International Food Automation Networking Conference

Business of the Future

Conference Report

Georgia Tech Research Institute Conference Center
Atlanta, Georgia, USA
April 25-26, 2016

Hosted by
Business & Manufacturing Consultancy
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Agricultural Technology Research Program
Georgia Tech Research Institute
Atlanta, Georgia USA

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Foreword
By 2016 IFAN Conference Co-chairs
Koorosh Khodabandehloo, BMC-Business & Manufacturing Consultancy, UK
Doug Britton, Georgia Tech Research Institute, USA

Competitiveness and sustainability in the supply of food continues to be a challenge for all processors and manufacturers of food. Delivering food that meet market demands in respect of nutrition and value has been the challenge for the industry. Production in the primary areas of food processing, particularly the meat sector continues to be labour intensive, whilst traceability and food safety remain a priority for the industry. If we are to achieve improvements that have significant impact, close interaction between end-users and technology providers is essential, especially where new developments are demanded, making advancements that meet the specific requirements.

The IFAN conference is proud to have had a part to play in bringing key players to a single event where the opportunities can be identified and discussed, whilst facilitating the prioritization process in the adoption of much automation by networking.

The first industrial robot in a welding application was installed in 1959, spot welding cars. The first meat cutting for pork primal went into operation as a commercial system in 2003. The car industry continues to be the biggest user of industrial robots and this required the concerted effort on the part of users as well as the suppliers of robot technologies. The past 30 years show that the meat industry, and in general the food sector has not had the same rate of progress as in the conventional manufacturing sectors. One contributing factor, is the motivation of the robotic community to be more involved with application research delivering solutions to the food or meat sectors.

The first IFAN held in USA has been a great success to present the state-of-the-art. This document proudly presents the findings and the outcome of the meeting, inviting participation at the next event in April 2018.

The 2018 event will be a unique opportunity for everyone to meet likeminded people and to engage opposing views, an important necessity in the learning process, contributing to formulation of sustainable solutions for the future. See you in 2018 at Georgia Tech and we look forward to welcoming you.

Conference Co-Chairs

Doug Britton    Koorosh Khodabandehloo
Executive Summary

The 2016 International Food Automation Networking (IFAN) Conference was held for the first time ever in the United States at the Georgia Tech Research Institute Conference Center on April 25-26. More than 70 food and allied industry professionals representing seven European countries, the United States, Canada, and Australia attended the two-day event, which focused on automation and technology R&D challenges/opportunities for creating the food processing system of the future.

Twenty-four presentations were delivered over the two-day conference by speakers representing international food and meat processing companies, equipment manufacturers, trade associations, government research agencies, and academia. Three keynote presentations provided insight on what is required for successful automation in the food industry with emphasis on the need for companies to make strategic R&D investments, while the remaining 21 presentations covered topics across six conference themes:

Opportunities and Challenges
Presentations provided perspectives on the opportunities and challenges facing differing food industries, including health and convenience foods, red meat, and quick service restaurants.

Primary Processing
Presentations focused on the motivations, challenges, and requirements for automating food and meat plants.

Secondary Processing
Presentations discussed next-generation machinery for poultry and meat production as well as food packaging operations.

Intelligent Systems and Technology
Presentations provided overviews of vision/image analysis technologies for beef, pork, lamb, and poultry carcass quality grading and defect inspection as well as agricultural robotics developments.

Innovative Processing and Operation
Presentations described flexible automation and digital manufacturing advancements for food and meat production.

Initiatives, International Collaboration, and Factories for the Future
Presentations highlighted private-public partnerships pursuing innovative R&D in food and agriculture.

In addition to the themed presentations, a roundtable discussion was held where attendees shared their ideas on R&D pursuits for the food business of the future.

Overall, IFAN 2016 helped define R&D opportunities and challenges facing the international food and agriculture business. It is the first step in fostering global information exchange and collaborative efforts to build the technologies needed for the food factories of the future.

