POST EVENT PROCEEDINGS

Pharmaceutical Mobile Robotics 2023

20 - 21 April 2023 | London, UK

Oxford Global was delighted to invite you to attend our **Pharma Automation & Robotics Congress**, consisting of the **2nd Annual Pharmaceutical Mobile Robotics Congress** and **Smartlabs Automation & Robotics Congress**. You engaged with esteemed pharmaceutical & biotech representatives as well as thought-leaders from academic & research institutions onsite and benefited from attending over 40 presentations. We welcomed 200+ delegates for two days of cutting-edge scientific sessions and case studies on advancing the development of pharma logistics & automation, plug and play robotics, digitalisation of labs and automation & process optimisation in R&D labs.

We are delighted to present you with concise and insightful summaries of presentations delivered by prominent thought leaders in this comprehensive post-event proceedings document.

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Day 1 Track 2: Development of Plug And Play Robotics In Drug Development & Automation

Automate The Boring Stuff, Talk To All Your Robots At Once With Beginner Python

Nessa Carson

The speaker starts by introducing their job title as a digital champion. They work in the digitalization team in pharmaceutical sciences, specifically in early process chemistry. They describe their role as a translator between the chemistry and IT/data teams, being able to speak both chemistry and computer languages. The goal of their team is to make the processes in early process chemistry smoother and more effective.

They emphasize the accessibility of coding, particularly Python, even for those who have never coded before. They share their personal experience of encountering a data analysis problem in a high throughput experimentation lab and realizing that coding could provide a more efficient solution. They highlight Python's accessibility and how it enabled them to quickly develop coding workflows that they now use on a daily basis.

The speaker mentions that while they will focus on high throughput experimentation as an example, their talk represents the projects undertaken by the digitalization team at AstraZeneca. They explain the various stages of the R&D cycle in which automation is used, from AI labs and discovery chemistry to early chemical development and reaction optimization. They emphasize the importance of software automation, which often goes unnoticed compared to the prominence of hardware automation in lab settings.

Within the context of reaction optimization, the speaker discusses the generation and management of data. They emphasize the criticality of data management and working with modeling, data science, and prediction. They mention the need for sharing and scaling up the work, as their team keeps growing and acquiring more data. The speaker also stresses the importance of adhering to the FAIR principles (findable, accessible, interoperable, reusable) to ensure the quality and usability of collected data.

They present a typical workflow in high throughput experimentation labs, involving steps such as solid dispensing, liquid dispensing, reaction running, analysis, and reporting. They highlight the need to incorporate metadata and adhere to good data standards. They also discuss the benefits of automation,

including decreasing administrative tasks and enabling everyday use of coding solutions. They emphasize the importance of user-friendly interfaces and the ability for lab users to interact with the automation systems.

The speaker addresses the question of whether everyone needs to code and acknowledges that not everyone may be interested or required to code in their roles. They mention alternative coding platforms such as VBA, MATLAB, and even no-code solutions, which are popular in the chemistry community. They share their personal experience of starting with VBA but finding Python to be easier and more resourceful. They mention the benefits of having at least one person in the lab with coding knowledge, as it can expedite the development of solutions and facilitate collaboration between the digitalization team and lab users.

The speaker suggests starting with a network map of the lab, mapping out the systems and interactions among people, to ensure effective solutions that cater to everyone's needs. They emphasize the significance of understanding the lab's workflow and mapping out the individual steps before diving into process optimization. They also note the importance of considering data flow optimization and the challenges of managing large amounts of data generated in high throughput experimentation.

Overall, the speaker advocates for automation and the use of coding to streamline processes, improve efficiency, and enhance data management in early process chemistry. They encourage individuals to explore coding options like Python and consider the benefits it can bring to their work.

Pfizer 2030 Vision – Progress Towards Automated Process R&D Labs

Philip Peach

In the presentation, the speaker emphasizes Pfizer's commitment to innovation and the need for collaboration and support to achieve their ambitious automation and robotics project. They describe the project as being in the early stages, with many decisions yet to be made, and they welcome engagement from collaborators and vendors who can contribute to their vision.

The speaker provides an overview of Pfizer's chemical research and development department, which plays a crucial role in developing first-generation manufacturing routes for novel API molecules. They also transfer these routes to their manufacturing colleagues and support regulatory filings. Additionally, the department manufactures clinical materials on a GMP (Good

Manufacturing Practice) scale to supply clinics, utilizing Pfizer's range of GMP facilities.

