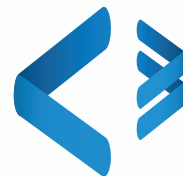


THE FUTURE OF
AG-FOOD-TECH
AT UC MERCED
AN EXECUTIVE ROUNDTABLE DISCUSSION
JULY 2019



UNIVERSITY OF CALIFORNIA
MERCED



CITRIS
AND THE
BANATAO
INSTITUTE

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Cover Photo: UC Merced Professor Stefano Carpin's USDA-funded Robot Assisted Precision Irrigation Delivery (RAPID) program student Thomas Thayer maps soil moisture in a Madera, California vineyard, 2017.

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EXECUTIVE SUMMARY



The University of California, Merced is the newest of the University of California (UC) system's ten campuses and the first American research university built in the 21st century. The campus is located in the heart of California's San Joaquin Valley where agricultural production and food processing industries are engines for the region's economy and communities. To date, however, the UC Merced has had defined engagement with these industries. Given UC Merced's location, as well as UC's mission to engage in knowledge creation (research), knowledge production (education), and knowledge translation (outreach), it is critically important to identify potential strengths and opportunities in collaborating with the agricultural sector broadly, and engineering technology as it relates to agricultural production and food processing specifically.

Fourteen years after the campus opened to students in 2005, UC Merced continues to grow at a rapid pace. With additional attention and focus, the opportunity to engage in an area of outsized importance to the region can become a reality. Each of these three pillars of UC Merced's mission (research, education and outreach) need attention, but the path forward is unclear.

During the 2019 Ag-Food-Tech Week at UC Merced, the Center for Information Technology Research in the Interest of Society (CITRIS) and Banatao Institute invited industry leaders to attend the Ag-Food-Tech Executive Roundtable to provide feedback and to guide strategic planning for CITRIS and the School of Engineering. The Ag-Food-Tech Executive Roundtable advised on the formation of dedicated research, education, and outreach foci on agricultural science and technology.

Feedback from attendees specifically suggested that UCM efforts should emphasize:

- (a) building trust and establishing strong relationships with industry partners,
- (b) finding narrow, but important, areas of engagement within the region and industry,
- (c) developing students with leadership and communication skills beyond technical ones,
- (d) finding the right faculty, and
- (e) investing in continuing education for industry partners.

At the conclusion of this report, we present a broader set of recommendations that fall into three categories:

- (1) Partnership with Regional Leadership Group like the Ag-Food-Tech attendees,
- (2) Pursuit of agricultural funding sources, and
- (3) Investment in programming.

This report provides background information on UC Merced and CITRIS, outlines the Ag-Food-Tech Executive Roundtable proceedings, provides an overview of feedback received by attendees, and offers industry-informed conclusions and recommendations for action.



INTRODUCTION

UC Merced

With more than 8,000 undergraduate and graduate students, UC Merced offers an educational environment that combines a commitment to diversity, inclusion, collaboration, and professional development. With bachelor's, master's, and doctoral degree programs, strong research and academic partnerships, and community involvement, the UC Merced campus is continually evolving. Designated as a Minority Serving Institution, UC Merced is also ranked among the best public universities in the nation by U.S. News and World Report. UC Merced is uniquely positioned to provide educational opportunities to highly qualified students from the San Joaquin Valley and throughout California. The main campus is on the cutting edge of sustainability in construction and design, and supports the economic development of Merced and the region as it continues to grow. In Fall 2016, UC Merced broke ground on a \$1.3 billion public-private partnership that is unprecedented in higher education. The Merced 2020 Project will nearly double the physical capacity of the campus by 2020, enhancing academic distinction, student success and research excellence. UC Merced is also building the Downtown Campus Center, a \$33 million administrative building in the heart of Merced.

