The Analytical Intelligence™ of Things

Improving productivity through AIoT technology for analytical laboratory

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1. Introduction

Major countries around the world are promoting AI / IoT and other ICT innovations to improve productivity, including Germany's Industry 4.0, the United States' Industrial Internet, and Japan's Connected Industry/Society 5.0.

AI/IoT extend beyond innovation in manufacturing to social infrastructure technologies. For example, it is applied to resolution of traffic jam, automation of construction site, agricultural innovation, telemedicine, etc. Sustainable growth of the society is expected by the utilization of AI / IoT.

Analytical laboratory faces such management challenges as a high-cost structure, a shortage of human resources, and the succession of knowledge and experience.

These management issues can be solved through labor-saving, efficient laboratory processes, and the development of new products and services.

Labor-saving and efficient laboratory processes are supported by transmitting and storing laboratory information directly from analytical instruments to the cloud and performing visualization and statistical analysis. This system improves lab operations by reducing downtime, simplifying consumables management, remote diagnostics, and investigating and visualizing ROI of lab assets.

New products that integrates analytical intelligence solve the issue of the succession of knowledge and experience. For example, AI peak processing can reduce data processing time by 1/3 compared to current processing methods without the need for expert knowledge. The automatic diagnostic function of the instrument predicts failures and automatically recovers errors. Monitoring the status of the instrument at all times enables to detect signs of pre-failure and dispatch field engineers as needed.

In this presentation, it is shown the future achieved by AI / IoT technologies and the current status of the Analytical Laboratory.

2. Sustainable Growth using AI / IoT

Major countries around the world are promoting changes such as productivity improvement using ICT especially AI / IoT. These technologies are driving innovation in various industries.

Germany	**Industry 4.0**
United States	**Industrial Internet**
Japan	**Connected Industry / Society 5.0**

Automatic driving
Traffic jam resolving

Construction
Automation

Smart Agriculture

Tele-medicine

3. Management issues and Solutions

To achieve business growth, it is necessary to solve management issues such as high-cost structure and personnel shortages. AI and IoT can help save labor of operations and improve operational processes.

Major Management challenges

- High-cost structure
- Personnel shortages
- Commoditization of products and services

Aspects resolved through ICT

1 Increasing the efficiency of the labor input
- Saving labor for operations
- Improve the efficiency of operational processes

2 Increasing the value added
- Enhancing the value added of existing products and services
- Developing new products and services

(Source) WHITE PAPER Information and Communications in Japan, MIC (2018)

4. Measures to Improve Productivity of Analytical Laboratory

Automated support functions utilizing AI / IoT technologies enable higher productivity and maximum reliability.

- AI / IoT technologies combine instrument and software to analyze system status and results.
- Support the acquisition of high quality, reproducible data regardless of an operator's skill level .

Data Collection
Intelligence

Store

Visualization

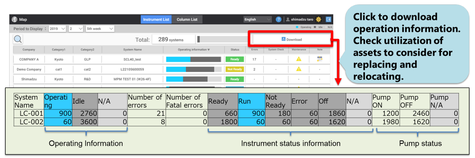
Big Data Analysis

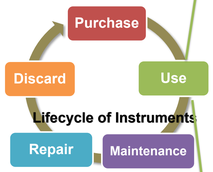
- Labor-saving of analytical lab
  - Reduction of preparation work
  - Reduction of downtime
  - Consumables management
  - Remote Diagnostics
- Improvement of business processes related to the lab operations
  - Study of the ROI of R&D assets
  - Improving lab operations through visualization

5. Examples of Analytical Intelligence to Improve Productivity

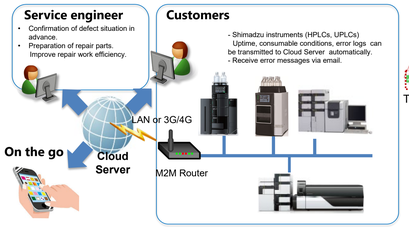
5.1 Asset Management and Remote Support

AI / IoT technologies support all lifecycle of analytical instruments from purchase to discard.





