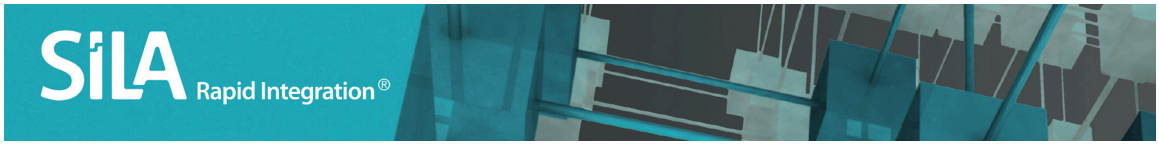

The Importance of Standardization in Laboratory Automation

In order for laboratory automation systems to follow a modular, plug-and-play architecture, vendors must agree upon standards, both in the hardware as well as the in software. Only then will laboratory systems and the data they produce withstand reconfiguration and the test of time. Such systems are needed to advance laboratory automation from high throughput to high complexity. Free and open standards will facilitate the emergence of this new robotics business ecosystem.

With the increased efficiency brought to labs by automated systems, the amount of data being collected, extracted, analyzed and manipulated is growing at an unprecedented rate. Likewise, the technology of automated devices, software platforms and information management systems is becoming more sophisticated to handle this surge in Big Data. However, further scientific advances and innovations critically depend on more complex, increasingly integrated, and highly adaptive systems.

In an effort to match these requirements, the lab automation's information and communications technology industry has recognized the need for a flexible, modular approach to both the hardware and software of system integrations. By staying modular, individual components of a system can be upgraded without compromising the system's integrity or function. However, modularity poses its own challenges. Laboratories still find themselves with a heterogeneous mix of different vendor hardware and software technologies, none of which easily lend themselves to seamless integration. In order for laboratory automation systems to adopt a modular, plug-and-play architecture, vendors must agree upon standards, both in the hardware as well as in the software, such that the system and the data the system produces can withstand reconfiguration and the test of time.

Standardization Organizations in Laboratory Automation

While over the years, several hardware standards have become adopted by laboratory automation device manufacturers (e.g. USB, Ethernet, SBS micro plate footprint), industry-wide software standards have been slower to emerge. Several standardization organizations have formed to combat the barriers to adoption of software and data standards, including the Society for Laboratory

Automation and Screening (SLAS), the Standardization in Laboratory Automation Consortium (SiLA), the Allotrope Foundation, the Pistoia Alliance, and 21st Century Bioanalytical Laboratories. Among these organizations, the SiLA Consortium is unique in that it is focused solely on providing standardization solutions for both the horizontal communication between devices (e.g. status data, commands) and the vertical integration of result data and workflows from the robotic and analytical devices to the system level (providing scheduling and data marshaling), to the laboratory management level (e.g. LIMS and ELN databases), and ultimately to the enterprise level (e.g. Cloud).

SiLA as a Standardization Solution

SiLA's primary interest in delivering a standard to the laboratory automation industry began by addressing device-to-device communication. SiLA's Device Control and Interface Standard now serves as the transport mechanism to carry communication between different devices within an automated system. Laboratory equipment has been categorized into subgroups, including readers, washers, incubators, etc., and the standard contains the common commands that are shared amongst devices within each given subgroup (e.g. read plate, open door). The adoption of this standard in the lab automation industry enables automation users to exploit the plug-and-play architecture by reconfiguring their systems as new applications arise and as new devices become available.

Next, SiLA tackled the first rung in the vertical communication ladder with its Data Capture Standard based on AnIML, Analytical Information Markup Language. No matter what instrument or measurement technique is to be used, the data capture structure defined in this standard is used to represent result data of micro plate readers, liquid transfer data, sample content, etc. Such data may include sample or method information, measurement results, and workflow information that tie the samples to the experiment that was run. When combined with the SiLA Device Control and Interface Standard, the SiLA Data Capture Standard enables robotic and analytical devices to communicate to the system level which can then push information through to a LIMS or ELN database.

SiLA has demonstrated its maturity as a standardization organization by establishing a progression of capability through the synergetic function of multiple technologies, the SiLA Device Control and Interface Standard and the SiLA Data Capture Standard based on the AnIML platform. Moreover, SiLA's demonstration of partnerships and continued gathering of information from collaborators and industry stakeholders makes the organization qualified to continue to confront the vertical integration puzzle in the lab automation industry. SiLA's future interest to provide standardization solutions along this path is demonstrated by its current working group in Process Management Systems to bring standards to data

tracking and scheduling, as well as in its working group at the laboratory management level to standardize LIMS and ELN databases, and finally at the enterprise level to bring standards which facilitate data exchange between databases.

Standardization Across Global Markets

The principles of standardization in software communication and data transmission are generic step changes that extend beyond the lab automation community and impact multiple applications and domains. Whether in the medical, engineering, life science, government or manufacturing industries, the increased demands for device communications, as well as the storage and retrieval of Big Data, invites each market to act.

Until each industry reaches a common understanding, the development of such standards and their adoption will continue to be a slow, laborious process. However, free and open standards, developed and maintained in a dialogue between academia and industry, can shape the future infrastructures of each domain and facilitate the emergence of new business ecosystems.