School of Engineering

The hallmarks of UC Merced's School of Engineering (SoE) are innovation, diversity, sustainability and personal interaction. The intellectual environment for education and research within the SoE attract world-class faculty, staff and students who collectively seek to have transformational impact on the society and the world in which we live. UCM SoE faculty with their graduate students and post-doctoral researchers are actively engaged in research areas including agricultural technology, artificial intelligence, big data systems, data drones, and much more. In Fall 2018, UCM SoE had 2,192 undergraduate students (19% women, 48% Hispanic, 4% Black, 4% Multi-ethnic, 12% White, 25% Asian, and 1% Native American/Pacific Islander) and 230 graduate students. The SoE offers five undergraduate engineering degrees – Bioengineering, Computer Science and Engineering, Environmental Engineering, Materials Science & Engineering, and Mechanical Engineering. Graduate programs (M.S./Ph.D) include Bioengineering, Electrical Engineering and Computer Science, Environmental Systems, Management of Complex Systems, Material and Biomaterial Science and Engineering, and Mechanical Engineering. SoE continues to build faculty agricultural expertise through hiring both traditional faculty lines and UC ANR Extension Specialists.

CITRIS

The Center for Information Technology Research in the Interest of Society (CITRIS) and the Banatao Institute has partnered with the School of Engineering, UC Merced, to spearhead a focused research and education thrust in Agriculture and Food Technology (Ag-Food-Tech). CITRIS and the Banatao Institute was created in 2001 as one of four interdisciplinary institutes for science and innovation at the University of California. Through collaboration with industry, government agencies, and international partners, CITRIS has enabled innovations in nanotechnology, computer science, engineering, manufacturing, social media, and other sectors. In 2016, CITRIS recognized the Banatao Institute as an integral part of its affiliated UC campuses. In alignment with the goals and values of Dado and Maria Banatao, the Banatao Institute at CITRIS leverages University of California expertise and IT solutions for the benefit of developing regions in the U.S. and abroad. As a multi-campus research unit, CITRIS operates from the Berkeley, Davis, Merced, and Santa Cruz campuses, with an underlying mission to shorten the pipeline between a good idea and its impact on all Californians. CITRIS currently facilitates basic and applied research with primary thrusts in sustainable infrastructure and community engagement. At UC Merced, CITRIS has articulated a vision for a Central Valley agricultural science and technology institute that would build on campus strengths and regional needs. This vision seeks to engage industry partners in collaborative solutions. CITRIS has built relationships within the agricultural sector, from individual growers to industries. In order for research to become useful in outreach, CITRIS has partnered with UC ANR to develop a suite of Ag-Tech training courses.

Since 2016, UC Merced has hosted events that showcase the future of agriculture in the Central Valley. **Ag-Food-Tech Week** promotes discussions about the intersections of food production and processing with advances in technology. On March 7, 2019, experts in the agricultural industry were invited to participate in the Ag-Food-Tech (AFT) Executive Roundtable to discuss the future of UC Merced, specifically with respect to the university’s relationship to agricultural production, food processing and technology.

Attendees

Twenty-nine industry leaders were identified via a broad network of UC Merced stakeholders to represent geographic breadth, industry diversity in focus and size, and a mix of functional titles within the company. Care was taken to have representation throughout the region as well as programmatic breadth. Twenty-five executives attended (Appendix, list of attendees).

Proceedings

The Ag-Tech-Food Executive Roundtable was hosted March 7, 2019 at UC Merced.

UC Merced School of Engineering Dean Mark Matsumoto introduced the roundtable, emphasizing recent growth in the School of Engineering and new faculty. Matsumoto characterized the of engineering research at UCM: “We don’t do ag engineering. We do engineering for ag.” Next UC Merced Trustee and Ruiz Foods Founder Fred Ruiz focused on the potential of technological advances, including artificial intelligence, and the importance of retaining talent in the San Joaquin Valley.

Professor Joshua Viers, CITRIS Director, presented a vision of Ag-Food-Tech at UC Merced, noting recent accomplishments and emerging opportunities for the university and its student body through the pursuit of agricultural research.