For information on the next IFAN Conference, visit www.ifan.gtri.gatech.edu.
Keynote Presentations

Advancement and Opportunities in Food Production
Presenter: Bill Crooks, Pilgrim’s, USA

Bill provided insight on what is required for successful automation in the food industry. He stressed that any viable innovation must be safe, reliable and maintenance-friendly, improve efficiency and yields, and provide a return on investment (ROI) in less than three years.
Automating the Food Factories of the Future

Presenter: Chad Ware, Marel, USA

Chad highlighted Marel’s history from an innovative start-up to the leading global provider of advanced processing systems for the poultry, meat, and fish industries. He stressed the company’s multi-million-dollar R&D investments as key to transforming the way food is processed. He highlighted several of Marel’s innovations, ranging from food traceability systems to robotic advancements.
Strategic R&D – Meeting the Challenge

Presenter: John McGuren, AMPC-Australian Meat Processor Corporation, Australia

John discussed several of AMPC’s R&D investments in meat processing technology and automation for Australian red meat processors. He argued that the major challenges and risks to strategic R&D are economics, technology performance, systems integration, industry capacity and ability to absorb technology, and change management/training, to name a few.
Conference Theme – Opportunities and Challenges

Food Automation: A World Class Retailer’s Perspective

Presenter: Simon Lushey, Marks and Spencer, UK

Simon gave an overview of Marks and Spencer, a market leader in health and convenience food in the United Kingdom that sells products under its own label. He stressed three drivers behind food automation: increasing population to feed, decreasing labor availability, and demand for greater value in food. He also described Marks and Spencer’s perspective that automation needs to be: flexible, affordable, collaborative, process-strategic, and integrated. He argued the more risk taken, the greater the reward, stating that “If it’s not radical and disruptive, it’s not innovative.”
Innovation in Meat R&D – Opportunities for Red Meat Applications

Presenter: David McKenna, Tyson Fresh Meats, USA

Dave discussed the notion that innovation equals automation. He argued that the perception of labor reduction as a driver is outdated. Instead, yield is the key. And the value of innovation lies in making process complexity efficient. Individual carcass optimization is the future; however, there are key challenges going forward, including physical space constraints and processing line speeds.
Challenges for the Meat Business

Presenter: Francisco Requena, FACCSA - PROLONGO, Spain

Paco discussed the challenges facing the meat business, stressing that resources are limited, and industry must find ways to adapt. Concerns include greenhouse gas emissions, global trade, and global consumers. He provided an overview of key challenges, including diet, models of growth, on-line sensing, logistics, and information systems.

ACTIVITIES

- Slaughtering
- Cutting and deboning
- Packing room
- Cold Store
- Tripe plant
- Process plant

ONLINE SENSING

- Hygiene
  - Bacterial detection/identification
    - A: non-invasive, non-destructive online measure
    - Lab-on-a-chip
  - Automation and decision making
    - Meat traits: color, tenderness, whc, ...
- Quality control
  - Animal feeding via fatty acids analysis
  - Packing control: foreign object detection, ...

INFORMATION SYSTEMS

- Market knowledge
  - Social networks
  - Big data
  - Social Physics
  - Production
    - Augmented reality
    - Gamification
  - Process optimization
  - Smart production

- Automation at all levels
  - Livestocks
  - Industry
  - Logistics

• Food production generates the 25% of GHGE
• Food production uses 50% of ice-free surface of the planet
• If all inhabitants in China should eat the same amount of meat that EU citizens, the system will not be sustainable
• 2,100 millions of overweight people
• 800 million people are hungry or under nourished in 2015
The Future for Quick Service Restaurants

Presenter: Brian Franklin, Chick-fil-A, USA

Brian highlighted Chick-fil-A’s strategy for business growth. He stressed the company’s supply chain process and spoke of company-led innovations that have helped address challenges such as transparency, talent acquisition, and quantity over quality.

Chick-fil-A – Who We Are

Corporate Purpose:
To glorify God by being a faithful steward of all that is entrusted to us. To have a positive influence on all who come in contact with Chick-fil-A.

