SESSION 1 – REMOTE MACHINERY REPAIR, MAINTENANCE AND ASSISTANCE (Coordinator: P. Pickel)
1.1 – Product Services in the digital age (Industrie 4.0) *E. Westkämper (Fraunhofer Inst. Manufacturing Engineering&Automation – Germany)* *(engelbert.westkaemper@ipa.fraunhofer.de)*
1.2 – The Farm Data Ecosystem *F. Protano, V. Vandecaveye (CNH Industrial)* *(francesca.protano@cnhind.com; vik.vandecaveye@cnhind.com)*
1.3 – Innovative Service Products for individual and availability-oriented business models for agriculture machinery *M. Pier (Grimme Gruppe – Germany)* *(m.pier@grimme.de)*
1.4 – T&Trac: the agriculture become 4.0 *A. Caffini (Caffini SpA – Italy)* *(amedeocaffini@caffini.com)*

1.1 – Product Services in the digital age (Industrie 4.0)

by Engelbert Westkämper – (Fraunhofer Inst. Manufacturing Engineering&Automation – Germany)

The digital environment allows the enlargement of production system over the whole life cycle of technical products from birth to end of life. This offers manufacturers possibilities to add value especially in after sales business by linking physical products with digital data at home (cyber) and monitoring usage und environment. In this future cyber-physical world (Industrie 4.0) customers get support by knowledge about best practices and efficient services. Some necessary requirements (public demand) are: reliable, fast and low cost Internet; standardised interfaces to sensors and actors; data analytics and visualisation techniques; security (regulations). Future innovation-drivers are to find in artificial and technical intelligence (machine learning) and practicable technologies for communication and sensors.

It seems that "Industrie 4.0" offers new business models in the relation with customers and connectivity to products in use. There are impacts on the management system for maintenance. E.g. event driven processes, intelligent diagnostics and knowledge based operations will change the organisation of services offered by manufacturers. We expect a fundamental change of the future products and their usage.

The presentation will show some fundamental visions the driving forces and consequences for manufacturing industries.

1.2 – The Farm Data Ecosystem

by Francesca Protano and Vik Vandecaveye – (CNH Industrial)

From the early 2010s, a challenging shift has been underway within the Ag Market Space and a new boost of smart technologies is now leading the transition from product driven to customer/service driven strategies.

This is forcing OEMs to transform their business model in order to find out a new paradigm and build a new technology infrastructure. CNH Industrial is driving this transformation through the integration and optimization of new technologies to empower customers to achieve success by sustainably growing their productivity with digital tools.

The usage of those advanced technologies, during the whole farming cycle, generates huge sets of data that is collected, transferred, processed and analyzed to produce value and to create business opportunities as:

- Machine data analysis: to achieve a better knowledge of products and customers' habits in the field for use in development, support and services.
- Remote Assistance: Software Updates, Remote Service Tool, Remote Display Viewing.
- Data Sharing: API data transfer to a 3rdparty service or farm/fleet management system.
- Farm/Fleet Management: to manage day-to-day operation of machines and equipment.

This presentation points out the importance of a data-driven approach which is nowadays a major factor of competitive advantage for enterprises, and especially a support for remote maintenance applications. CNH Industrial's architecture allows to connect a skilled operator in a control room where thousands readings from several sensors embedded in the machine are captured and analyzed to identify specific patterns, showing, on one side, how performance can be correlated with machine's engineering specifications and, on the other hand, how a root cause of a failure can be unveiled combining those readings with the recurrence of problems.

1.3 – Innovative Service Products for individual and availability-oriented business models for agriculture machinery

by Marcus Pier (Grimme Gruppe – Germany)

Increasing interests in availability-oriented business models are reasoning the need of practical predictive maintenance concepts for different agriculture machinery.

In availability-oriented business models, the manufacturer guarantees the availability of capital goods. To realize these business models, innovative services need to be developed, which are based on current operating data and machine condition. To establish these services, robust sensors with the ability to communicate and smart system concepts have to be elaborated.

Therefore, a use case is defined; business models, extended value networks, persona analyses and customer journey are elaborated. The results show the applicability of the concept for the development of availability-oriented business models for a potato harvester to avoid downtime.

1.4 – T&Trac: the agriculture become 4.0

by Amedeo Caffini (Caffini Spa – Italy)

In these years, the increasing demand of environmental protection has pushed the constructors of agriculture machineries to improve their products to follow this trend. In parallel with this market wills, the regional authorities have started to give economical supports only to the farmers that want buy products of the last generation, to incentivize this trend even in the end users.