Viers offered a developmental timeline for UC Merced Ag-Food-Tech research alongside the growth of other UC campuses and two regional CSUs, suggesting that at the current rate, the university will match its peers in 2065. By comparison, UC Merced was established a century after the other “ag schools” and is relatively small (Table 1). With aggressive effort to grow research funding, the campus could achieve the same level of growth by 2030. He also presented data on Agricultural and Natural Resources and the Agricultural Experiment Station (AES) funding, which UC Merced currently does not receive. Three other University of California campuses (Davis, Riverside, and Berkeley) are funded with \$165 million, ranging from \$38 to 86 million per campus. Viers noted that several internal UC reports have identified the potential of UCM research to fill the substantial needs of the Central Valley agriculture, especially in robotics and informatics.

We don’t do ag engineering.

We do engineering for ag.

—Mark Matsumoto,
Dean of the School of Engineering

PARTICIPANT INSIGHTS

The presentations by UC Merced leadership were followed by a facilitated feedback session. The purpose of this session was to identify emerging and desired technological trends in agricultural production and food processing, articulating needs in skill development for the future labor market, and guiding next steps as UC Merced positions itself within the region, state and beyond.

In the feedback session, participants were invited to reflect individually and in small groups on specific questions in a twenty-eight item survey. The survey was divided into the following sections:

- Closing the Gap (“to becoming a recognized leader in Ag-Food-Tech, bringing added value to the region in research, education, and outreach”)
- Perspective on UC ANR (Agriculture and Natural Resources)
- Personal Perspective
- Industry Perspective
- Perspective on Research
- Perspective on Higher Education
- Perspective on Outreach

To ensure that attendees had adequate time to consider the items in depth, the questions in the first section, Closing the Gap, were part of a facilitated discussion. Participants were asked to meet in small groups to identify the Must Do’s and Must Not Do’s for the future of UC Merced and Ag-Food-Tech, as well as identify their own opportunities to act in support of future agricultural research. The small group discussions informed individual responses, which were submitted via paper survey.

Institution	Year Est.	Enrollment	Faculty*	Dedicated Facilities include:
UC Merced	2005	8,500	233	No dedicated facilities
UC Davis	1905 AES, 1959 campus	38,000	1,726	USDA Smart Farm World Food Center Ag Sustainability Institute
UC Riverside	1907 AES, 1959 campus	23,000	840	AES Citrus Research Center California Agriculture and Food Enterprise
Fresno State	1911	25,000	579	Center for Irrigation Technology BlueTechValley
Cal Poly SLO	1901	22,000	665	Boswell Agricultural Technology Center

Table 1. A sample of agricultural universities in California. Established in a new agricultural and technological era, UC Merced is building capacity. *All fields ladder-rank faculty.

Alpinista Consulting and CITRIS received eighteen handwritten surveys from roundtable attendees. These surveys were transcribed and put into a spreadsheet, and scanned images of the original surveys were accessible for analysis. Survey data was analyzed in the spreadsheet by identifying patterns within each individual survey response and across each open-ended item's responses across all surveys. Yes-No question responses were tallied across all surveys. For scaled items, averages were calculated and compared. Overall themes are presented below, along with themes identified through a Strengths, Weaknesses, Opportunities, Threats (SWOT) analysis framework.

THEMES

- Attendees indicated a strong interest in continuing to participate in strategic discussions like the roundtable about the future of UC Merced and its role in agricultural research in the region. Of the respondents, **83% indicated they would continue advising and providing industry perspectives while UCM grows in Ag-Food-Tech**, ensuring that research and innovation is useful to the region.
- Respondents delivered a mostly positive response with respect to whether UC Merced would benefit from more Agricultural and Natural Resources support and involvement (Fig. 1).
 - Half of the respondents suggest enthusiasm for increased ANR coordination. There may also be some lack of understanding about the potential benefits of the AES designation, including associated funding, and what would be required in order to receive this designation.
 - “No” comments suggest wariness about further investment in research and development over addressing practical challenges or commercialization. A possible explanation for this perspective is that some companies do not directly benefit from UC ANR: in response to “To what extent does your company benefit from UC ANR,” with a scale of 0 = not at all, 5 = great deal, the average across responses was a tepid 3.15.

