a critical role in developing a framework that accommodates such a wide range of facility types within a coherent whole. The careful siting of prototyping or manufacturing facilities with respect to other spaces and companies is only one example of the issues master planners must address. A design language that can allow office buildings, retail development and manufacturing to maintain consistency and remain flexible is a particular challenge for planners.

Of course, each area of innovation must apply this common framework within the context of its own unique appeal. Some may choose to capitalize on a specific concentration of research expertise, others on geographic advantages. Building on this individualistic core, the new area of innovation will be one that fosters collaborative economic growth, and sets the stage for the next phase of evolution.

Three case studies –Chrysler Group World Headquarters and Technology Center, Clemson University International Center for Automotive Research, and First Automotive Works (FAW) Research and Development Center—further describe how automotive research is a magnet for innovative communities and industry developments.

CASE STUDY: CHRYSLER GROUP WORLD HEADQUARTERS AND TECHNOLOGY CENTER

Described by Fiat Chrysler Automobiles as “the only automotive facility bringing together cutting-edge scientific research, industry-leading creative design, vehicle development, engineering, manufacturing, marketing and corporate leadership under one roof,” the Chrysler Group World Headquarters and Technology Center is truly the economic engine of Auburn Hills, Michigan. In addition to employing approximately 15,000 people inside its 4.4 million square foot complex, the Center has brought about tremendous economic growth for this northern Detroit suburb over the past couple of decades.

Formerly housed in deteriorated facilities in Detroit, Chrysler’s original site had poor infrastructure and no room to expand. Chrysler made the bold move to relocate to an undeveloped area 30 miles north of the city. With only 5,435 households and mostly farmland, Auburn Hills did not have a lot to offer. However, armed with tax incentives and grants for roadway and infrastructure improvements, Chrysler began laying the groundwork for its new 500-acre home. Although the move was considered risky at the time, Chrysler counted on its extensive Tier I and Tier II supplier base following them to the new site, which is exactly what occurred with the evolution of Oakland Technology Park, currently serving as the epicenter for top automotive and manufacturing firms in the area.

Bordering Chrysler to the north, the Park is now home to several major automotive suppliers including[2]:
· US Farathane’s 250,000 square-foot plastic injection mold facility.
· Henniges Automotive North America’s 55,000 square-foot, LEED Silver headquarters to support its automotive sealing business.
· Faurecia’s new 288,800 square-foot North American headquarters – employing 700 – with business groups in automotive seating, emissions control technologies, interior systems and automotive exteriors.
· Atlas Copco’s North American headquarters for its tools and assembly division supporting the company’s industrial productivity solutions business.

2. http://www.friedmanrealestate.com/news/partnership-between-friedman-and-general-development-proves-to-be-a-winning-combination-at-oakland-technology-park/

· Hirotec America's new 216,000 square-foot headquarters, currently under construction, for its closure panel product line.

Driven by the Chrysler economic machine, Auburn Hills continues to boom with hotels, retail and food service vendors springing up to support the city's large automotive industry base. Additionally, Auburn Hills became the home to the Palace where the National Basketball Association's Detroit Pistons play.

Education and Research

Another major aspect of Chrysler's involvement in driving local economic growth, education and research is its relationship with neighboring Oakland University. In fact, Chrysler has been so intimately involved with the University's engineering program that 80 percent of the University's graduates were coming to work at Chrysler at one time.

One stand-out example of this close-knit collaboration is the Chrysler Learning and Innovation Center for Sheet Metal Forming (CLIC-FORM). Originally established through a $110,000 grant from Chrysler, seven Oakland faculty members teach courses on properties of sheet metal, sheet metal production, trouble shooting, lubrication, tool & die, presses, root cause analysis, computer-aided drafting and finite element analysis application for the two-year program. CLIC-FORM also offers paid internships at Chrysler and other steel companies, regularly scheduled workshops, publication opportunities and enhanced post-graduation job prospects.

Before re-locating to the Auburn Hills R&D center, Chrysler was working out of an outdated Detroit campus, stretched out over multiple buildings, which did not support a team-based process. Fortunately, the new facility brings the full development cycle – from research to prototyping to testing – all under one contiguous roof. The Chrysler facility was designed to support a more streamlined workflow, enhanced collaboration and a much more efficient process, supporting the total research cycle of concept, testing, refinement, and prototyping.

Design Enhances Workflow

The facility features a 15-story Headquarters Tower, Chrysler Technology Center and two-story Commons Wing creating a loft-like, open environment.

