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ENGINEERING TRANSFORMATION

Maximizing Growth with Smart Engineering

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Executive Summary

The future of manufacturing industries will be reformed by smart products and robust industrial equipment. And this is primarily due to the mounting consumer expectations that have been reset to nothing less than Cloud-connected appliances, driverless cars, biometric wearables and the like.

On one hand manufacturers have the comfort and safety benchmarks that their products have to live up to and on the other, there are Government regulations and compliance standards to adhere to. This in turn has contributed to the adoption of Industry 4.0, the fourth industrial revolution, across the manufacturing industry. With cyber-physical systems, IoT, cloud computing and cognitive computing capabilities, Industry 4.0 helps manufacturers streamline their roll-out cycles, abide by changing Government regulations, and attain faster time to market.

In order to make Industry 4.0 successful and efficient, it is important that the underlying engineering processes used to design and develop products are successful and efficient. This White Paper focuses on the need for **Engineering Transformation**, the challenges manufacturers face with their product development, and a holistic solution to address this. With engineering transformation and improved processes for engineering products, manufacturers are not only coping with the changing expectations of customers, but are also able to do more justice to the adoption of Industry 4.0.

Introduction

Manufacturers and OEMs continue to face innumerable challenges that hinder opportunities to seize bigger market shares. Customers expect new updates and newer versions of devices and they want it now, pushing organizations to launch their new products faster than ever before. The integration of electronics and software content in every product engineering cycle brings its own set of complexities and challenges that organizations must address and update. To top it all, the ever-changing and increasing regulatory requirements burden the whole engineering and roll out process.

In order to stay relevant and competitive in the market, organizations need to look at the processes, methods, and tools that are used to engineer the product.

Engineering transformation looks at a more holistic approach, so as to address the underlying system and the software engineering methods, processes and tools that can be transformed to meet the business objectives seamlessly.

Here a few key industry challenges

Engineering change request

The process has become more complex, given that it needs to transcend through various domains of the mechanical, electrical/electric structure. Organizations are struggling to bring in traceability from one phase to another.

Lack of Real-Time Visibility

Program managers and business leaders are grappling to gain real time visibility of a program and are thereby unable to balance between the business needs and risks that accompany the program.

Redundancy

Due to poor tracking mechanisms, enterprises witness the challenge of replicated data across systems, which results in redundancy and lack of consistency.

Manual Collaboration

Most organizations still practice manual collaboration within different domains, thereby increasing time lag at every stage of product development.

Moving towards a Holistic Approach and Understanding How it Helps

Engineering transformation adopts a holistic approach towards how the product development techniques could be enhanced to achieve greater efficiency. Let's understand the various building blocks of engineering transformation.

System Engineering Building Block

Systems architecture
Organizations should explore how the systems architecture has been arranged with a focus on reuse and creating a consistent tool suite to aid the systems architecture development.

Model based system engineering (MBSE)
Recent studies have shown that the usage of MBSE has enabled organizations to greatly reduce the time involved in development. Usage of various modeling tools for various disciplines of mechanical and software development should be mooted by organizations. Also what's important is to explore how the MBSE lifecycle could be integrated with the Software lifecycle.

Variant management & Product line engineering (PLE)
In order to reach markets faster with newer models, it is important to establish methods of variant management. By combining product line engineering & applying variant management at different levels of product development, organizations could develop newer variants with minimal development effort.

Aligning Project Lifecycle Management (PLM) & Application Lifecycle Management (ALM)
Mechanical development and the software development clock cycles differ, in the sense that changes occur at a very rapid pace in software development as compared to mechanical development. However, it is very important to integrate them so that the stages of product development could be tracked more efficiently. ALM & PLM integrations gets deeper into how these two worlds could be aligned together at different stages of the product development.

Software Engineering block

Requirement Engineering
Requirements management is the first step towards identifying, prioritizing and communicating product requirements between suppliers and OEMS across different areas including mechanical, hardware, software and calibration. Managing requirements in a multi-disciplinary environment poses a series of challenges. Creating a single source for all product related requirements would be the first big step towards creating a greater transformation.

Planning Change Management
Creating changes to a manufacturing process can be extremely complex. Even a small change in the process will require a multi-disciplinary team to identify, analyze, evaluate, plan, implement and review the changes. The main objective however is to track and document the entire process change.

Continuous Integration and Deployment
Be it a feature enhancement or a complete product overhaul; it is recommended to adopt to an environment of continuous integration and deployment. Integrate small changes and review the product as this helps in increasing productivity and gaining efficiency.

Test Management
Test management can be split into a four-phased process that includes
1) Creation of a basic plan including a different set of criteria for testing.
2) Definition of specific test cases and development of test scripts.
3) Execution of test scripts and test suites resulting in defect submission.
4) Analysis on test efforts and test results communicating project status and product quality.