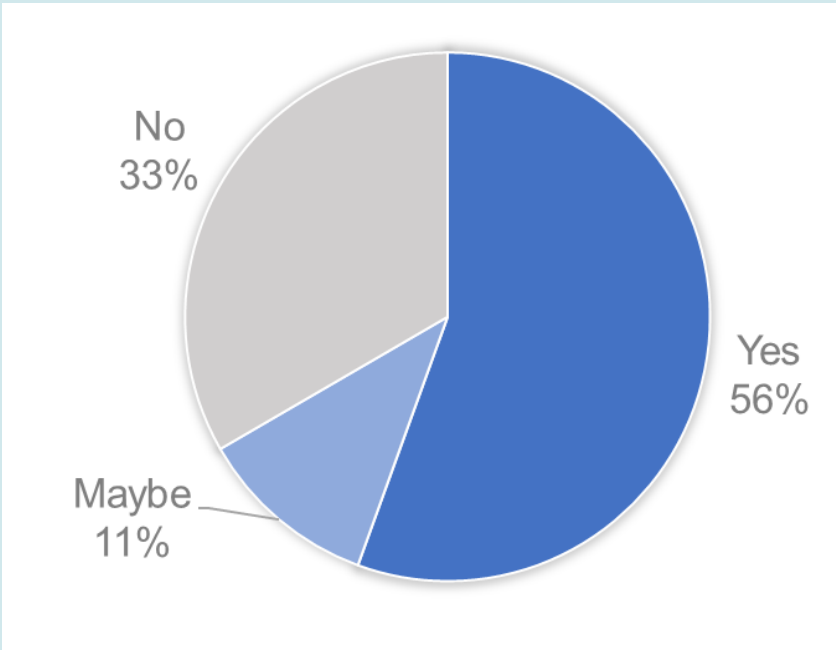


Figure 1. Should UC Merced increase coordination with UC ANR and seek unique funding opportunities? **Most participants were supportive of partnering across UC’s existing programs.**

SURVEY ANALYSIS

THEMES

- Respondents recommended “Must Do’s” for success: distinguish and develop a key niche for the university to excel within. Participants shared enthusiasm for UC Merced to pursue agricultural research, especially if research focus aligns with industry needs.
- Respondents recommended “Must Not Do’s” for success: the most common responses shared a cautionary perspective, advising UC Merced to avoid duplication and unnecessary competition with other universities. Attendees emphasized the importance of identifying and recruiting more of and the “right faculty” to serve in the School of Engineering.
- Participants identified industry challenges that could benefit from additional research, education and outreach: Sustainability, mechanization, automation, providing for the increasing demand for healthier products, and a shrinking workforce were the most frequently cited industry trends.

Don't be an ag school. That constituency is farmers. Be a food school. The constituency is all humans.
—AFT Participant

- The current UC Merced programs that received the highest indication of interest were:
 - Joining a research consortium with other like-minded companies,
 - Innovation Design Clinic,
 - Engaging a specific faculty member and lab on directed research, and
 - Engaging a graduate student team on a semester long project.