Designed with cold Michigan winters in mind, staff can move about from department to department – inside a comfortable, conditioned environment – to the vehicle platforms aligned with different sections of the building. This level of efficiency and convenience also extends to the testing vehicles themselves, which are all housed in the facility's bottom floor and can easily be transported from one dock to another without exiting the facility's interior. The space is also designed to allow automobiles to run indoors.

Supporting both formal and informal collaboration, a large atrium connects all of the building's departments and floors. The floors are organized in six pairs, connected by smaller atria with communicating staircases, creating flexible space for interrelated functional groups within the company.

Image 2: Chrysler World Headquarters Atrium

With a number of coffee stands and snack areas strategically set up throughout the building, employees are frequently found socializing and sharing ideas in these casual break areas. Chrysler also invested in sprucing up its dining options to encourage workers to stay on-site during lunchtime in order to increase opportunities for co-worker engagement.

No work station is located more than 55 feet away from natural light, further enhancing worker productivity and satisfaction. Wall colors, finishes, and furnishings were all designed to create a friendly, upbeat environment. The campus is replete with walking trails and outdoor areas and a large fitness center.

In terms of the mechanical and electrical design, a distributed mechanical room scheme is comprised of smaller, mechanical equipment rooms housing a highly efficient custom air handling unit serving two floors. With a smaller overall footprint, this strategy creates more office space, reduces the mechanical floor slab area and eliminates primary maintenance access requirements for a number of the floors in the tower.

As for operational benefits, the distributed system has fewer air handling units to control and maintain, it promotes better air handling unit capacity, offers partial redundancy with twin supply and relief air fans, reduces the number of motor control centers and provides elevator and catwalk access to equipment like control valves, compression tanks, relief and exhaust fans.

To reduce the large facility's peak demand, a 2 million chilled water storage tank produces chilled water at night for more cost-effective daytime cooling.

CASE STUDY: CLEMSON UNIVERSITY INTERNATIONAL CENTER FOR AUTOMOTIVE RESEARCH

Greenville, S.C., is located at the epicenter of the I-85 Boom Belt running from Richmond Va., through North Carolina and South Carolina, past Atlanta, and down to Montgomery, Ala. This area is ranked as the 8th largest mega region in the world, with a combined gross domestic product greater than both Canada and India. This is due in large part to more than 1,000 automotive assemblers and suppliers located within a 500-mile radius of upstate South Carolina, with 125 automotive suppliers and related companies working out of a 10-county region.

Working from its ideal location, the visionary Clemson University – considered a public Ivy League school and ranked in the Top 25 by U.S. News & Report – set out to build a premier automotive research, innovation and educational world-wide enterprise in 2007. With BMW as a large financial backer, and Michelin, Timken, and the State of South Carolina serving as leading partners, (now including more than 130 partnerships) Clemson University's International Center for Automotive Research (CU-ICAR) is a

Image 3: CU-ICAR Technology Neighborhood Master Plan

3. http://cuicar.com/

stunning example of academia, government and industry teaming up for the greater good of automotive research, technological and industrial advancement[3].

CU-ICAR's five technology neighborhoods on its 250-acre campus define a new-generation research park for automotive and motorsports innovation. Envisioned as a "Technopolis" by its founders, the compact and connected technology neighborhoods support a more collaborative community for advanced research and development.

While still in its first phase of development, CU-ICAR is already sparking an unprecedented level of public-private initiatives and achievements. It has been named 1 of 4 "best practices" for facilitating university-industry collaboration by the U.S. Department of Commerce, and recognized by the National Academies of Science as an example of five global best practices in its "Understanding Research, Science and Technology Parks" report.

Automotive Education

Clemson University's Campbell Graduate Engineering Center is a unique educational program offering masters and doctorate degrees. The program is based on a holistic, systems integration approach to designing automobiles with all its components and systems working seamlessly together. Seeking to address the gap between what today's automotive companies need and what university engineering programs are producing, this cutting-edge program takes students through the full cycle of product development starting with strategy and market analysis, followed by design, concept development and series development, all the way to prototype, build and target validation.

In fact, through Clemson's "Deep Orange" project, graduate students work with multi-disciplinary faculty and industry partners – such as Mazda, BMW, GM and Toyota – to produce a vehicle prototype every year, incorporating breakthrough product innovations and new processes[4].

Overall, the graduate program's main areas of strategic research include advance powertrains, vehicular electronics, manufacturing and materials, vehicle-to-vehicle infrastructure, vehicle performance, human factors and systems integration. With such a high level of industry support and involvement, the program produces a great deal of industry-sponsored research, in addition to offering testing services.

