Product Engineering - Filling a Software Systems Engineering Gap at KLA-Tencor

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Abstract – KLA-Tencor places great emphasis on Systems Engineering (SE) as a holistic, interdisciplinary expertise and indeed SE is considered a core competency at KT. In practice, however, Systems Engineering at KLA-Tencor is almost exclusively focused on optics, mechanics, and control systems, and systems engineers rarely participate significantly in software, compute, and storage architecture decisions. This is becoming increasingly problematic for KLA-Tencor as our products become more software & IT centric with the advent of design guided inspection and metrology applications which utilize Electronic Design Automation (EDA) tools, design data, and methodologies. To fill this expertise and responsibility gap, WIN created a new engineering organizational group, Product Engineering, modelled after a similar organizational structure used in the EDA industry.

I. Introduction

The increasing use of design-guided inspection and metrology applications that utilize Electronic Design Automation (EDA) tools and methodologies is dramatically increasing the complexity of KLA-Tencor's software, compute, and storage components. Data dependencies and coupling between once disparate components and products are also increasing rapidly. To accommodate this, KLA-Tencor's engineering organizations need to place more emphasis on holistic solutions to software application development, data flow design, User Experience Design, and Information Technology design.

KLA-Tencor uses EDA design data to discover defects with higher precision and sensitivity than has ever been possible through a set of tool capabilities referred to as *NanoPoint*. Processing a customer's EDA design data with NanoPoint presents unique challenges to KLA-Tencor because our defect-centric customers do not have prior EDA design knowledge, and they are unable to share their proprietary design files outside of the fab. With chip designs increasing in density by 2X for every technology node, it is imperative that KLA-Tencor go onsite to observe these customer designs and how their increasing complexity impacts the performance of KT's inspection and metrology systems at 10nm, 7nm, and beyond.

In theory, Systems Engineers would fill this need, but in practice, responsibility for these has fallen on Software Engineering and Applications Engineering. Another aspect, which may be unique to WIN, is that

Applications Engineering tends to be comprised of relatively junior engineers. As a result, key decisions in these areas are made by software engineers, many of whom are not equipped with the experience and expertise to approach problems and solutions as holistically as required.

KLA-Tencor's engineering organizations need to change in order to fill this gap.

II. The Solution - Product Engineering

In late CY 2014, WIN Software Engineering established a new organizational group, called Product Engineering, modelled after a similar team used in the EDA industry. The vision was to build a team of individuals in R&D with cross-functional skills in EDA, customer management, communication, software development, and information technology. This group represents the engineering organization in customer facing roles with responsibilities like:

- Act as resident experts on EDA data and techniques to our customers and within KLA-Tencor.
- Define requirements for software & IT features and components.
- Manage communication and be part of tiger teams during customer escalations.
- Validate new requirements through customer interaction and drive these requirements into KT products.
- Validate new software features or versions during Joint Development Projects, external Alpha, and Beta testing.
- Represent software R&D during quarterly Technical Committee (TC) meetings with key customers.

III. Results

Since its creation, the Product Engineering group has completed a number of projects internally and with customers. Some examples of these projects are highlighted in the next sub-sections.

Software Architecture

- Prototyped a solution for Pixel-To-Design (PDA) alignment with an EDA technique ("outline layer") which demonstrated a 10x performance improvement in PDA training on the BBP inspection tool. This concept has now been productized by R&D and the customer has moved from 10% adoption of NanoPoint in BBP recipes to a plan for 100% adoption based on the improved TTR.
- Documented the data flow for all software systems in NanoPoint. The flow is complex, and the document represents the accumulated knowledge of a dozen or so engineers. 1/10th of this data flow is seen in Figure 1.

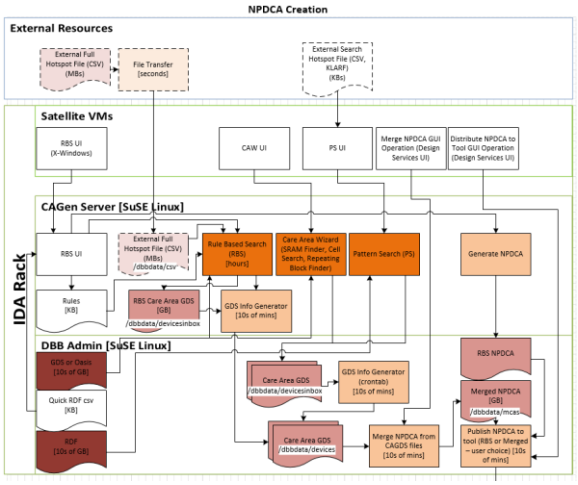

Figure 1: NanoPoint Design Care-Area Creation (NPDCA) Flow. This document is available at KTDC-1098-155.

- Evaluated next generation EDA tools for use in NanoPoint.
- Implemented the prototype of a "job queue" feature for NanoPoint to improve utilization of its computational resources. This feature is being productized for the next NanoPoint release.

- Defined the next generation computational requirements for NanoPoint data preparation.
- Defined requirements for a next-generation, care-area creation tool based on apps and customer feedback.

Onsite Customer Interaction

- Managed field escalations for EDA design-related issues at every major BBP/NanoPoint site.
- Created Best Known Methods for using EDA design data with NanoPoint.
- Resolved network and IT issues on BBP tools and IDA/XP Racks at customer sites, including some issues that had caused tool-down situations.

Because the Product Engineering resources are able to travel, with VISAs and work permits already available, they can leave on a moment's notice to help a customer in need. We estimate that the Product Engineering team has reduced root-cause determination for NanoPoint field escalations by as much as 4X. Further, program managers and software engineers no longer have to disrupt their planned work to fly to a customer site. We estimate a 20% productivity improvement in the NanoPoint software engineering team by being able to rely on the Product Engineering team for these escalations.

IV. Conclusion and Continuing Work

We have demonstrated that KLA-Tencor's product portfolio is becoming more dependent on software and IT solutions, and that our engineering organization needs to change to meet these needs. We have also demonstrated that a Product Engineering organization, reporting through Software Engineering, is an effective structural response to that need.

Acknowledgment

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