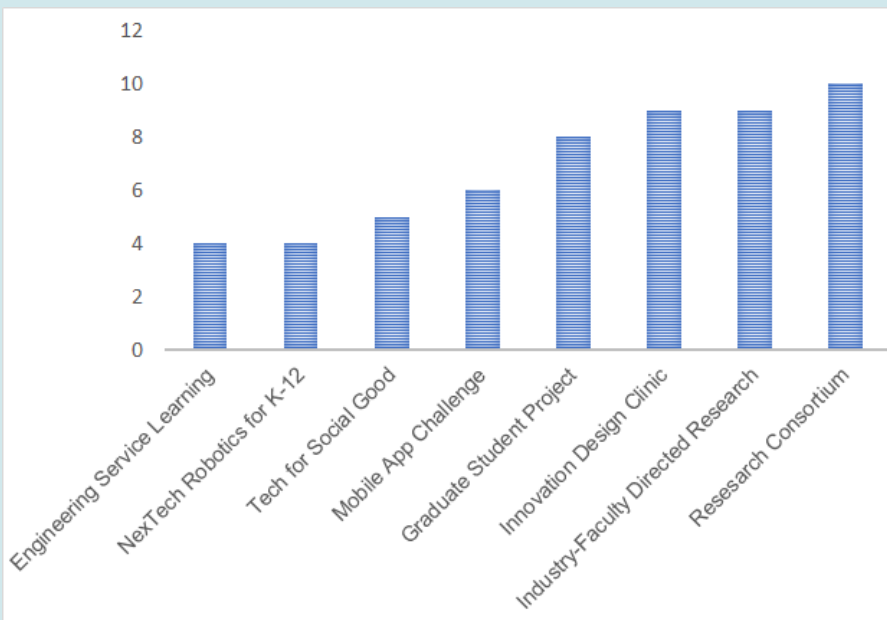


Figure 2. Which UC Merced Ag-Food-Tech programs are you most interested in participating in? Most participants were interested in supporting and participating in more than three programs, especially working on research.

- Respondents identified areas to help serve industry needs and help UC Merced students find careers in the Ag-Tech space. UC Merced can educate for specific workforce development gaps identified by participants:
 - management and leadership;
 - communication, writing, interpersonal skills, flexibility;
 - technical knowledge and knowledge of the industry.

What our industry needs right now are sensors for irrigation quality and robotics. We also need new employees who can communicate.

—AFT Participant

- Responses indicated that the companies represented at the roundtable place a high value on continuing education (average of 4.7 on a 0 – 5 scale), but a lower emphasis on executive education, in particular (average of 3.8 on a 0 – 5 scale).

- AFT Executive Roundtable participants may represent a distinct portion of the industry because of the high emphasis placed on research. Most respondents characterized the value their company places on research in the high (n=10) and medium (n=5) categories.

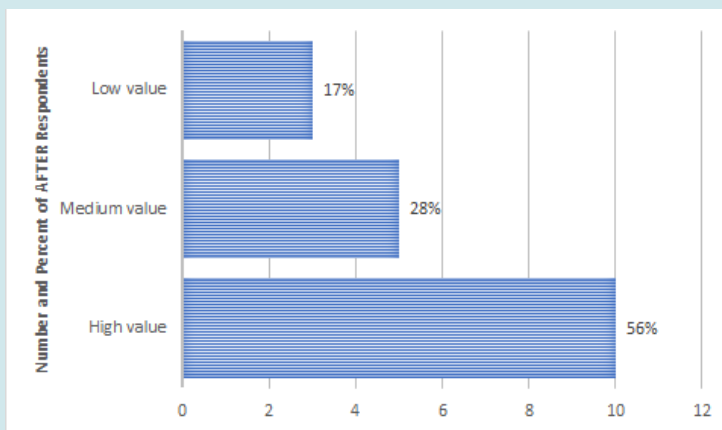


Figure 3. What value does your company place on research? Half of the AFT participants indicated that there is a high value (marking 4 or 5 out of 5) for their company.



Overall, respondents clarified the workforce landscape, educational needs for the industry and areas of growth. They identified pathways for success for UC Merced in the Ag-Food-Tech space and improved understanding of future partnerships. The discussions will continue in future events, including subsequent Ag-Food-Tech Executive Roundtables.

SURVEY ANALYSIS

Typically, the purpose examining strengths, weaknesses, opportunities and challenges is to study the internal and external environments of an organization through the identification and analysis of its strengths and weaknesses, and the opportunities and challenges to which it is exposed. This modified-SWOT analysis is intended to clarify strategic options for UC Merced, CITRIS and SoE as interdependent organizations. For the purposes of this summary, we used the SWOC lenses to interpret survey responses and to inform recommendations for action.

STRENGTHS

- Some attendees report that their companies already benefit from partnerships with universities that receive ANR funding.
- Attendees, who represent a variety of leadership perspectives/roles/disciplines, perceive direct benefits to UCM partnership.
- UCM and SoE faculty have extensive capacity and expertise.
- UCM's demographics mirror those of California and the region.
- UCM's dedication to sustainability and interdisciplinarity lends to the potential for robust contributions to the field.
- As a new and developing university, there is considerable opportunity to shape the future identity of SoE, the UC, and the region.
- The university's location places it at the center of needs and advances in ag-food-tech, making it ripe for partnership. UCM is positioned to make meaningful contributions that shape the future of ag-food-tech.