In fact, 82 percent of research funding at CU-ICAR comes from private industry, as compared to 6 or 7 percent for a typical university. Another interesting differential between Clemson's automotive program and other universities is the fact that Clemson's graduates are much better prepared to work in the industry, offering an almost immediate return on investment for the companies that hire them. Thus far, CU-ICAR has produced 256 graduates from its automotive engineering program, who are quickly become the corporate leaders of tomorrow.

The Master Plan

Located along I-85, CU-ICAR's five technology neighborhoods are buffered by green valleys and connected by multi-modal greenways, trails and bridges. In its beautiful, natural setting, the campus takes advantage of the natural gifts which the site offers.

"There are very few places in the world like this, a center established by a University, and completely dedicated to economic development for a particular business sector," explains UC-ICAR Director Fred

4. http://www.cuicardeeporange.com/

Cartwright. “Bringing research, education and economic development together in a collaborative environment is unusual. It has really helped to put the city of Greenville on the map in terms of investment and economic development.”

So far, the facilities populating the first technology neighborhood is Clemson University’s Carroll A. Campbell Jr. Graduate Engineering Center, Timken’s automotive powertrain engineering center and BMW’s Information Technology Research Center where hardware and software research is led by BMW, in collaboration with Microsoft, IBM and others.

In addition, the State of South Carolina backed funds for a parking garage to support the 20 different companies currently occupying space in this first neighborhood cluster.

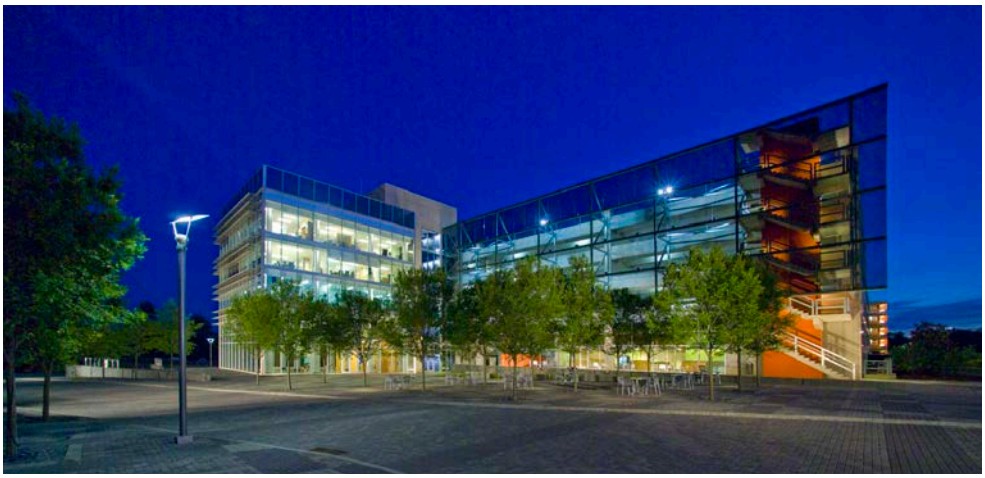

Image 4: CU-ICAR Innovation Place

Each facility opens up into a pedestrian plaza that creates an organic environment where folks can cross paths in a social, friendly environment. Boosted by Greenville’s warm weather, the plaza has become somewhat of a mini-campus and has created a certain level of visibility, connectivity and buzz.

In particular, the Graduate Engineering Center is a 90,000 square-foot LEED Silver facility designed with an open plan to enhance communication and collaboration between offices, laboratories and classrooms. A curvilinear public atrium and glass walls provide visitors with an opportunity to observe students and faculty at work inside large open bays. In addition, the facility houses multiple testing cells ranging in capability from small component to full engine and vehicle testing.

Another 118,000 square-foot office building houses JTEKT Group’s Koyo Bearings USA, serving as a global center of excellence for roller needle bearing design and technology development[5].

At this time, CU-ICAR is revisiting its original master plan with a diverse group of stakeholders before moving on to developing the next technology neighborhood. As development unfolds, CU-ICAR is anticipating a tremendous amount of growth over the next two decades with its unique ability to provide the talent pool,

5. http://cuicar.com/campus/

resources and local automotive market to encourage more and more automobile companies and suppliers to set up shop in Greenville and become part of the growing southeastern automobile sector.

