Interoperability Between Product Life Cycle Management (PLM) & Electronic Lab Note Book (ELN) for Chemical Companies to Accelerate Product Development

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Abstract: Many companies struggle to integrate various system & sub-system used for their Product development. Even though product lifecycle Management System are claimed to be eco-system to integrate all systems & sub-system into one place but that is still not reached to a certain level of maturity. There are challenges being faced by companies. Information are still available on island of silos. These Island of Silos impacts business productivity, time to market, cost, rework etc. This paper presents need & challenges of the interoperability between Electronic Lab note book (ELN) used by R & Din design & develop phase of product life cycle management (PLM).Earlier there wireless focus on ELN software integration with PLM in context to process industries like Chemicals. ELN plays a significant role to complete the product evolution chain. In context to discrete industry like automobile & aerospace, PDM (Product Data Management) is handled through design tools like CAD / CAM. These tools are sufficiently integrated with PLM and resulting into higher productivity, better collaboration, less product cost & launch time. Whereas in case of chemical industry, CAD/CAM role is played by ELN. ELN is not sufficiently integrated with PLM. The purpose of this paper is to study, how to realize interaction & integration between ELN & PLM. Find out "what data" need to be exchanged between ELN & PLM. There is possibility to increase productivity, better collaboration between different stages of PLM which may result into reduction in product launch time & cost.

Keywords: (ELN), (PLM). PLM, ELN & PLM, CAD/CAM, (Product Data Management).

I. INTRODUCTION

1.1. What is PLM (Product Lifecycle Management)

Companies dealing with product related activities facing more challenges year on year due to complex development process, complex workflow system, complex product data, and large team working across the globe, Aligning corporate strategy with product development/commercialization. Companies having pressure on cost reduction & shorter time to market for new products. Product lifecycle management (PLM) systems can be considered as important enablers for achieving true coordination and effective management of product development processes. PLM Strategy is used to work upon complex product related activities which works with People, Process & Technology. PLM Strategy start with product concept to commercialization and ends with product retrials.

Product Life Cycle Management runes through various phases of product.

1. Concept
2. Design & Develop
3. Prototype & Pilot
4. Launch & Ramp
5. Production
6. Service & Support
7. Phase out & Retrials

Product Life Cycle Management Solution is IT based Tool which enables PLM Strategy.

1.2. What is ELN (Electronic Note Book)

A electronic system which create, store, retrieve and share full electronic Research & Development records in ways that meet all legal, regulatory, technical and scientific requirements. ELN is used by Scientists, Chemists, engineers & technicians to document research, experiments, procedures performed in a laboratory. It Support to analytical groups through inclusion of structures, spectra, chromatograms, pictures, text, etc. it offers full document version control and revision management control with security for all data acceptance and audit trails. Direct link to laboratory equipment, Allow data to be interrogated, tabulated, checked, approved, stored and archived to comply GLP & 21 CFR Part 11.

II. NEED OF INTEGRATION

Product information is not effectively passed on to laboratory for executing the actual experiments. Experiment documents are not effectively achieved & linked to product database. Engineering Team involved in process scale-up is not having instant access to all experiment documents including failed/ repeat experiments. Failed/ Repeat experiment details are vital information during process scale-up 1. To identify the critical process parameters 2. To make the process feasible in terms of safety & repeatability. This results into delay in product launch & ramp under Product lifecycle Management.

III. CHALLENGES

a) PLM & ELN are standalone environment
b) PLM & ELN are provided by different vendors
c) There is no standard way available to integrate PLM & ELN
d) What data need to be exchanged between ELN & PLM

e)   How to pass between PLM & ELN.

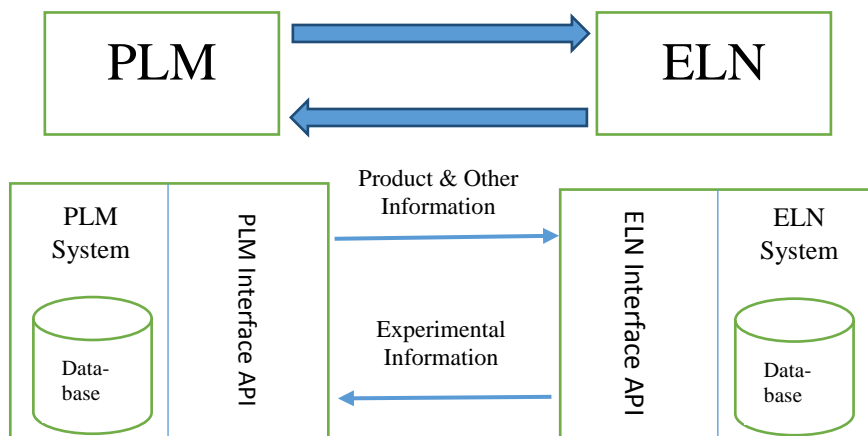## IV.   GENERAL APPROACH

Block Diagram - Information Flow

4.1. *Product Information: initiation & working with PLM*

As first step, new product information is introduced in to PLM Software by providing product name, CAS (Chemical Abstracts Service) Number, Application, Product Specification, Market. Project is created by R&D for Design & Development of new product.

