Research Center
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Fraunhofer FIT
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Business & Information
Systems Engineering

Enabling Flexible Laboratory Processes – Designing the Laboratory Information System of the Future

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appears in: Business Process Management. Cases, 2016

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Abstract

(a) **Situation faced**: Recent developments in the medical and industrial laboratory market boost the need for highly flexible laboratory processes. This pressure results from new requirements that go along with the internationalization of laboratories and the digitalization of formerly paper-based and bureaucratic work practices. The execution of laboratory processes is supported by laboratory information systems (LIS), which handle the control and information flow of incoming orders end-to-end. State-of-the-art LIS do not feature sufficient flexibility-to-use and flexibility-to-change capabilities. To prepare medical and industrial laboratories for the challenges ahead, LIS require more advanced flexibility capabilities that enable meeting the need for flexibility in complex laboratory processes.

(b) **Action taken**: To tackle the challenges of medical and industrial laboratories, MELOS, a leading German LIS provider, and the Project Group BISE of the Fraunhofer FIT conducted the *LIS4FUTURE* project. The project team compiled requirements on the flexibility of laboratory processes and derived corresponding requirements on the flexibility-to-use and the flexibility-to-change of LIS. Missing configuration capabilities and lacking modularity across all software architecture layers were identified as major inhibitors of flexible laboratory processes. Following an agile development process and grounded on extant knowledge, the project team developed the *LIS4FUTURE* demonstrator, a process-aware LIS with a modular architecture and a rule-based configuration mechanism.

(c) **Results achieved**: Based on the identified requirements, the project team iteratively developed and evaluated both the modular architecture and the rule-based configuration mechanism within the development of the *LIS4FUTURE* demonstrator. Finally, the modular architecture allows for the complete replacement of process steps at build time, while the rule-based configuration mechanism implements the possibility to tackle the ever-increasing flexibility demands at runtime. The *LIS4FUTURE* demonstrator shows the applicability of the developed concepts in real-world scenarios and helps MELOS develop an innovative release of their LIS in the future.

(d) **Lessons learned**: During the *LIS4FUTURE* project, the project team made diverse learnings: (1) advanced flexibility-to-use and flexibility-to-change IS capabilities are needed to prepare for flexibility demands on the process level, (2) radical redesign of existing processes and systems should be preferred over incremental improvement to tap the disruptive potential of innovation opportunities, (3) the LIS architecture must be aligned with the process paradigm in order to become flexible, (4) discussions among academics and practitioners are more effective if based on running prototypes instead of theoretical concepts, (5) project results improve if project team members work a substantial fraction of their time at the same location.