Analyzing Clinical Laboratories using Object-Oriented Hierarchies and Discrete-Event Simulation

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The process flow in clinical laboratories resembles that in a traditional manufacturing setting, but there are distinct differences between the former and the latter which make it difficult to directly reflect the essential functions of a clinical laboratory in a simulation model. Creating a simulation model enables us to analyze and determine the impact on key metrics such as turnaround time and utilization rates when we change the physical configuration of the laboratory and vary the input parameters of the model. We have adapted the object-oriented nature of SIMIO, a program commonly used in a manufacturing setting, to create a discrete-event simulation modeling language for clinical laboratories reflecting the technical knowledge of experts from the clinical laboratory domain. We organized critical aspects of the clinical laboratory into class hierarchies to clearly delineate their functions and relationships. We then developed specific modules using the class hierarchies to represent the unique behavior of instruments, equipment and processes in a clinical laboratory. Using these modules, we created a simulation model of the clinical laboratory. The domain-specific modules we have formulated provide clinical laboratory experts with a customized tool to understand and improve their own system from a modeling perspective.