

*Poultry Technology Innovation*

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Poultry production is a globalized economic activity, which must be analyzed not only in the context of production, processing and distribution, but also through a systemic sector approach. In Brazil, this can be considered an example of growth and modernization in Agribusiness, since the activity brings together a model of an effective organization system (integration), cutting-edge technology, qualified labor, productive efficiency and a broad os portfolio product.

In the beginning of the poultry evolution was based on the development of disruptive technological innovations in the main sectors that can be briefly cited:

***Productive Efficiency*** - Evolution through the introduction of specialized lines, based on innovative genetic selection methodologies, new technologies for management, food, health, equipment, facilities, ambience and continuous training of the workforce, among others .

***Product*** - Systemic expansion of the portfolio of industrialized products and improved versions of the existing, adding value to the system and (or) the consumer is a strong point for the majority food companies. From a global point of view, this is the main type of innovation that promotes the sustainability of the sector.

***Services*** - The current market demands require significant changes in the services provided by food companies, since the mere consumer has become the beacon of the paths of innovation. In this sense, companies have been invested in innovation, focusing mainly on new trends in demand for differentiated products, adding value to consumers.

***Processes*** - In Brazil, the poultry production success has occurred through the improvement of methods, flows and solutions aimed at the development of new governance models at the integration, production, processing and marketing and new forms of service provision and operational processes, expanding the organization's effectiveness. These actions created, for example, values for consumers, by increasing productivity and, consequently, reducing the

cost of the product.

**Marketing** - New marketing approaches transformed the way that companies has developing their actions, segmented consumers, established prices, positioned themselves in the market and established the communication channels with consumers, creating differentiation and strengthening the image

**Organizational** - The innovation of companies' organizational structure allowed expanding the competitive capacity, reducing costs and increasing productive efficiency, in all segments. Integration model, used in the poultry production, is an example of success. Internally, the improvement of people management processes, logistics, among others, also determined significant gains for the value chain.

**Business Model** - Poultry companies constantly innovate the business models in order to maintain and (or) expand the competitive advantage. These were comprehensive innovations, as it operated both in the offer to the consumer and in the internal operation model.

These innovations have placed Brazilian poultry production as fundamental in the production of animal protein to meet the needs of a large part of the world population with quality and affordable prices. The chain structure provides for the generation and adoption of technologies quickly and systematically, causing positive impacts on the efficiency and effectiveness of the system.

The technological level added, from production to making the product available to the consumer, is the largely responsible for the chain success. During decades, the Public Research Institutes were principal responsible for the generation and (or) adaptation and, Technology Transfer for the productive sector. Currently, using tax incentives, private companies have implemented their own Innovation projects, acting on specific and prioritized needs. In addition, supply chains have started, as a way of attracting customers, to provide technological innovations generated from Public/Private Partnerships.

Due to the chains complexity and the technological level reached, disruptive innovations became less frequent and, incremental innovations, which do not aim to break paradigms and, even add new non-existent functionalities, became the focus of applied research. In this context, Public Institutions lost space, mainly due to the distance from the productive sector and the difficulties in obtaining resources for the development of applied research and started to work in basic research projects.

The problems have become complex and, therefore, cannot be solved in a simple way, without considering the interaction between the various factors involved in the problems solutions.

Several areas have been the focus for the development of new technological innovations, both disruptive and incremental point of view, that can expand the chain's competitive ca-

capacity, as well as, that meet the market demand and ensure the consumer a quality product. Among the main areas can mention:

## 1. Robotics and Automation

This area has generated great interest by agroindustry due to the potential to reduce the demand for labor and for improvements in production efficiency, consequently reducing the cost of production, in addition to providing animal welfare and quality of life to employees.

Among the various technologies under development there is equipment developed by the “Georgia Tech Research Institute”, called “ChickenBoy”. A robot with image sensors, that circulates on the installations, with the ability to detect and collect eggs on the floor, record and control the temperature, gases and light levels in the environment. This equipment is an autonomous robot suspended from the ceiling, which incorporates artificial intelligence and sensors, which make it possible to assess the conditions of the environment, health, well-being and equipment failures. New resources, including the removal of dead birds and analysis of chicken bed moisture, are under development and, in the medium term, should be made available on the market.

A Brazilian company called AUTAVI is the pioneer in the development of a fully automatic system (robot) to stimulate the consumption of feed and water by the chicken from the housing to the removal of the batch. Preliminary tests have shown that this technology has a significant impact on production efficiency, improving average daily weight gain (6%) and reduction in feed conversion (5%) and mortality (40%), in addition to improving the producer life quality by the reduction of 200 man hours for each batch housed.

