Assessing the impact of automation in pharmaceutical quality control labs using a digital twin

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Abstract: Nowadays, pharmaceutical Quality Control (QC) laboratories have complex workflows where analysts test different samples simultaneously. Tests ensure the physical properties of drugs are expected and within guidelines. Each test follows an analytical procedure containing tasks. Cyber-Physical Production System (CPPS) improves tasks/operations; however, accurate cost analysis with reasoned data is challenging. Theoretical estimation of impacts requires a high level of abstraction and fails to capture the proper behavior of the workflow. This paper proposes a method for evaluating the introduction of automation in a pharmaceutical QC laboratory. In the proposed methodology, this paper developed a simulation model of the analytical workflow of the tests. The impact assessment compares the current As-Is and future To-Be workflows, reworking the affected tasks. The model of the new resource is a hybrid parallel process with an initial buffer. The paper analyses several scenarios on parameters such as throughput, resource occupation, and annual man-hours gained. The simulation model was validated against actual historical data and compared to theoretical projections on the impact of automation. From our results, we found the available equipment has a high impact. Using production data, we project an increase in the analyst availability of 4,7% and equipment availability of 1,2%.

Keywords: Pharmaceutical Quality Control, Cyber-Physical Production Systems, Automation, Digital twin