One of the main challenges highlighted in the presentation is the rapidly changing landscape of the pharmaceutical industry. The speaker stresses the need for a solution to cope with this acceleration, and the project aims to address this challenge through automation and robotics. The speaker identifies four key goals for the project: digital transformation, automated high-throughput robotic labs, sustainable chemistry, and a resilient drug supply chain.

Regarding automation, the speaker discusses the benefits of increased throughput and enhanced data quality that can be achieved through the utilization of robots. They emphasize the importance of integrating data management and interpretation throughout the automation process to maximize efficiency and effectiveness. The speaker envisions a system where individual control software and equipment are interconnected through an orchestration software, with a comprehensive data management system wrapped around it.

The presentation then delves into the two specific goals set for the current year: a reaction understanding system and the automation of full end-to-end process development. The reaction understanding system aims to optimize reactions by extrapolating kinetics on a small scale. The speaker describes the development of modular islands of automation, comprising stations for preparation, reaction, and analysis, which would be connected to create an end-to-end system. They highlight the importance of modular design to enable scalability and flexibility in the future.

In terms of full end-to-end process development, the speaker discusses the challenges and opportunities associated with automating various unit operations such as liquid-liquid extractions, crystallization, and filtration. They propose the idea of miniaturizing the plant setup and using a fixed jacketed vessel approach. This approach allows for the incorporation of probes for real-time monitoring and optimization, including pH, conductivity, and particle sizing probes. The speaker also mentions the potential use of machine vision algorithms for visual observations and analysis of processes within the vessel.

Throughout the presentation, the speaker acknowledges that while some commercial systems exist, they may not fully meet Pfizer's needs. They express openness to exploring bespoke solutions and seek input from collaborators and vendors who can provide valuable expertise and guidance in realizing their automation and robotics vision.

In conclusion, the presentation highlights Pfizer's vision for automation and robotics in their R&D labs, focusing on the goals of a reaction understanding system and full end-to-end process development. The speaker outlines the challenges, proposed solutions, and the importance of collaboration in achieving this transformative project.

Day 2 Track 2: Innovation in QC Labs Of the Future & Pharma Logistics & Automation

Feasibility Study of Mobile UVC Technology in Pharmaceutical Environment

Anna-Maria Hasenbichler

In the presented talk, the speaker shared insights into a feasibility study conducted on the use of mobile UVC technology in a pharmaceutical environment. They began by introducing themselves as an innovation lead, change manager, and yoga teacher, emphasizing their focus on combining health and innovation in their work. The study aimed to develop career-focused employees through various events and initiatives.

The speaker proceeded to discuss the UVC feasibility study setup, which involved forming a project team consisting of representatives from different departments. Inspired by the use of UVC mobile robots in hospitals during the pandemic, the team sought to explore the applicability of this technology in pharmaceutical settings. The vision was to reduce chemical usage and exposure, while ensuring the technology's effectiveness in pharmaceutical areas.

The study results were presented, highlighting the use of UVC-sensitive dosimeters to measure the strength of UV radiation on different surfaces, contact plates to assess microbial load, and viable air measurements to evaluate the robot's impact on room air quality. The results indicated that the UVC robot was effective in reducing contamination.

The speaker outlined the pros and cons of the technology. While the UVC robot was advantageous in reducing chemical usage and exposure to personnel, challenges included qualifying the technology for pharmaceutical use and gaining user acceptance.

The recommended implementation approach was introduced, suggesting using the UVC technology as an add-on to current disinfection procedures in both classified and unclassified areas, particularly outside office and production hours. The objective was to enhance cleaning and disinfection regimes, reduce manual work, and ensure personnel safety.

The significance of change management in successful robotics projects was emphasized. The speaker highlighted their approach of engaging stakeholders and addressing resistance through dialogue formats for leadership alliance and stakeholder assessment. They shared how this resulted in positive

feedback and appreciation from the shop floor, high engagement, and interest from impacted groups.

The regulatory challenges related to the technology's qualification for pharmaceutical use were acknowledged. The speaker mentioned ongoing discussions with the FDA and the need to convince internal quality personnel to embrace innovative solutions. They also expressed the desire to collaborate with other pharma companies to establish common approaches and standards for data integrity and qualification.