OPPORTUNITIES

- Many attendees are enthusiastic about UCM engaging in agricultural research.
- The opportunity to shape the direction of Ag-Food-Tech research seems to be an attractive opportunity to industry partners. Attendees demonstrated high engagement during the roundtable and willingness to attend future meetings that help support UCM explore strategic direction. Most respondents indicated wanting to participate in 3-5 existing programs on campus.
- If a niche is identified, attendees demonstrated optimism that UCM can meaningfully contribute to ag-food-tech industries in the San Joaquin Valley.
- Industry needs are not viewed as being fully met by other academic institutions in the region. In response to "What do you see as your industry's greatest needs in five years?" One response captured the group's conversation: "Greater alignment between education and industry."
- Industry partners have practical needs that can be address through partnership: "Help with harvesting of our berries, labor is very tight, fields have gone not harvested and rotted. Traceability of fruit and vegetables. Need mechanical harvesting solutions."
- UCM's current activities are viewed as valuable to industry partners and worthy of further investment (i.e. workforce development, sustainability and climate change, sensor development).

As baby boomers retire, we will see major gaps in the workforce.
—AFT Participant

Watch out for intellectual property barriers. More often than not great solutions are not sent out for industry to use because of this.
—AFT Participant

WEAKNESSES

- Some respondents indicate skepticism about university and industry partnerships and a desire for universities to integrate more practically with industry.
- Respondents indicate mixed attitudes about whether UCM should take more time to reflect on strategic options before pursuing more research opportunities in agriculture and food production.
- UCM is still relatively small and young compared to other universities that pursue similar research.
- As a new university, UCM's reputation is still being established and it may not yet have as much credibility as some of its peer institutions.
- Implicitly or explicitly, the perception of not doing agricultural research makes it harder to do agricultural research: for example, it takes a lot of logistics to setup experiments because there are not standard protocols.

CHALLENGES

- Attendees view the efforts of universities engaged in agricultural research as potentially duplicative, creating unproductive competition between UC Merced and other universities (e.g. UC Davis has a substantial presence in the veterinary studies space): “there are plenty of others already existing; concentrate on workforce development.”
- If UCM employs a strategy without thoughtful planning or the reverse—paralysis by analysis—it is likely to lose the support of some industry partners.
- Partnership with universities may be viewed with some skepticism by certain industry leaders, and without intentional cultivation of such partners UCM may miss an opportunity to build credibility and support with influential stakeholders.
- Of the 18 people who responded to the question of further integration with ANR, 10 agreed that UCM should be more connected to ANR, 6 indicated No, and 2 Maybe. With one-third of respondents indicating “No”, UCM may need to do more outreach regarding their existing ANR footprint and further inform stakeholders.

ACTION STEPS



This set of recommendations has been developed based on survey responses and discussion among attendees during the Executive Roundtable.

Partner with Regional Leadership Group like the AFTER Attendees

- Share this report with the Ag-Food-Tech Executive Roundtable invitees and invite comment.
- Invite leaders back for a specific planning session to further develop strategic approach.
- Provide additional information to stakeholders about the Agriculture and Natural Resources Agricultural Experiment Campus designation, associated funding, feasibility of receiving such designation, and the risks and benefits.
- Consider creating an advisory committee if an ongoing need for guidance from industry leaders will be needed to move forward. If there is no apparent need for an ongoing committee, invite attendees to contribute feedback in an ad hoc, but structured, format like that of the roundtable.

Integrate with UC Agriculture and Natural Resources

- Meet with federal and state elected officials to explore Agricultural Experiment Campus designation and funding opportunity.
- Identify and share feasibility of other funding sources (e.g. industry-funded research) with stakeholders.
- Conduct individual interviews with stakeholders with informed perspectives on particular issues, such as university-industry partnership or the use of particular technologies within domains of industry.

Invest in Programming

- Develop a research consortium that companies can take part in alongside peer companies.
- Continue to invest in current programs, such as the Innovation Design Clinic, partnering with faculty on specific projects, and engaging graduate students on a semester-long project.
- Increase continuing education opportunities for companies to provide to employees. While executive education may continue to be of interest, responses indicate a significantly higher interest in continuing education than executive education.

