Industrial adoption of integrated microphysiological systems: progress and challenges

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Reyk studied Medical Biotechnology at the Technische Universität Berlin with a focus on tissue engineering concepts. Over the course of his academic career at the German Arthritis Research Center and the TU Berlin in the group of Prof. Roland Lauster, he has pursued the development of tissue models that can mimic human biology *in vitro*. The group especially focused on emulating the critical development steps during organ neogenesis employing the innate self-assembly processes of human organs and tissues. Utilizing this approach, he successfully developed a complex hair follicle model that can be used for *in vitro* screening purposes as well as for cell therapy based hair restoration strategies. In addition, he investigated the use of novel bioreactor systems to scale up production of tissue engineered skin models for use in transplant surgeries.

Since 2010 Reyk is actively involved in the development of TissUse's Multi-Organ-Chip platform for culture analysis of drug candidates, cosmetics, chemicals and consumer products. Here he led the efforts to establish and characterize a chip-based vascular model in an interdisciplinary team of engineers, computational modellers and biologists. He currently holds the position of CEO TissUse.

Microphysiological systems (MPS) have proven to be a powerful tool for recreating human tissue- and organ-like functions at research level, providing the basis for the establishment of qualified preclinical assays with improved predictive power. However, industrial adoption of microphysiological systems and respective assays is progressing slowly due to their complexity. In the first part of the presentation examples of established single-organ chip, two-organ and four-organ chip solutions are highlighted. The underlying universal microfluidic Multi-Organ-Chip (MOC) platform of a size of a microscopic slide integrating an on-chip micro-pump and capable to interconnect different organ equivalents will be presented. Issues to ensure long-term performance and industrial acceptance of MPS, such as design criteria, tissue supply and on chip tissue homeostasis will be discussed. The second part of the presentation focusses on the establishment of automated MOC-based assays as a robust tool for safety and efficacy testing of drug candidates. These automated assays will allow for increased throughput and higher inter-laboratory reproducibility thus eventually enabling broad industrial implementation. Finally, a roadmap to bring these assays into regulatory-accepted drug testing on a global scale will be outlined.