*Proceedings of the 2020 Winter Simulation Conference*
*K.-H. Bae, B. Feng, S. Kim, S. Lazarova-Molnar, Z. Zheng, T. Roeder, and R. Thiesing, eds.*

# VIRTUAL LAB: A FRAMEWORK FOR MODELING DECISIONS IN R&D AT BAYER CROP SCIENCE

Shrikant Jarugumilli
Yiou Wang
Yao Nie
Anirudha Kulkarni
Meng Liu

Data Science Center of Excellence
Bayer
800 N Lindbergh Blvd
Saint Louis, MO 63157, USA

Megan Castle

Precision Genomics, Plant Biotechnology
Bayer Crop Science
3302 SE Convenience Blvd
Ankeny, IA, 50021, USA

Jeff Woessner

ITBP CS Research and Development
Bayer Crop Science
700 Chesterfield Parkway West
Chesterfield, MO 63017, USA

Dave Baitinger

Automation Engineering, Global Breeding
Bayer Crop Science
1551 Highway 210
Huxley, IA, 50021, USA

Jennifer L. Becker

Seed Production Innovation
Bayer Crop Science
800 N Lindbergh Blvd
Saint Louis, MO 63157, USA

Jesus Jimenez

TalentWave
172 Sweet Gum Dr
Kyle, TX 78640, USA

## ABSTRACT

This paper summarizes the applications of the "Virtual Lab," a generic computer simulation framework for modeling both strategic and operational decisions within Bayer Crop Sciences. The Virtual Lab framework generates a computer simulation model that is configurable to different business scenarios by enabling what-if analyses. The modeling architecture combines discrete-event simulation and agent-based simulation. The applications of the simulation framework include lab capacity analysis, shift planning, batch-sizing analysis, job sequencing and scheduling. The presentation will explain how this framework can be used in an R&D function; it will also discuss the challenges and opportunities of building, validating and implementing the framework from a practitioner's viewpoint.

## 1 INTRODUCTION

Bayer Crop Science has a number of labs in R&D performing molecular genotyping on a variety of crops and vegetables. The sample (seeds) flows through the labs following a product recipe known as the Workflow. Furthermore, the lab uses numerous technologies (referred to as Platforms) for the genotyping. Each Platform technology applies different methods to analyze the samples. So, the time to obtain the data points varies per Platform. The mix of samples processed by the lab varies driven by field testing needs in R&D.

## 2 PROCESS OVERVIEW

The Virtual Lab simulates the sample as it works its way through the physical lab according to the sequence specified by the Workflow. The Virtual Lab simulates dozens of Platform devices and operations. These devices process samples in batches or as unit operations. Besides incurring time to form a batch, each device also incurs setup time, warm-up time, and processing time while completing the process of the entire batch and/or unit operations. Although devices may be completely automated, significant time lags associated with the manual loading/unloading steps for transferring batches between Workflow steps.

## 3 VIRTUAL LAB FRAMEWORK

The Virtual Lab simulation framework, which was built in AnyLogic, has three main modules: “Model Input”, “Simulation”, and “Output Statistics. The “Model Input” module allows the user to read from the lab information management systems providing the details of the samples to be run by the lab in a specified period of time on certain platforms. The user is capable of configuring the number of devices, as well as specifying setup times, warm-up times and processing times. The “Simulation” module uses discrete-event simulation to represent the sample flowing through the Workflow and agent-based simulation to represent the devices’ states. The “Output Statistics” module provides visualizations of key system performance indicators, such as the sample’s cycle time, throughput, and tardiness. It is anticipated that additional modules will be added to the framework in future instances of the project.

## 4 CASE STUDY

This presentation will cover the Virtual Lab framework applied at R&D labs. The development of the framework has provided insight regarding best practices for data collection design parameters, such as frequency and methods. It has also provided insight regarding true lab capacity indicators, such as actual cycle time statistics and bottleneck visualizations.