Economic Impact

In addition to technology-based businesses, the creation of jobs and the ripple effect on local food, retail and hospitality establishments, CU-ICAR has also given rise to other economic development in the area.
Hubbell Lighting re-located its corporate headquarters to Greenville, the St. Francis Health System has undergone significant expansion with 50 acres of medical buildings, creating 500 new jobs. An adjacent private sector mixed-use development will provide housing for a population of 10,000, on 1,100 acres.

Upon graduation, 26 percent of Clemson's automotive engineering alumni are employed in South Carolina, and 95 percent are gainfully employed in the automotive industry. However, as more and more overseas automobile manufacturers – like BMW's Spartanburg, S.C. R&D center – consider moving sectors of their product design and development to the Southeast, Clemson anticipates that it will eventually be able to keep a higher percentage of its sought-after graduates local.

Clemson University's Automotive Research Campus: Lessons Learned

Based on experiences gleaned from the past seven years of active development at Clemson's University's International Center for Automotive Research (CU-ICAR), its leadership shares the following lessons learned:

· The way in which the campus and facilities are designed really does matter. A well-executed master plan will be conducive to collaboration and its potential to serve as a community venue with plenty of real estate.

· It's important to staff the project's development team with a mix of industry- experienced professionals and fresh talent.

· Branding should be incorporated into the budget and stakeholders should be encouraged to serve as ambassadors.

· Be dedicated to building long-term relationships, especially with industry. Set up a business office where "partnership" is the focus.

· Work to truly understand industry partner needs and help them meet these needs, e.g., education, research or other "problems" where the University can provide innovative solutions.

· It really helps to be singularly focused on one industry. Resist the temptation to deviate.

· Align the project's vision and organizational structure with local and state government structure.

· Expect that the journey will include some highs and lows.

· Believe in the power of a great idea and lead by example.

· The stewards of land and capital are key players. Involve them in all aspects of project development.

· Emphasis on industry-sponsored research maximizes economic development and creates a robust funding source, but be prepared to manage it.

CASE STUDY: FIRST AUTOMOTIVE WORKS (FAW) RESEARCH AND DEVELOPMENT CENTER

Mirroring China's industrialization and modernization efforts, the China FAW Group Corporation is currently undergoing a renaissance in the way in which it develops and produces a wide range of vehicles on both a domestic and global scale.

As one of China's leading vehicle manufacturers, FAW is committed to a long term strategy that will bring its R&D and manufacturing of light, medium, and heavy-duty trucks, automobiles, municipal buses and luxury

tourist coaches, custom bus chassis, and mini-vehicles to the next level. This strategy is in response to the perception that China has traditionally been a big manufacturing nation, but not a powerful one, as observed by President Zhou Ji of the China Academy of Engineering.

Part and parcel of this initiative is the design and construction of a state-of-the-art, five million square-foot facility with all research and development functions under one roof in Changchun, China. Benchmarking other cutting-edge R&D automotive facilities including Toyota, Renault and Chrysler, FAW is combining this "all under one roof" style with traditional Chinese building practices.

Image 5: FAW Research & Development Center

Situated on a lakefront with a major pedestrian promenade, the contiguous five-story, U-shaped structure is a half a mile long and surrounds a central courtyard. Workers can walk the entire length of the building while remaining indoors, which is key for northern China's sub-zero winters.

Each building level is set up to accommodate two to three teams with workspace set aside for outside vendors who work regularly with their project team. In order to protect confidentiality, these team spaces are segregated and secure. For example, outside suppliers are only authorized to travel to the floor where they are working.

At the same time, within the team area, the building design promotes optimal collaboration and communication. For example, a very large atrium space – the size of three soccer fields – is illuminated by three skylights and provides a comfortable, daylit space where people can gather and products can be displayed.

The work and lab areas themselves contain every resource required to bring a vehicle from the conceptual stage all the way through to the building's pilot plant where the engineers can then determine exactly how they're going to manufacture their new prototype. In essence, this new facility will significantly improve FAW's total research and development cycle with the engineers and technicians housed within one space.

In FAW's quest to become part of the world's automotive leadership, recruiting and retaining top talent is essential. While certain kinds of amenities have traditionally not been part of the Chinese workplace, this business model is evolving. In a distinct departure from their former 1950's R&D space that resembled a military compound, the new R&D center offers beautiful dining areas, outdoor spaces and a fitness center.

At the same time, this progressive modern workplace still incorporates the more spiritual building practices stemming from Chinese tradition. FAW's executive offices are located in the Administration Building's 7th floor, the highest point on the site. In addition, the existing lake sits to the east of the complex and reflecting pools are located on the south side to fulfill the feng shui tradition of water on the south and east sides bringing good luck.