4.2. *Product Information flow PLM to ELN*

After PLM activity completion Product & project data information need to passed on the ELN through APIs. Below information need to passed through APIs.

a)   Name of Project (i.e. PQR16XXXX-XXX)
b)   Type of Project : Lab Sample/ Pilot Sample/ Commercial Campaign
c)   Name of Task (i.e. Lab Trails (all steps) / Analytical Method Development(all Steps))
d)   PLM Experiment Number (i.e PQR16XXXX-XXX-EXP-XXX)
e)   Team Members (i.e. Synthesis Lead Chemist / Synthesis Chemist / Analytical Lead Chemist/ Analytical Chemist)
f)   Name of Chemist

Figure 2: Structure of PLM Project
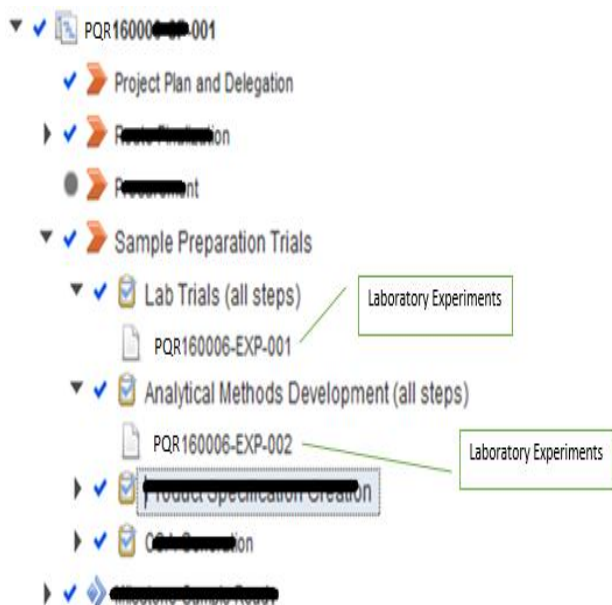
Synthesis Lead Chemist: Sam
Synthesis Chemist: Paul
Analytical Lead Chemist: Andrew
Analytical Chemist: Erik

Figure 3: Structure of Team under project in PLM

4.3. *Product Information: working with ELN*

ELN API will establish communication with PLM & received the information passed on by PLM. ELN will store information in ELN database. ELN will start with Synthesis Experiments which will use the details received from PLM as shown in below Forms.

Synthesis Experiment Form – 1*

1.   Date : < Autofill by system>
2.   Project Name: <Autofill from PLM>
3.   Type of Project <Autofill from PLM>
4.   Team Members <Autofill from PLM>
5.   Name of Chemist<Autofill from PLM
6.   Experiment Number : < autofill from PLM>
7.   Experiment AIM/ Objective : *(Free Text)*
8.   Reaction Scheme : *(Chemical Drawing Tool invokes & Free text)*
9.   Raw Material List

S. no	Chemical name	Qty	Mol. Wt	M/R	Purity	Source (Make/lot Number/ Batch Number)

5a) Sample request for analysis using **Sample Request Form 2***
10.   Brief Procedure
(Free Text)
11.   Reaction Setup

(Chemical Drawing Tool invoke & Free text)

12. Observation

(Chemical Drawing Tool invoke & Free text)

Sample request for analysis using **Sample Request Form 2***

13. Work-up

(Free Text)

Sample request for analysis using **Sample Request Form 2***

Sample Request Form 2*

Sample ID	Name of Synthesis Scientist	Name of Project	Experiment Number	Sample Type	Qty	Analysis Required (GC/HPLC/ etc)
Autofill	Autofill	Autofill	Autofill	Drop down	To be filled	selection

Test Result Form 3*

Analysis	Result	Attachment	Remark	Done by	COA required(YES/No)	COA Attachment	Approved by (Analytical Group lead)
				Auto			Auto

Analytical Experiment Form – 4*(For reporting)

1. Date :<Auto fill >
2. Experiment Number:<Autofill>
3. Experiment AIM/ Objective :

(Free Text)

4. Analysis Type : (GC/ HPLC / IC / Titration)<auto>
5. Calculations

(Free Text / Excel Calculation)

6. Conclusion

(Free Text)

4.4. Product Information flow ELN to PLM

After Completing the Experiments in ELN, ELN experimental data & results will be send back to PLM so that experimental data including analytical results should be achieved in product database. ELN APIs will communicate with PLM APIs.

1. Experiment details in PDF
2. Experiment link (ELN link)

V. CONCLUSION & FUTURE WORK

In this paper we have identified the information required to be exchange between PLM & ELM. We have also shown that how the PLM supplied information is consumed by ELN & vice-versa. Seamless product information availability is will result into higher productivity, shorter time to market & reduction in development cost. For Future work, Study need to conducted over available APIs with PLM & ELN. Need to find out degree of fitment/ compatibility between APIs. Need to work on common interface guidelines for APIs.

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14. Calculations

(Free Text / Excel Calculation)

15. Conclusion

(Free Text)

11 a) Consolidation of Analytical Results sent through **sample Request Form2*** & response received via **Test Result Form 3***