In the era of IoT and Big Data, this innovation process is culminated with T&Trac, a project developed by 6 companies, leaded by Caffini.

T&Trac is an end-to-end electronic system with digital authentication that automatically trac the operations soil working, seeding, fertilizer distributions and spray treatments done by the agriculture machines. T&Trac will be a stand-alone system can be installed on the implements Iso Bus ready.

The data detected during the operations are saved in *cloud* that is linked with the informatic system of the producer and also the farm, creating a multifunctional database. In this way, the producer has a view of the machine's state and it can make a better maintenance plan to reduce the machine breaks down. Furthermore, with these information, the farmer is able to plan, rationalize and optimize both the operations and the chemical products utilization, with an automatic compilation of the farm register.

This cloud platform has been designed to be compatible with the informatic systems of the regional authorities that give the financing to the farmers, in this way the can have a real time control of the agriculture area of their competence.

SESSION 2 – AGRICULTURAL MACHINERY NEW TECHNOLOGIES: CHALLENGES AND LIMITS FOR USERS (Coordinator: H. Auernhammer)
2.1 – Trends and new Technologies for Agricultural Machinery *B. Pichlmaier (AGCO – Germany)* *(benno.pichlmaier@agcocorp.com)*
2.2 – New technologies for agricultural machinery: the contractors' point of view *M. Schulman (Copa-Cogeca – Finland)* *(max.schulman@mtk.fi)*
2.3 – New technologies for agricultural machinery: the farmers' point of view *I. Robertson (Farmer – UK)* *(iain.robertson1971@virgin.net)*

2.1 – Trends and new Technologies for Agricultural Machinery

by Benno Pichlmaier (AGCO – Germany)

Sustainable productivity is the fundamental objective for farming.

To achieve this day by day the agricultural community has a mindset of idealism and optimism continuously striving to find solutions, create ideas, deliver qualified research, develop products and grow crops to feed the world while facing a broad variety of challenges along this journey.

To name a few:

Structural changes, volatile incomes and skilled labour shortages, weed resistances, more existing or expected regulations from all perspectives (e.g. engine emissions, use of pesticides, CO_2 goals, etc.), preservation of fertile soils, scarce water resources, seamless traceability from seed to fork, impacts of climate change, high investments in ever growing equipment, complexity of fragmented value chains in global markets, uncertainty around digital transformation, an often dogmatic societal debate etc...

Technology has played a crucial role in farming history to secure stable production of food, feed, fuel and fibre. Going forward an eye level collaboration of engineers, agronomists and farmers will be key to identify the right opportunities and solutions to address these challenges. Connectivity and smart data, automation and autonomy, electrification and future fuels are technology approaches on hand, that will play a vital role in the years to come. Controlled environment agriculture, artificial intelligence and robotics can be the disruptors enabling new farming systems and business models.

2.2 – New technologies for agricultural machinery: the contractors' point of view

by Max Schulman (Copa-Cogeca – Finland)

Extended Abstract not submitted by the Author

2.3 – New technologies for agricultural machinery: the farmers' point of view

by Iain Robertson (Farmer – UK)

Extended Abstract not submitted by the Author

SESSION 3 – SPECIFIC MECHANIZATION: MACHINES FOR HORTICULTURE (Coordinator: P. Balsari)
3.1 – The future of horticultural mechanization *S. Nicola (University of Turin – Italy)* *(silvana.nicola@unito.it)*
3.2 – Horticulture mechanization and automation in open-field: state of the art and future perspectives *D. Monarca (University of Tuscia – Italy)* *(monarca@unitus.it)*
3.3 – Automation and robotics in the protected environment, current developments and challenges for the future *J. Hemming (Wageningen University & Research – The Netherlands)* *(jochen.hemming@wur.nl)*
3.4 – Mechanization and automation in post-harvest processing *G. Colelli (University of Foggia – Italy)* *(giancarlo.colelli@unifg.it)*

3.1 – The future of horticultural mechanization

by Silvana Nicola (University of Turin – Italy)