Looking forward, the speaker outlined the future steps, which included selecting pilot sites for a long-term study, conducting a disinfectant efficacy qualification study, and further exploring the qualification process for UVC technology. They encouraged engagement with regulatory bodies to define requirements specifications that align with pharmaceutical industry needs.

During the Q&A session, the audience raised questions about robot cleanability, supplier adaptability to pharmaceutical requirements, and the challenges of validating the technology for pharmaceutical use.

In conclusion, the presentation highlighted the potential benefits of using UVC technology in pharmaceutical environments while acknowledging the need for collaboration, change management, and regulatory discussions to overcome challenges and ensure the successful implementation of innovative robotic solutions in the pharmaceutical industry.

Mobile Robotics For Inspection And Sample Taking In Chemical Pharmaceutical Plants.

Carl-Helmut Holton

In Carl's speech about Mobile-Robotics-For-Inspection in Chemical-Pharmaceutical Plants, he shared the journey of an exciting project that addressed the demand for a fleet of robots to perform various tasks within chemical plants. The project originated from frequent requests by colleagues and partners who wanted a solution to efficiently gather information, scan equipment, and perform tasks in hazardous areas.

Initially, Carl's response to these requests was optimistic but cautious, as the technology required for such a fleet of robots seemed far from being feasible. However, as he engaged with technology companies, he realized that the possibility of achieving this vision was becoming more and more realistic. To tackle this challenge, they organized an open innovation challenge in collaboration with leading industry players and "invite," a platform for fostering innovation.

Carl introduced his organization, Enlightenment, as a private-public partnership focused on innovative production technologies. They collaborated with universities and companies to drive research and new applications, bridging the gap between theoretical advancements and real-world implementation. Their ambition was to create joint developments and pre-competitive projects to industrialize future technologies.

The main objectives of the mobile robotics challenge were to increase safety, improve data collection, detect changes early, and reduce manual labor in chemical plants. They were seeking a versatile and autonomous robot capable of navigating the challenging environments of chemical plants, including areas with hazardous substances.

The challenge attracted various teams, ranging from university-based groups to fully professional robotics companies. Each team showcased their robotic platforms, demonstrating their capabilities to navigate the chemical plant and perform tasks like sensing, data collection, and manipulation.

A significant breakthrough during the challenge was the emergence of walking robots with ATEX certification, which allows them to operate autonomously in explosive zones. This achievement was considered a major step forward, and leading companies in the industry adopted development roadmaps based on the demands created by the challenge.

Due to the success of the challenge, the sponsors decided to continue the initiative, focusing on two key areas. The first involved jointly proposing a vision for 24/7 site logistics, aiming to have autonomous robotic solutions for continuous material handling within chemical plants. The second area was to explore the combination of teleoperation with autonomous robots, allowing human operators to take control when needed, enhancing the flexibility and usability of the robotic systems.

In conclusion, Carl emphasized the importance of open innovation and collaboration to meet industry demands effectively. The challenge demonstrated the potential for mobile robotics to revolutionize inspection and operations within chemical and pharmaceutical plants. Through continued collaboration and exploration of innovative solutions, the industry can make significant strides in advancing its automation capabilities.

Implementation of Mobile Robots in QC Laboratories

David Wolton

Automating storage systems is a critical first step in achieving lights-out operation. The speaker emphasizes the importance of selecting storage systems that are compatible with mobile robots from the start. Companies like S-CELL, Hamilton, and Biosero are at the forefront of developing automated fridges, freezers, and incubators. These systems allow for plug-and-play operation, making them easy to integrate with mobile robots without requiring revalidation of assays. One notable advantage of automating storage systems is that it doesn't impact assay validation, making it a faster and more straightforward process compared to automating assays directly. This means laboratories can quickly upgrade their storage capabilities and move towards lights-out operation without significant delays.

Delivery from Storage System to Bench: Once the storage systems are automated and integrated with mobile robots, the next step is to enable smooth and efficient delivery of samples from the storage system to the bench (e.g., liquid handler or assay). Hamilton is pioneering the concept of attaching storage systems directly to liquid handlers. This allows for seamless transfer of samples and reagents between storage and assay systems. By integrating storage and liquid handling systems, the mobile robot's role becomes simpler, as it only needs to transfer samples between the two systems. This integration facilitates the 24/7 lights-out operation, as samples can be retrieved from storage and processed by the liquid handler without human intervention.