Our Mission:
Be “REMARK”able

Biggest Challenges for Chick-fil-A Supply Integrity

1st Challenge: TRANSPARENCY

2nd Challenge: WAR FOR TALENT
- In our restaurants
- At our corporate Support Center
- At our production facilities

3rd Challenge: QUANTITY OVER QUALITY
How have we helped to grow our business?
- Ensuring that our products, service, and cleanliness are all right vs. alright.
- Innovate
  - Drive Thru
  - Mom’s Valet
  - Face to Face Ordering
  - Double Drive-thru lanes
  - Lean Chicken Program
  - Mobile Pick-up
Conference Theme – Primary Processing

Designing Automation into Existing Plants

*Presenter: Tyler Randolph, FPL Food, USA*

Mr. Randolph discussed the motivations, challenges, and requirements plants should consider when thinking of automation. He provided as an example FPL’s case study of its beef processing Trim Management System, which addresses common automation challenges/requirements, namely that it has a rugged design, manual backup, and a human in the loop. He also shared his thoughts on hopes for the future of automated solutions for beef slaughter, including various carcass processing and inspection innovations, wash-down-grade equipment standards, stainless steel-only equipment construction, and access to 3D models of equipment, to name a few.

**Challenges and Requirements**
- Very limited space
- Minimal business interruption
- Large variation in cow size
- Equipment must survive harsh environments
- Having qualified personnel to maintain automation
- Proper training and documentation
- Manual backups

**Motivation for Automation**
- Improve food safety and quality
- Achieve higher overall line efficiency
- Remove human error
- Replace humans for dangerous jobs
- Replace humans at jobs they aren't good/efficient at

**Case Study** Lessons Learned
- Project would have failed without manual backup
- Human in the loop
- Partner with right team
Modern Plants – Total Solutions

Presenter: Antoine Winkelmolen, MPS-Meat Processing Systems, USA

Antoine provided an overview of what he argues is the next generation of automation for meat plants. He stressed that robotic solutions are more robust, very dependable/reliable, and freely programmable multi-axis machines enable optimal/precision cutting. He also noted that MPS has developed innovations with added features that deal with harsh conditions in meat plants, including hygienic operation. He added that machine vision solutions also key to success.
Outside-In Meat Factory

Presenter: Ole Alvseike, Animalia-Norwegian Meat and Poultry Research Centre, Norway

Ole discussed the global challenges facing meat production, highlighting the constant expectations on growth, which include: better prices, lower costs (salaries, pressure on suppliers, volumes, plants, equipment, etc.), and more efficient production (smarter or faster). He also provided an overview of an innovation project underway known as Meat 2.0 – The Meat Factory Cell, which seeks to define solutions for greater flexibility in meat production practices.
Conference Theme – Secondary Processing

Advances in Poultry Machinery: Industry 4.0

Presenter: Oliver Hahn, BAADER LINCO, USA

Oliver discussed the concept called Industry 4.0, which originated in Europe and stands for 4th Industrial Revolution. He explained that the future of Industry 4.0 is a factory in your hand (smart automation = mobile device management capabilities). With Industry 4.0, collaborative data will be used to optimize processing results, and machines will adapt and align themselves based on information from other machines in the process. In addition, Industry 4.0 poultry machinery will take advantage of the adage, “the whole is greater than the sum of the parts,” meaning all machines working together improve the overall product quality and process profitability. He also argued that blue collar and white collar workers will blend to accomplish Industry 4.0 and that a skilled workforce and enthusiasm are key to its success.
Automation in Food Packaging: Primary/Secondary

Presenter: Craig Souser, JLS Automation, USA

Craig provided an overview of technologies developed by JLS Automation. He also gave his ideas on what the future holds for automated food packaging operations. Key concepts discussed included remote access (utilizing the Internet of Things), data mining, vision sensing/3D, EOAT (end-of-arm tooling) advancements, and collaborative robots.
Automation for Meat Production

Presenter: Koorosh Khodabandehloo, BMC-Business & Manufacturing Consultancy, UK

Koorosh discussed various robotic systems developments from the mid-1980s to 2015, highlighting the progression of automation for meat production. He outlined the key motivating factors for automation such as safety and work-related health issues, yield improvements, labor shortages, quality and consistency, and operations control, among others, highlighting reduction in absenteeism, which is costing billions of dollars per year, needs to be the main driving motivator for industry to adopt automation. He also stressed that many tasks still need automated solutions, and argued that skilled robotics, not intelligent robotics, will be the solution.