In the medium term, the technology will make it possible to include sensors that will allow the monitoring of temperature, ammonia, humidity and thermal sensation indicators, allowing a more detailed analysis of the aviary’s environment. Using technology information and cloud processing, will be possible to control the robot and give technical support remotely. In addition, it will be possible to integrate implements that make to move the bed and to monitor and collect dead birds. In the long term, it will be possible to insert video monitoring technologies for remote verification of the state of the physical installation and the comfort of the birds in order to meet the welfare of the birds.

In the area of slaughter and processing, the use of equipment with high-speed cameras may enable the detection of anomalies in the carcass, for example, “Woody Breast”, and (or) the classification of breast fillets on the production line without contact, and product damage. Muscle stiffness is measured when the fillets move and fall off a conveyor. In addition to this equipment, a 3D virtual system for automatic deboning is being developed and should be

available soon on the market.

## 2. Alimento Seguro

The safe food production is a crucial point for the poultry industry and the development of technological innovations encompass stages of production, processing and storage.

The development of storage boxes, composed of steel structure, can eliminate rust, increase heat dissipation and present greater resistance to washing processes and, combined with an antimicrobial material, which does not present an odor; it should reduce the contamination of the materials, in addition to presenting greater durability. The expectation is that the boxes will be available soon in the market and at competitive prices in relation to the painted cast iron boxes.

Advanced data analysis and bioinformatics tools for the detection of *Salmonella* spp. serotypes, in samples taken during carcass washing and at other critical points in the slaughter and processing line will be important for the accuracy and analysis time, reducing the waiting time of the results, avoiding confirmation delays, costs and the possibility of punishment by the Federal Inspection System due to possible sources of contamination.

## 3. “Big data” and artificial intelligence

The use of the volume and complexity of data available in the poultry company to improve processes and productive efficiency is an opportunity to be explored, therefore, it is necessary to address these challenges in the following ways:

**Feed Control** - estimates the amount of feed available through an application that analyzes the vibration on the surface of the feeder. The management units can be powered by solar energy, indicate the levels of feed, via Web Portal and a mobile application, for the producer, feed mill and integrator. The system maintains a history of the feed levels of each feeder and displays a projection of consumption, reducing or eliminating losses and, consequently, improving production efficiency.

**Slaughter and Processing** - The “Georgia Tech Research Institute” developed a simulation model for the use of water, energy, effluents and labor for the slaughter and poultry processing plant. Based on the VENSIM Software (<http://vensim.com/vensim-software/>) is possible to simulate all the processes that involve the use of water, being a tool for decision making with predictive resources and also includes modules for related processes for labor, water, energy and wastewater.

**Statistical Control of the Process** - uses artificial intelligence and historical data to modeled dynamically active supply chain operations, predicting results and allowing for faster and more accurate identification and responses to possible changes in variables that affect food security or the production results across the poultry supply chain.

**Regulatory Compliance** - data management applies “blockchain” technology to inspection records to maintain transparency and traceability, in addition to providing data for assessing treatment efficiency. A set of tools enables the integration of data sources and traditional systems and internet network devices.

**Value Chain Management** - uses predictive and learning analysis to predict future performance across the chain. An integrated view of the data allows the finished product to be traced a minute level of detail. The platform is cloud-based and uses “blockchain” technology and artificial intelligence to monitor operations on a large scale and across regions.

## 4. Biotechnology

The use of biotechnology has been explored for the development of technological innovations in several areas, including health, nutrition and management. Among the various innovations could be cited:

1. The development of specific probiotics, genetically modified, for use in the feeding of birds (feed and / or water) may detect and generate antimicrobials to combat specific pathogens. Prototypes against Salmonella, Campylobacter and Clostridia have already been developed and the regulatory requirements for placing the product on the market should be completed in the coming years.
2. The vaccines under development by Mazen Animal Health originate from the insertion of specific genes in corn. It allows producers to dose the vaccine, which are stable at room temperature, in the feed, both for the protection of the intestinal mucosa and systemic, intracellular against coccidiosis. It is estimated that this technology should be on the market in the coming years.
3. Egg XYT CRISP gene editing technology inserts a biomarker into the DNA of males creating an optical signature that allows the detection of male embryos in laying birds. When scanning embryos still in formation, it is possible to perform an early sexing, identifying the eggs that contain male embryos that will be destined for human consumption, eliminating the sacrifice of male chicks at birth and allowing them to be

commercialized. This technology is advanced, however, some adjustments are necessary to increase the speed of processing and reduce the costs of implementation.