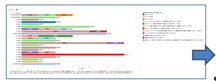
Shimadzu LabTotal™ Smart Service Net operates via M2M Router and enables our customers to reduce instrument downtime and manage the cost of assets by automatically collecting the system check report, conditions of the consumables, and error logs efficiently by utilizing IoT.



The maintenance date is predicted.

The use history of consumable parts is shown.

Email about the maintenance



The error history is displayed.

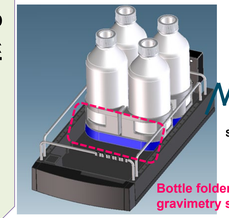
Service engineer
- Schedules to visit for the maintenance
- Prepare the needed consumable part

Lab manager
Schedules to stop the system for the maintenance

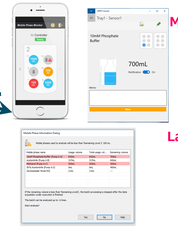
Setting-up

5.2 Prevention of Mobile Phase Shortage by Monitoring Mobile Phase Volume

The gravimetry of the mobile phase is observed through smart devices. The alert is sent in case of shortage. Prevents from damaging the column or wasting the precious sample.



Sends the data to the PC or smart device (iOS / Android)

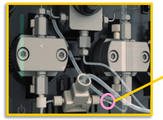


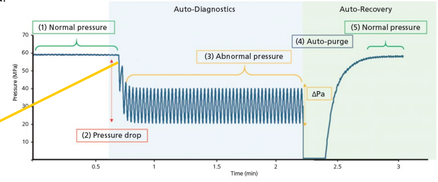
Analysis

5.3 Reduce Downtime by Auto Error Detection and Auto Recovery

PAT.P

The air bubble interfusion brings for a drop in the flow rate resulting in a wrong chromatogram. It rarely happens so then is difficult to predict or manage especially during a long sequence. AI handles it instead of you.





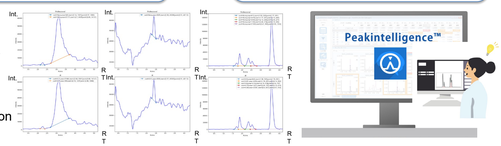
Postrun

5.4 Auto Peak integration using AI technology

AI solution for simultaneous determination of multiple components in multiple samples.

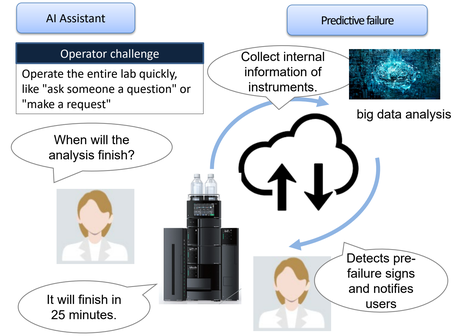
Challenges
- Peak integration results depend on user experience
- Processing large amounts of data takes huge time

Peakintelligence™ Peak integration using AI
- **90%** match of expert integration results
- **1/3** of the time compared to the current algorithm



6. Future Laboratory

In the future, laboratory operators will have more benefit from AI / IoT technologies. AI assistant help a lot of analysis work, and predictive failure function can reduce instruments downtime to notice users pre-failure signs.



Solutions
- Checking the instrument status
- Review Lab Schedule
- Suggest instruction by AI speaker

Solutions
- No downtime due to pre-failure
- Dispatch field engineers as needed

7. Conclusion

New lab management through AI / IoT helps reduce lab work, streamline processes, add value, deliver new services, and increase productivity.

- **Improvement of business processes related to the lab operations**
  By collecting various information from analytical instrument can make effective use of laboratory assets and improve operations.
- **Labor-saving of analytical laboratory work**
  Smart analytical platform that incorporates AI / IoT with advanced monitoring, self-diagnostics and auto-recovery capabilities, and AI peak integration dramatically improves the overall performance of analytical laboratory.
- **AI / IoT technologies bring infinite possibility**
  AI / IoT technologies will contribute significantly to the sustainable growth of our society, and analytical laboratory will benefit from it.

Reference:

1) The White Paper on Information and Communications in Japan, MIC (2018)
2) S. Kanazawa, et al., Deep learning methods applied to the analysis of metabolomics data, 67th ASMS Conference on Mass Spectrometry and Allied Topics, June 5th, 2019