Automation vs Employment

Patterns of absence
- Average rates of absence across Europe are between 3% and 6% of working time.
- Estimated cost is about 2.5% of GDP.
- Emphasis has been on promoting well-being and this must continue
- Specific stated headline figures range from 0.8% in Italy to 7.7% in Norway (meat sector 20%).
- US Manufacturing productivity loss $2.8b/year

Source: European Observatory of Working Life

20,000 robots per year may be installed with this money, but this would deal with only the absenteeism in Norway.

The installation work to install 20,000 robots could take over 10 years.
Conference Theme – Intelligent Systems and Technology

On-line Instrumental Evaluation of Meat Quality

Steven Shackelford, U.S. Meat Animal Research Center, USA

Steven gave an overview of vision/image analysis technologies developed by the U.S. Department of Agriculture’s Meat Animal Research Center, a research unit focused on beef and pork. He discussed MARC’s work in vision quality grading, yield evaluation, and tenderness prediction. He also highlighted the Center’s vision live cattle system, which is a low-input method that allows feedlots to accurately predict the optimal time to feed calves. Over- and underfeeding affect yield and thus profits, so any ability to optimize feed levels is beneficial.

Instrument grading research

- Prediction of tenderness
  - VISNIR technology commercialized in 2005
  - Used by NRTAB

Vision Live Cattle System

- Can we predict yield grade?
  - 1,440 calf-fed steers and heifers imaged <10 days prior to harvest.
  - Grading camera data collected.
    - 240 w/ and 240 w/o Zilmax
    - Implant × Optaflexx
    - Diverse beef genetics.
  - Lots of variation....
Vision Systems for Beef, Pork, Lamb, and Poultry

Presenter: Horst Eger, E+V Technology, Germany

Horst discussed several E+V vision-based technologies. Systems already in market include beef carcass grading, sheep/lamb/veal carcass grading, pork carcass grading, pork primal cutting, pork primal grading, and poultry grading and defect inspection. Systems currently being developed include live cattle grading, tray inspection, liver inspection, and bone inspection (system for determining amount of meat left on bones after processing).
Learning from Other Robot Applications – Agricultural Robotics

Presenter: Pål Johan From, Norwegian University of Life Sciences, Norway

Pål Johan provided an overview of robotic systems developed by the Robotics and Control Group at the Norwegian University of Life Sciences, Norway’s main agricultural university. He spoke of a four-year research initiative underway titled Innovative Flexible Food Processing Technology (iProcess). The project seeks to develop novel concepts and methods for flexible and sustainable food processing in Norway, increase raw material utilization efficiency, and increase profitability. He argued that agricultural robots will be widely used by 2025, estimating 1 million robots performing tasks ranging from physical work in the field to surveillance/mapping. He stressed flexible solutions are most needed; robotic developments must address natural and structural variability in products and resource efficiency (reduce inputs and loss).
Carcass Classification and Quality Measurements in Pigs

Presenter: Henrik Andersen, Carometec Food Technology, Denmark

Henrik highlighted several Carometec products developed for pork processing operations. He described how two products, the NitFom™ and AutoFom™, work in a pork plant. The NitFom™ provides information on product quality, slicing yield optimization, fat melting point, and shelf life, while the AutoFom™ provides information on carcass optimization and yield management.
Alan Spreckley, ABB, Global

Alan argued that automation will be key to producing enough food to feed the global “population explosion,” referring to the estimate that by 2050 there will be 9 billion people in the world. He said countries must rethink food production while considering global economic, demographic, labor, and consumer trends, all of which he believes favor automation, even force it. He noted that with advances in vision systems and robotic grippers, robotic technologies are becoming more flexible and suitable for various human-related tasks. Automation provides benefits in every process step, including improved safety, reliability, efficiency, and capacity. He also gave an overview of several ABB robotic and automated systems for food processing applications and their benefits.
IT – Solutions in the Meat and Food Industry

Presenter: Klemens van Betteray, CSB-System AG, Germany

Klemens provided an overview of digital manufacturing initiatives across Europe. He also highlighted several Industry 4.0-based advancements by CSB-System, all of which provide network and data integration to address food processing quality controls, including traceability and quality management, as well as process efficiency/sustainability. He argued that Industry 4.0-ready automation provides a step-by-step pathway to the smart food factory.
Robotic Sensing and Grasping Research for the Food Industry