Transfer from Production Areas to QC Lab: Moving samples from production areas to the QC lab is another crucial aspect of lights-out operation. A factory in Switzerland has already demonstrated successful implementation by using mobile robots to pick up samples from production areas and transport them to the QC lab. However, retrofitting such systems in existing facilities may be challenging due to constraints like doors, lifts, fire systems, congestion, stairs, sloped floors, and movement between buildings. To fully automate this transfer process, facilities may need to reconsider their designs, potentially favoring single-site configurations with a central corridor to simplify robot movement. Newer facilities or those with more flexible layouts may find it easier to implement this milestone.

Taking of Samples: The final and most challenging milestone is automating the process of taking samples, especially in biologics facilities where samples often need to be sterile. Companies like Cellular Origins are working on robotic systems that can handle pumping between disposable systems and tubing welding, enabling sterile sample collection into single-use containers. The process of automating sample-taking is complex, as there are numerous

methods of sample collection in various factory environments. Accessing and handling samples may not always be straightforward for robots. As a result, achieving this milestone requires careful consideration of different sample-taking scenarios and specialized robotic solutions.

Challenges: Throughout the presentation, the speaker highlights several challenges that need to be addressed to achieve seamless integration and lights-out operation: Standardization of Communication Protocols, Simple Operator Interfaces, Laboratory Scheduling Software, Retrofitting Existing Facilities. In conclusion, the talk highlights the promising progress made in automating quality control laboratories through mobile robots and automated storage systems. Achieving 24/7 lights-out operation requires a step-by-step approach, starting with automated storage, followed by smooth delivery to the bench, transfer from production areas, and finally, automating the sample-taking process. Overcoming challenges related to standardization, user interfaces, scheduling software, and facility retrofitting will be critical to realizing this vision of lights-out laboratories in the future.

A 2D Drone Swarm System For Sample Transfer

Edy Mariano

Edy's presentation centered around the development of a groundbreaking "A-2D-Drone-Swarm-System-For-Sample-Transfer" within the SwissCat Plus project. The project is an academic laboratory in Switzerland that focuses on high-throughput experiments for catalysts discovery. The primary objective is to optimize and discover new catalysts while generating large amounts of clean and replicable data. The lab aims to be fully automated and data-driven, catering to industry needs as an Open Access service.

To achieve their goals, the SwissCat Plus project requires efficient sample transfer automation. Edy discussed the challenges involved in automating sample transfer between different analytical devices in the laboratory. Most of these devices are semi-automated, originally designed to be operated by humans. This creates obstacles in achieving seamless automation. Additionally, safety concerns, the evolving nature of the laboratory, and the need for human-robot interaction further complicate the automation process.

Edy then highlighted existing solutions such as conveyor belt and fixed workflow setups, mobile platforms, and collaborative robots. While each option offered some benefits, they all had their limitations. The team at SwissCat Plus needed a solution that would be both flexible and safe, adaptable to the laboratory's layout and capable of separating the human workspace from the robotic area.

To address these challenges, Edy and his team developed the 2D drone swarm system for sample transfer. This system features small mobile platforms known as "drones" that move along a modular track suspended above the laboratory. The drones are 25 centimeters in size and utilize a differential wheeled design, allowing them to move forward, backward, and turn efficiently. The track was designed in collaboration with the Creative Labs at EPFL, ensuring its compatibility with the laboratory's layout.

The drones in the swarm are not individual entities making their own decisions. Instead, they operate under centralized intelligence. A server sends tasks to the fleet of drones, and a fleet manager optimizes the path planning and task allocation, ensuring efficient sample transfer between devices.

One of the significant advantages of the 2D drone swarm system is its open-source nature. Being an academic laboratory, SwissCat Plus made their system open-source, encouraging collaboration and replication of their innovative solution in other research environments.

Edy further discussed ongoing developments and improvements in the system. They are optimizing navigation to ensure that the drones move precisely to their intended locations. Additionally, the fleet manager is being enhanced with path planning and task allocation optimizations, further streamlining the automation process. The team is also working on a charging strategy, deploying charging stations at each station to ensure that the drones are always powered and operational.

In conclusion, Edy's presentation showcased a highly flexible and efficient 2D drone swarm system for sample transfer automation in the SwissCat Plus project. With centralized intelligence, safety measures, and an open-source approach, the system presents a promising solution for high-throughput catalysts discovery and experimentation. It opens up new possibilities for fundamental research, software developments, and collaboration within the scientific community.