Mr. James Clarke is the EU Strategic Liaison manager at the Telecommunications Software and Systems Group (TSSG) of Waterford Institute of Technology in Ireland. Mr. Clarke has been involved in international cooperation between the EU and many countries for nearly the last ten years.

Since 2014, he has been coordinator of the EU-India FI-Media[1] project, which is funded by the Delegation of the European Union to India[2], to facilitate the building of cluster to cluster (C2C) partnerships between the EU and India clusters of research and industry stakeholders related to Next Generation Internet, including IoT topics. He is also participating to two H2020 projects of relevance to today's panel session: EU-US project DISCOVERY[3], and EU-Brazil project entitled EUBrasilCloudFORUM[4].

- **What are the main ingredients for global success of European IoT applications in the whole agricultural chain?**

Mr. Clarke started by pointing out that there were a lot of interesting discussions in the smart cities/IoT sessions during the first day of IoT week when discussing developing global platforms or systems of systems covering the different layers, which are also applicable to the Agri-tech chain, such as Applications, Communications, Infrastructure and Devices, with necessary buy-in needed from the policy/decision makers within the governments, and the need for an open platform [good example - FIWARE] can help in this regard. There were also discussions how we need to be careful that platforms don't somehow sever or break apart what is happening in the local environments, and this is especially important for the Agri tech sectors, where there is very little room for profit margins.

Clarke went on to say that, in addition, there must be a clear identification of the stakeholders involved, and identifying where the money will come from has been the biggest blocker to innovation in Ag tech and potentially the route to the market. For a lot of Ag tech products, the farmer is seen as the primary customer and is targeted with large scale platforms (similar to investments in on-farm equipment and machinery); However, they are often not the sole beneficiary of the outputs (e.g. the processor, the retailer or government agencies also benefit) but the costs aren't shared. The agri sector in EU has suffered for decades with trust issues along the supply chain, which restricts innovative business models from alleviating these barriers. IoT technology has a role to play in securing the values and concerns of the producers and the entire supply chain.

Clarke pointed out that scalability is also a necessary ingredient. He continued that what we should be doing is design for the EU with IoT solutions but then scale it up for US/Brazil/India/China and that is when the EU can make cost effective IoT Solutions on a global scale, and this ties in well with the work of the different projects that I am involved in, including H2020 EU-US DISCOVERY H2020 EUBRasilCloudFORUM and the EU-India FI-MEDIA projects, which is funded directly by the Delegation of the European Union to India. We are welcoming participants from these countries to work together with us on topics of mutual interest.

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[1] http://www.bic-fimedia.eu/
[2] https://eeas.europa.eu/delegations/india_en
[3] http://discoveryproject.eu/
[4] https://www.eubrasilcloudforum.eu/

- **Is the innovation in Ag Tech currently more driven by larger industry players or by smaller SMEs and start-ups?**

Clarke responded he felt it was a bit of both. As mentioned by my co-panellists, it is being primarily being driven by the large Industry - Monsanto, John Deere, All tech - with all the major technology companies trying to get a leg in (Intel, IBM , Analog, Ericsson, and others). However, in Ireland, we are seeing some exciting research focused Small and Medium Sized Enterprieses (Dairymaster and Keenans are two prime Irish examples) along with Agri-tech focused accelerators (THRIVE in California and WIT's hosted NDRC digital accelerator program, which is a catalyst launch program for digital SMEs).

Clarke concluded with stating that currently larger players have access to the scale and technology (Since IoT is in the early stages). Soon we can see smaller players too coming in to picture due to commoditisation of sensors and open source platforms.

- **What are in your opinion the most striking challenges of agriculture in the next decade and how can IoT help to solve them?**

In terms of innovation maturing over the next decade, Clarke suggested the following:

1. Precision agriculture for sustainable farming is a very hot, but broad topic.

   a) In dairy/ beef, the biggest challenge will be to intensify production but with an overall reduction in greenhouse gas emissions. Advances are being made on this front by using IoT devices to capture very granular data about how the animal is performing in relation to the environment it is in. We have a project involved in developing this technology and running trials. This data is being passed to decision support systems that are shaping the actions and processes of farmers. It is also being analysed on aggregation by genetics organisations for breed selection etc. We are seeing advances in on-farm automation technologies (automatic milking and feeding technologies) and while they have impacts on sustainability, their impacts are predominantly on labour saving currently. Future advances will see automation as a key driver of precision dairy farming.

   b) Within intensive indoor farming, managing waste is a key problem; However, the problems here are typically financial (cost of transporting slurry outweighs the value of it; cost of bio-digesters also outweighs the value of energy, etc..) It is still unclear whether IoT will have a major role to play here – as it may involve more financial incentives.

   c) Arable. The challenges here are identifying subtle changes in the crops, which indicate a nutrient deficiency/saturation during the growing period and also identifying key time to harvest (right amount of dry matter/water ratios). This is primarily being driven by R&D in satellite imagery (visible/ non-visible (IR) spectrum) and building services to government, producers and retailers. The machinery manufactures are focusing on IoT technologies built in to their farm machinery to detect these changes. High value crops (wine) and indoor soft fruit and veg, where automation is already prevalent, the systems are getting smarter and more autonomous.