The horticulture industry is one of the largest industries in several countries and it is labor intensive. However, most of the labor intensive industries could face several challenges, such as: 1) High production costs and low productivity; 2) Internal and external business risks; 3) Maintain product performance and quality control; 4) Threat from emerging economies with significantly larger and cheaper labor; 5) Various risks in managing work health and safety. As labor costs increase every year, plant growers tend to look for alternative options, which is mechanization and automation. Intensive horticultural crops require much more skilled labor than broad scale agriculture. There are many benefits of adopting mechanization and automation in the horticulture industry. Mechanization of an operation can provide mechanical power, speed, repetition, safety, and a greater potential for consistency and quality control. Intelligent sensing systems, robotics and precision agriculture automation ('Hort Technologies') are seen as means to reduce production costs and increase on farm productivity. Robots in horticulture are useful in nurseries and greenhouses, parks and golf courses, in the field for monitoring, serve as mechanical aids, allow high level of mechanization and can be real machines, help during post-harvest practices for picking and harvesting, grading and sorting, and packing. Harvesting fruits and vegetables proves to be a difficult problem to automate, but several companies are up to the challenge. By interconnecting crops, tools and vehicles to smart devices and sensors, farmers will soon be able to increase productivity saving money and conserving natural resources by making the right decision at the right time based on data.

3.2 – Horticulture mechanization and automation in open-field: state of the art and future perspectives

by Danilo Monarca (University of Tuscia – Italy)

The mechanization of horticultural productions is a determining factor in all stages of the production chain, from soil tillage to sowing or transplanting, from fertilization to irrigation, from the control of biotic and abiotic adversities to the harvest, transport and post-harvest phases.
The factors that drive production in the world, dominated by the eastern countries (China alone produces more than 50% of the vegetables in the world), are the climatic factors, internal consumption, market trends, international agreements, but above all, as regards mechanization, cost and labor availability. While in many Eastern countries even today most of the operations are carried out manually, in the western countries (Europe, USA) farmers can use advanced and efficient machines.
The author describes the machines for the production in open field, starting from the sowing and transplanting machinery and their most recent innovations (transplanters, mulchers, combined machines).
After a short description of some machines for pesticide application and weed control, ample space is given to the harvesters. The distinction between product for the fresh market and for the processing industry is fundamental. For the product destined directly to the table, the use of manual and only partially facilitated harvesting yards is still very widespread (asparagus, artichoke, cauliflower), while for the productions destined for industry, harvesting operations

are widely mechanized. The harvesting process must then be integrated with the post-harvest phase, taking into account the final destination of the product.
In the paper some case studies are illustrated (asparagus, artichoke, salads, tomato for processing industry) and the possible future evolutions in the cultivation techniques and in the harvesting machines are analyzed.

3.3 – Automation and robotics in the protected environment, current developments and challenges for the future

by Jochen Hemming - Wageningen University & Research - The Netherlands

The horticultural production faces a growing demand for mechanisation, automation and robotics as labour costs are increasing and the availability of skilled labour is decreasing. The modern consumer demands guaranteed and constant quality. Moreover, there are intensified hygiene, food safety and traceability demands. Automated production and quality assessment systems can contribute to fulfil these demands. It is proven that the use of more technology in protected cultivation results in more yield, better product quality, and much higher resource efficiency. Many highly automated systems are already applied in commercial greenhouses. This includes logistics and autonomous transport of plants and harvested product in the greenhouse, spraying robots, machine vision based sorting systems for pot-plants and cut-flowers and robotic cutting, planting and grafting machines. Actual research focus on automated crop scouting (e.g. insect and disease detection), phenotyping (e.g. monitoring and predicting fruit setting) and robotic harvesting (e.g. of tomatoes, sweet pepper, strawberries). Still more research is needed to make such systems performing fast, simple and safe to use in practice. The current developments in high-tech horticulture are supported by the worldwide rapid improvements in computer hardware, software and artificial intelligence.

3.4 – Equipment innovations in postharvest handling and minimally processing of fresh fruit and vegetables

by Giancarlo Colelli (University of Foggia – Italy)

Fresh fruit and vegetables are constituted by living tissues which carry on metabolic processes related to ripening and senescence. They are important for human diet as they represent an important source for bioactive compounds. Postharvest handling of these products is aimed to conditioning (cooling, grading and packaging) and to storing and/or shipping to more or less distant markets. Minimally processing is aimed to trim, wash, and cut into 100% usable product that is then packaged to offer high nutrition, convenience and value while still maintaining freshness. Despite available measures for maintaining quality of raw and processed material, degradation due to minimally processing is unavoidable, also considering that peeling, trimming and/or cutting operations are often present. In addition, other operations as washing and drying are known to cause mechanical stresses and loss of sugars and nutrients. However, the extent to which quality is compromised depends on the produce and on the processing conditions, including equipment and their operational settings. Main objectives of recent innovations in postharvest handling have been the following: (i) reducing the cost of operations; (ii) increasing automation and work capacity; reducing environmental impact; increasing safety and well being of labour force; reducing the impact on quality. Main innovations wil be described with information on their impact on final quality, and areas for future research will be identified.