INTELLIGENTLY IMPROVING PROCEDURES AND WORKFLOWS IN A GMP LABORATORY

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INTRODUCTION

Pharmaceutical manufacturing costs the industry approximately $90 billion each year and represents twice the expenditure of R&D.[1] A 2001 study conducted by the MIT Pharmaceutical Manufacturing Initiative (PHARMI) indicated that significant time was spent conducting quality control (QC) testing and documenting QC results during the manufacturing process.[2] Eroding profit margins from stiff competition, increasing product defects[1,3], and the FDA's focus on a "quality by design model" has led the industry to reevaluate manufacturing efficiency. Recently the industry has begun adopting both Lean Manufacturing and Six Sigma to achieve the efficiency and quality gains achieved by other industries.[4,5,6] IT solutions will play a significant role in managing QC standard operating procedure (SOP) documentation during the focus on Lean and Six Sigma to eliminate waste, improve workflows, improve quality, and reduce variability.

QC operations represent an expensive component of the manufacturing process largely due to the slow turn-around time for results. GMP regulations require maintaining thorough documentation to better ensure strict compliance with established SOP's during product testing. Maintaining GxP documentation by utilizing paper dramatically reduces QC result turn-around time. Hence, completing paper documents and ensuring their authenticity creates a burdensome bottleneck in the QC laboratory. Electronic SOP Form and Worksheet systems, like Waters SDMS Intelligent Procedure Manager, present an opportunity to create a semi-automatic Lean Process during the SOP documentation process thereby boosting productivity and accuracy in the largely labor intensive component of the QC testing laboratory.

DISCUSSION

The Problem:

	Sigma	Defects (ppm)	Defect Free
	1σ	690,000	31%
Pharmaceuticals	2σ	308,537	69.2%
	3σ	66,807	93.3%
	4σ	6,210	99.4%
	5σ	233	99.98%
Semi-Conductors	6σ	3.4	99.99966%

Figure 1. Pharmaceutical Manufacturing product defects exceed those in other industries such as semi-conductors and airlines. This table highlights the 2-to-3 sigma defect rate for pharmaceutical manufacturing per million units translates to approximately 300,000 defective units per 1 million units manufactured versus approximately 3 for the semi-conductor industry operating at 6 sigma. (Table: Reference 7).

Industry's Strategy for Addressing Problem:

Figure 2. Pharmaceutical manufacturing has re-evaluated manufacturing efficiency and have been adopting Lean Process Improvements. The basic tenants of Lean Process Improvements focus on eliminating wasted effort, streamlining the workflow, and reducing cycle-time in a process.

Informatics Tactic for Reducing Paper and Implementing Lean:

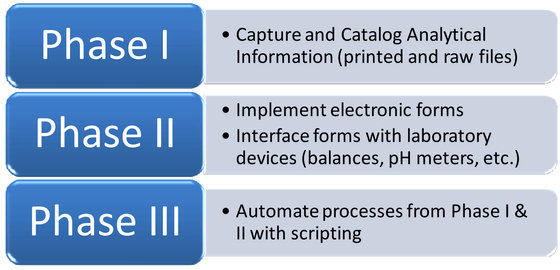

Figure 3. Implementing a paperless SOP workflow requires (1) capture of raw data and printed records, (2) implementing intelligent electronic forms, (3) automating repetitive tasks.

Phase I Digitally capturing printed documents and data files:

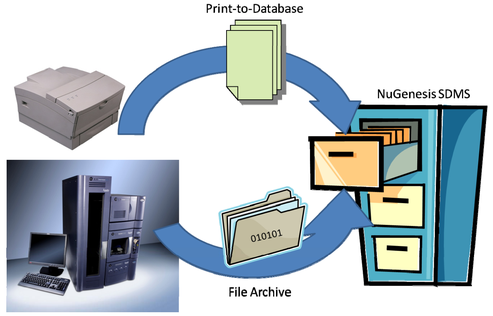

Figure 4. Capturing and cataloging raw data and printed documents constitutes the foundational step for migrating a paper-based GMP workflow to a digital GMP SOP workflow.

Phase II Implementing Electronic SOP Workflows and Forms:

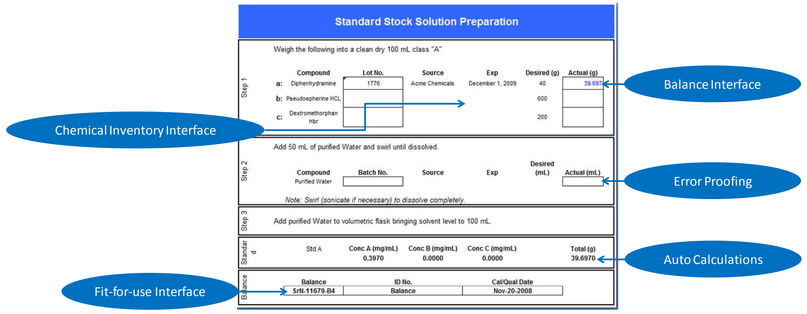

Figure 5. This form illustrates the second step required to migrate to a digital GMP SOP workflow. The electronic form interfaces to external data sources such as electronic balances and databases (like chemical inventories), performs automated calculations, error-proofs input data (flagging out-of-range values), and ensures that electronic equipment such as balances are properly calibrated before allowing use.

Phase III Automating the GMP SOP workflow and documentation life-cycle.

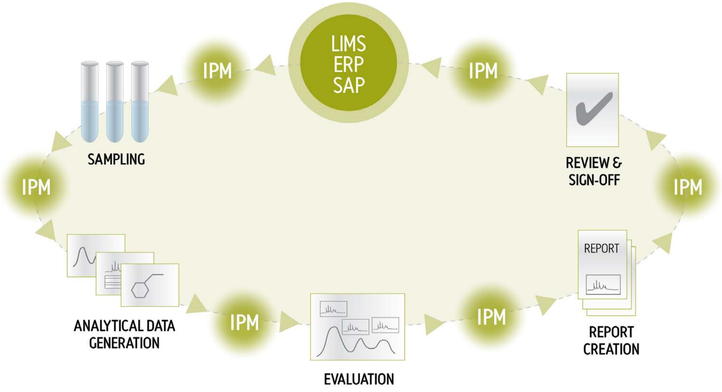

Figure 6. The final implementation phase for migrating to a digital SOP workflow. This workflow captures and catalogs both raw analytical data and printed documents, replaces paper SOP forms with intelligent electronic SOP forms, and automates repetitive data-entry tasks.

CONCLUSION

- **Electronic SOP systems, like Waters SDMS Intelligent Procedure Manager, offer the potential to reduce wasted data management efforts, improve documentation workflows, and improve QC testing cycle-times, thereby addressing the central tenets of Lean process improvement.**
- **Electronic SOP systems benefit other heavily standardized SOP processes such as medical device testing, food testing and environmental testing.**

BENEFITS

- **Reduces Paper Usage**
- **Enhances Productivity**
- **Improves Accuracy of Records**
- **Promotes Collaboration**
- **Integrates Operations with LIMS and/or ERP**
- **Accelerates Product Release**

References

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