CONCLUSIONS

UC Merced is poised to be a testbed for solving global issues of food, energy, and water sustainability with industry partnerships.

As UC Merced grows, opportunities to broaden and deepen its strategic impact in the San Joaquin Valley will be created and cultivated. Industry attendance at the Ag-Food-Tech Executive Roundtable and interest in attending future meetings suggest a high level of enthusiasm for partnership between regional industry leadership and UC Merced.

In summary, UC Merced, School of Engineering, and CITRIS are well positioned to be regional leaders in agricultural science and technology. Given the socioeconomic challenges found through the San Joaquin Valley, including widespread economic poverty, environmental health concerns, and persistently low educational outcomes, UC Merced may be a key component to ameliorating these issues.

UC Merced is ideally located to be a catalyst in this dynamic place, leveraging unparalleled agricultural productivity and university engagement and innovation to build emerging ag-food-tech opportunities and promoting pathways to prosperity. UC Merced is poised to be a testbed for solving global issues of food, energy, and water sustainability, and with industry partnerships, it can address challenges within the region by:

1. **bringing new investment** to the region in the form of both **financial and intellectual capital**;
2. **developing educational programs of excellence** at all levels that integrate disciplinary theory with applied practice in core areas of agricultural production;
3. **catalyzing novel breakthroughs** in agricultural science and technology through high impact research and development;
4. **translating these educational and research outcomes into widespread practice**; and
5. **creating a platform for innovation, and a commensurate culture for entrepreneurial enterprise.**

With a focus on next-generation agriculture, UC Merced can become the regional leader in technological solutions to the most pressing issues and, in turn, ignite socioeconomic transformation.

APPENDIX

Appendix List of Ag-Food-Tech Executive Roundtable Attendees

Name	Title	Organization
Tom Bower	Vice President of Supply Chain	Foster Farms
Donna Lynn Browne	Director of Food Safety & Social Responsibility	Natureripe Farms, LLC.
Jeffrey Dahl	Thermal Porcessing Business Manager	John Bean Technologies Coporation
John Duarte	President	Duarte Nursery, Inc.
Randy Fiorini	Managing Partner Vice-Chair of Delta Stewardship Council	Fiorini Ranch, Farmco
Jaylen French	Director	Community & Economic Development Department, City of Modesto
Anna Jackson	Founder & Principal Consultant	Alpinista Consulting
Sumer Johal	Founder	Agralogics
Emily Lawrence	Executive Director	National Ag Science Center
Mel Machado	Director of Member Relations	Blue Diamond Growers
Aaron Magenheim	CEO & Founder	AgTech Insight
Rob Neenan	President & CEO	California League of Food Producers
Rick Palmer	President	Morning Star Company
Fred Ruiz	Co-Founder Chairman Emeritus of UC Merced Board of Trustees	Ruiz Foods

Name	Title	Organization
John Salmonson	Chair, Co-Investment Comm.	Central Valley Angels Group
Gary Shulz	CEO & Founder	Vistage Worldwide Inc.
Jennifer Shipman	Talent Acquisition Partner Relations Manager	The Wine Group
David Souza	Founder, Master Distiller	Corbin Cash Sweet Potato Spirits
Roger Sturdevant	EVP and Division Manager of Agribusiness (retired)	Bank of the West
Alessandro Turatti	President & CEO	Turatti North America
Richard Waycott	President & CEO	Almond Board of California
Brett Zall	PV Human Resources	Lyons Magnus
Hector Cuevas	Assistant Director	Center for Career and Professional Advancement, UC Merced
Stefano Foresti	Associate Director Director of Innovation	CITRIS School of Engineering, UC Merced
Sang Han	Associate Vice Chancellor and Chief Development Officer	External Relations, UC Merced
Ed Klotzbier	Vice Chancellor and Chief External Relations Officer	External Relations, UC Merced
Mark Matsumoto	Dean	School of Engineering, UC Merced
Joshua Viers	Director and Professor	CITRIS and School of Engineering, UC Merced