Extending traditional practices even further, entrances and exits are limited to honor the Chinese belief that good energy can escape and bad energy can enter through the gates. This being the case, the south serves as the ceremonial entrance through a gate, forecourt and reflecting pool. The east serves as the visitor entrance, and the west has two entry points, one for employees and the other for service access.

While the vast majority of the complex sits under one roof, a separate conference and training center is sited on the other side of the lake, to create a different environment for employees attending training sessions and conferences. Located near the main entrance, FAW can also host industry and educational events without compromising security.

Research and Education

Backing FAW's commitment to furthering China's automotive industry, the company is involved in a number of partnerships and cooperation agreements.

Under a scientific and technological cooperation agreement with the Chinese Academy of Engineering, FAW and CAE are working together to apply research to production methods, implement an innovation-driven development strategy and address technological difficulties facing the carmaker[6].

Other initiatives include a cooperative research agreement with nearby Jilin University and the U.K.'s Nottingham University[7] to pursue research on low carbon technologies, namely thermal management and heat transfer for low carbon vehicles to assist with the development of hybrid electric vehicles[8].

In terms of FAW's impact on its supporting supplier base and economic development in the area, the Changchun Automotive Economic Trade and Development Zone sits directly adjacent to FAW's facility. Spanning 300,000 square meters, the zone plays host to the largest automobile and spare parts wholesale center in China, in addition to a resale center for used cars, a specialized center for industrial and commercial vehicles and a tire wholesale center[9].

In addition, the Changchun Technology Development Zone encompasses 19 square miles and is home to 18 full-time universities and colleges, 39 state and provincial-level scientific research institutions and 11 key national laboratories. Among the industries which the zone is focused on developing is automobile engineering.

6. http://en.cae.cn/en/Local%20Development/Activities%20with%20Provinces%20and%20Cities/20130313/cae11750.html
7. http://www.nottingham.ac.uk/news/pressreleases/2012/july/faw-research-collaboration.aspx
8. http://fawengine.net/en/list.asp?id=564
9. http://www.sicas.cn/Theme/study_in_Changchun/Contents_131008154224324.shtml

CONCLUSION: THE AUTOMOTIVE MACHINE

As illustrated by these three compelling case studies, the automotive R&D industry is a major global economic force with the potential to grow local economies and drive technological discovery and application.

In the U.S. alone, more than seven million private sector jobs are supported by auto manufacturers, suppliers and dealers, and each vehicle manufacturer is currently supporting close to seven jobs in industries across the economy, according to the Center for Automotive Research.[http://www.autoalliance.org/files/dmfile/2015-Auto-Industry-Jobs-Report.pdf]

Armed with a clear understanding of the vast potential inherent in the location, planning and design of automotive R&D facilities, organizations will be well-positioned to maximize the developmental and operational potential of these major centers of world-wide innovation.

PRESENTERS:

Given Name: Mary
Surname: JUKURI
Position: Senior Campus Planner
Email Address: mary.jukuri@smithgroupjjr.com
Organization: SmithGroupJJR
Mailing Address: 201 Depot Street, Second Floor, Ann Arbor, MI 48104
Phone: 734-669-2777

Given Name: Paul
Surname: URBANEK
Position: Design Principal
Email Address: paul.urbanek@smithgroupjjr.com
Organization: SmithGroupJJR
Mailing Address: 500 Griswold Street, Suite 1700, Detroit, MI 48226
Phone: 313-442-8453

ADDITIONAL CONTRIBUTORS:

Given Name: Russ
Surname: SYKES
Position: Managing Partner
Email Address: russ.sykes@smithgroupjjr.com
Organization: SmithGroupJJR
Mailing Address: 500 Griswold Street, Suite 1700, Detroit, MI 48226
Phone: 313-442-8440

Given Name: Tom
Surname: MROZ
Position: Office Director
Email Address: tom.mroz@smithgroupjjr.com
Organization: SmithGroupJJR
Mailing Address: 201 Depot Street, Second Floor, Ann Arbor, MI 48104

Phone: 734-669-2737

Given Name: Frederick
Surname: CARTWRIGHT
Position: Executive Director
Email Address: fcartwr@clemson.edu
Organization: Clemson University International Center for Automotive Research (CU-ICAR)
Mailing Address: 5 Research Drive, Greenville, SC 29607-5257
Phone: 864.283.7102