Presenter: Ai-Ping Hu, Georgia Tech Research Institute, USA

Ai-Ping discussed robotics research underway in the Food Processing Technology Division at the Georgia Tech Research Institute. He explained the division’s research approach focuses on developing robotic solutions that can perform in unstructured environments and interact with deformable objects. He calls this approach Robotics 2.0, and provided several examples of food processing applications where the approach could be used. He highlighted a recent project that focuses on the bin picking application, where dynamic sensing and grasping capabilities are implemented into a robotic system that mimics how human workers perform the task.
Roll It – Efficiency by Automation

Presenter: René Senn, Neumeyer AG, Switzerland

Rene provided an overview of Neumeyer’s Roll It technology, a one-machine solution for rolling, wrapping, and folding food products. The innovative machine can be adjusted to perform each of the tasks individually, for example, rolled slice, wrapped sausage, or filled roll. He commented on the advantages of rolled products, key among them being products that are ready to eat out of a tray and constant quality.
Conference Theme – Initiatives, International Collaboration, and Factories for the Future

Horizon 2020 – Factories of the Future

Presenter: Jan Ramboer, European Commission, Belgium

Jan described Europe’s research and innovation strategy for creating factories of the future known as Horizon 2020. One objective of the public-private partnership is to integrate and demonstrate at least 40 innovative manufacturing technologies in six areas: high-tech manufacturing processes and systems, adaptive and smart manufacturing equipment, intelligent and holistic processes to increase performance using ICT (information and communication technologies), collaborative and mobile enterprises, human-centered manufacturing, and customer-focused manufacturing. He also highlighted several current factories of the future projects.

Five of the Priority areas from Juncker’s Agenda:
- To boost jobs, growth and investment;
- To realise a connected digital single market;
- To implement a resilient Energy Union with a forward looking climate change policy;
- To develop a deeper and fairer internal market with a strengthened industrial base;
- To make Europe a stronger global actor

The Framework Programme Horizon 2020
- Excellent science, Competitiveness, Better society

New R&I Strategic Priorities
- Open Innovation
  - Reforming the Regulatory Environment
  - Boosting Private Investment in R&I
  - Maximising impacts of Horizon 2020
- Open Science
  - Better Science through openness
  - A research Integrity Initiative
- Open to the World
  - International Cooperation for Global Challenges
  - Science Diplomacy

Europe’s Factories of the Future Association
- Representing private side in ‘Factories of the Future’ PPP
- 156 members (Largo, SME, RTD etc.)
- An experienced, engaged and motivated community
- Actively promotes Factories of the Future PPP & projects
- Collaborates closely with EC to develop strategic research agenda (‘roadmap’)
- Supports members from across Europe

Projects
- Project PicknPack
  - Flexible robotic systems for automated adaptive packaging of fresh and processed food products
  - http://www.picknpack.eu
  - Start: October 2012
  - End: September 2016
  - €8.8m in EC funding
- Expected impacts:
  - cost reduction
  - greater hygiene
  - efficient use of resources

Join EFFRA
- Shape the new multi-annual research roadmap for FoF
- Participate in the upcoming FoF call 2017
- Work Programme available at EC Participant Portal
- Come to the 2016 FoF Information Day on 14th October 2016 in Brussels, Belgium
- Contact me jan.ramboer@ec.europa.eu
Future Agriculture and Food Research Initiatives

Presenter: Lowell Randel, NAAAS-National Association for the Advancement of Animal Science, USA

Lowell gave an overview of the history of animal science research funding in the United States. He described NAAAS’ role in advocating for increased funding for animal science, which led to an authorization of $25 million allocated to the U.S. Department of Agriculture for a competitive grants program focused on animal science-based research projects. He also mentioned the Foundation for Food and Agriculture Research, which was established as a non-profit foundation with seed money from the U.S. government to fund innovative R&D projects. He outlined likely areas for increased research funding, including antibiotics, foreign animal disease, avian influenza, and genomics. He concluded by arguing that academia, industry, and other stakeholders all have a role in advancing animal science research.
Agricultural Technology Research at Georgia Tech

