Deep integration of low-cost liquid Roche handling robots in an industrial pharmaceutical development environment Anton Thieme<sup>1</sup>, Sean Renwick<sup>1</sup>, Michaela Marschmann<sup>1</sup>, Susanne weissenborn<sup>1</sup>, Jamie Clifton<sup>1</sup> <sup>1</sup>Roche Pharma Research and Early Development, Pharmaceutical Sciences, Roche Innovation Center Basel, F. Hoffmann-La Roche, Basel, Switzerland



# Introduction

### **Barriers to Automation**

Barriers commonly faces by industrial labs can include high initial investment costs, space constraints, lack of specialized

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service (device connector) (B). The device connector executes the corresponding batch script (C) in the method library (D) which interacts with the OT-2 via one of the protocols below (E) and saves the response to a file which then gets uploaded to the temporary file storage and processed.

mDNS	HTTP	SSH	
ONS was implemented	The OT-2's HTTP API was	SCP was used to	
th dns-sd to account	used with curl to	facilitate file transfers of	
r the OT-2's flexible IP	implement all standard	input sheets (e.g. lists of	
	functionality	ninotting stops)	

#### Gain of protocol flexibility

The deep integration enabled two approaches for flexible workflows previously not possible:

Input sheets automatically generated by the workflow based on user input can be sent to the OT-2 and protocols can be configured to execute steps based on their



# **Opentrons OT-2**

The OT-2 is a low-cost benchtop liquid handling robot. Its protocols are programmed

in python and in addition to an app to execute them, it offers an integration-friendly HTTP-API.

#### Workflow **Orchestration Suite**

Roche's internal workflow orchestration software combines:



## content

<u>Variables</u> in protocols can be automatically updated by the workflow before a run by treating protocols as text files and editing certain sections based on user input

### Improved Reproducibility for MetID assay

Performing the MetID assay with the OT-2 improved variation between replicates by a factor of ~3 when compared to manual assay execution by an expert professional.

	Intraclass CV
Manual	0.39
OT-2	0.12

# Conclusions

#### The successful deep integration with relative

- BPMN (Business Process Model Notation) through Camunda for workflow design and execution • Python scripts for data
- transformation and connectivity with internal databases
- IoT (Internet of Things) hub for device connectivity allowing file system manipulation and execution of command line scripts
- Temporary file storage

The OT-2 enables automation of simple assays (A). The lab PC acts a connecting node and storage for OT-2 scripts (B). The central workflow is defined as a BPM (C) which can interact with users and external services (D). In the beginning it guides the user through their experiment setup, then automated sections follow, including transfer of input sheets and execution of protocols. The status of the protocol run is monitored and the user is informed via email upon status updates. At this point they can confirm successful completion of the experiment and data can automatically be uploaded to appropriate databases ensuring FAIR principles.

**FACS FMO:** Fluorescence-activated cell sorting fluorescence minus one antibody mix preparation (low complexity, error-prone)

MetID: Metabolic soft spot identification assay (medium complexity, low use frequency)

ease was enabled by the OT-2's HTTP API with good documentation and the simple, yet flexible architecture of Roche's in-house orchestration software. Cost benefits, even with this low-cost system, will only arise with more use-cases and we plan on using the integration for several more low- to medium-complexity assays.

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