Presenter: Doug Britton, Georgia Tech Research Institute, USA

Doug discussed several research projects underway in the Georgia Tech Research Institute’s Agricultural Technology Research Program. The projects range from addressing the future of poultry production and processing to food safety sampling and sensing to agri-robotics. He shared his thoughts on what the poultry industry will look like in the future, arguing that pushing boundaries in R&D will be critical to creating transformational innovation. He provided an overview of an initiative underway called Poultry 2050 Vision, which seeks to fundamentally rethink the poultry processing and production system. The main objective being to pursue an integrated, systems-based approach focused on food safety, environmental impact, animal well-being, and labor/automation.
Roundtable Discussion

Ideas for the Food Business of the Future

A roundtable discussion was held where attendees shared their thoughts on the types of automated solutions needed for the food production system of the future.

- Modular automation for different steps in the process
- How to hold onto chicken parts until complete process is finished
- Legislation and industry to rethink processes to allow next generation of processing automation using robots; must consider legislation/regulation when attempting to change process
- More collaborative robots suitable for food; industry education to increase viability and calm fears concerning labor displacement
- Simplified solutions for beef packaging
- How can efficiencies be achieved at small scales; is there potential with new technology to have disperse and diversified food industry that is in many locations that creates a different food in place or local food system that has efficiency, safety, lack of cross-contamination, more lower risk in production
- Learn more about the variations in beef, poultry, pork measurements to help automation
- Develop more flexible tools for standard machines; develop more specialized machines
- Need fundamental data sets that characterize carcasses and carcass variations to build intelligence into machines
- Ensure more government acceptance, recognition, commitment, and investment in research, education, and technology and leveraging that across economies
- Handling of fully cooked products, how to maneuver them in ways that are nonstandard
- Use the enhancement of vision technology and apply to robots to catch chickens
- Develop better coatings and materials for articulated robots
- Have a common platform for information interchange in such a way that all the equipment coming from different manufacturers may be easy to integrate in individual plants, but not through a software engineering project
- Research is a long-term investment and should be in line with the strategies of companies to ensure needed/wanted technologies are developed; strategic development is important; food security is biggest challenge in future; have to exploit/embrace variation; need communication between industry, scientists, suppliers, consumers, food authorities; invite food authorities into discussion to ensure trust and ease anxieties
- Roadmap for the development and implementation of Industry 4.0 for the food industry; explore collaborative frameworks, structures, and funding mechanisms that would allow creativity and technical ability to break through barriers to transformational change; need appropriate mechanisms to carry conversation forward in a meaningful way
- If food safety responsibility rests solely with industry rather than government, are industry and technology providers ready to provide solutions to ensure the food safety aspect
- New technology must embrace variation and be able to robustly deal with it; there is a disconnect between industry and academia regarding R&D, find a way to bridge that gap for the benefit of both sides
- Need conversation with high school and middle school teachers to develop curriculum for students to prepare for workforce of future
- Think about how labor fits into new developments; think of processes that develop around human-in-the-loop algorithms, what can humans do that machines cannot, and really pinpoint engineering around those issues to keep some level of human jobs
• Take the mystery out of technology to develop systems the public can accept and embrace; remove/explain the unknowns, which are barriers to technology adoption
• Ways to incorporate six degrees of freedom into one robotic arm; look at entire system to identify processes that can be eliminated or modified; design systems that can incorporate flexibility
Sponsors and Contributors

The organizers of this conference would like to say a special “Thank You” to the sponsors of this conference. Without their contributions, the conference would not have been possible.

**AMPC** - The Australian Meat Processor Corporation (AMPC) is the Rural Research and Development Corporation that supports the red meat processing industry throughout Australia.

**e+v Technology GmbH** is a world-wide operating company that has as its main focus the realization of automation projects in the food industry.

**BAADER** is a worldwide manufacturer of innovative machinery for the food processing industry.

The **Georgia Manufacturing Extension Partnership** (GaMEP) offers solution based approaches through coaching and education designed to increase top line growth and reduce bottom line cost.

The **Center of Innovation for Agribusiness** accelerates the growth and development of Georgia’s number one industry by providing focused industry expertise, product commercialization assistance and access to ground-breaking research.