As engineering transformation affects a lot of disciplines in the organization and also questions the long standing practices, it becomes extremely essential that this transformation is well planned and carefully executed to ensure that the core objectives are addressed. Apart from it being a strong technical solution, engineering transformation also assists in planning for a strong organizational change management (OCM), that further contributes to its success.

The Typical Engineering Transformation Journey

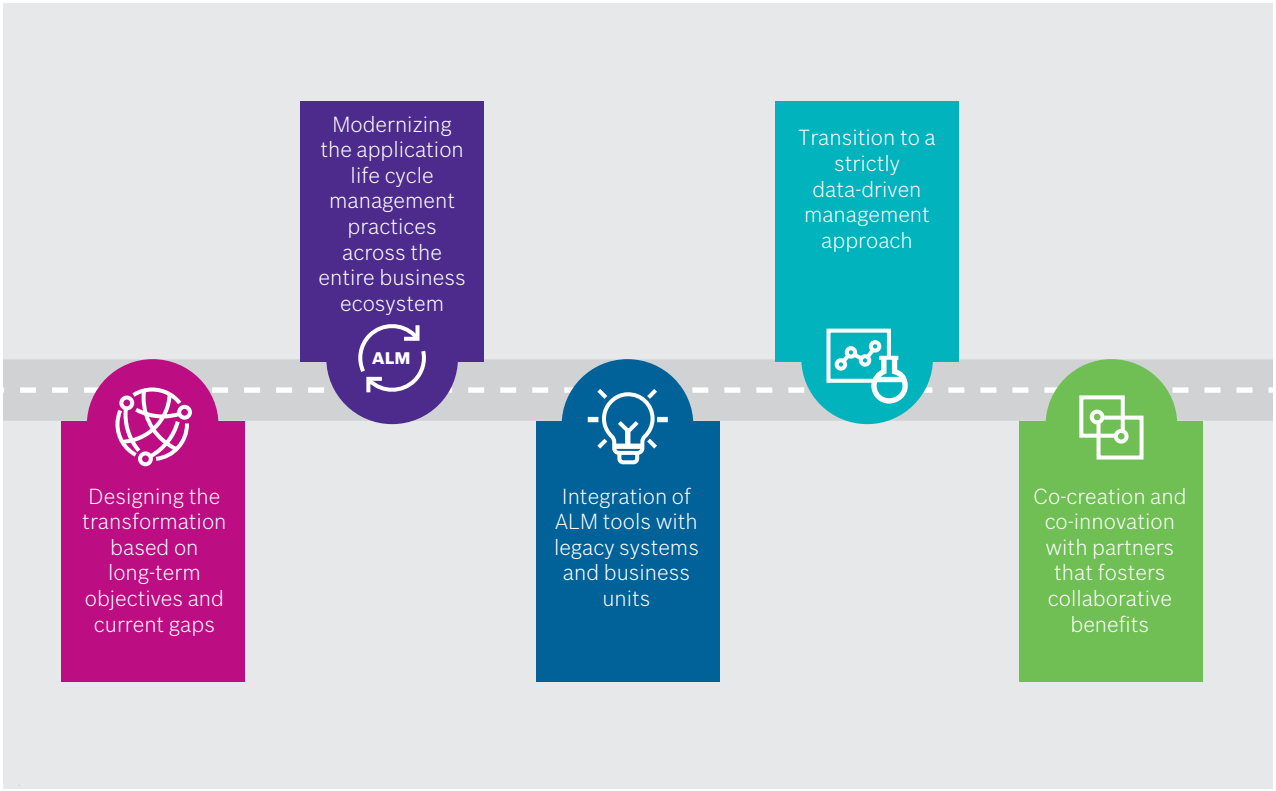
With modern products bearing unprecedented intelligence and customers expecting a seamless experience, the manufacturing industry is increasingly relying on complex data sets. This brings the need to incorporate a new approach to designing. Software will thereby need to contribute to data-driven products, plants, and business communication systems that address customer expectations dynamically.

Organizational change needs to clearly define the roles and responsibilities, and identify pilots for rollout. A deployment approach should concern platforms, teams, and projects across the organization.

Business leadership must focus on practices that bring in standard measures to cope with the complexity curve. To be a future ready-organization, an evolutionary approach needs to span the entire organization.

When consumers get more and more accustomed to smart devices, new-age manufacturing will have to rely on a technology framework that achieves mechanical ends through faster, self-correcting systems. However, addressing efficiencies partially is a typical drawback companies show when they have budgetary restrictions for digital transformation. Thus, organizations need to broaden their perspective on transformation.

The journey must include the following parameters



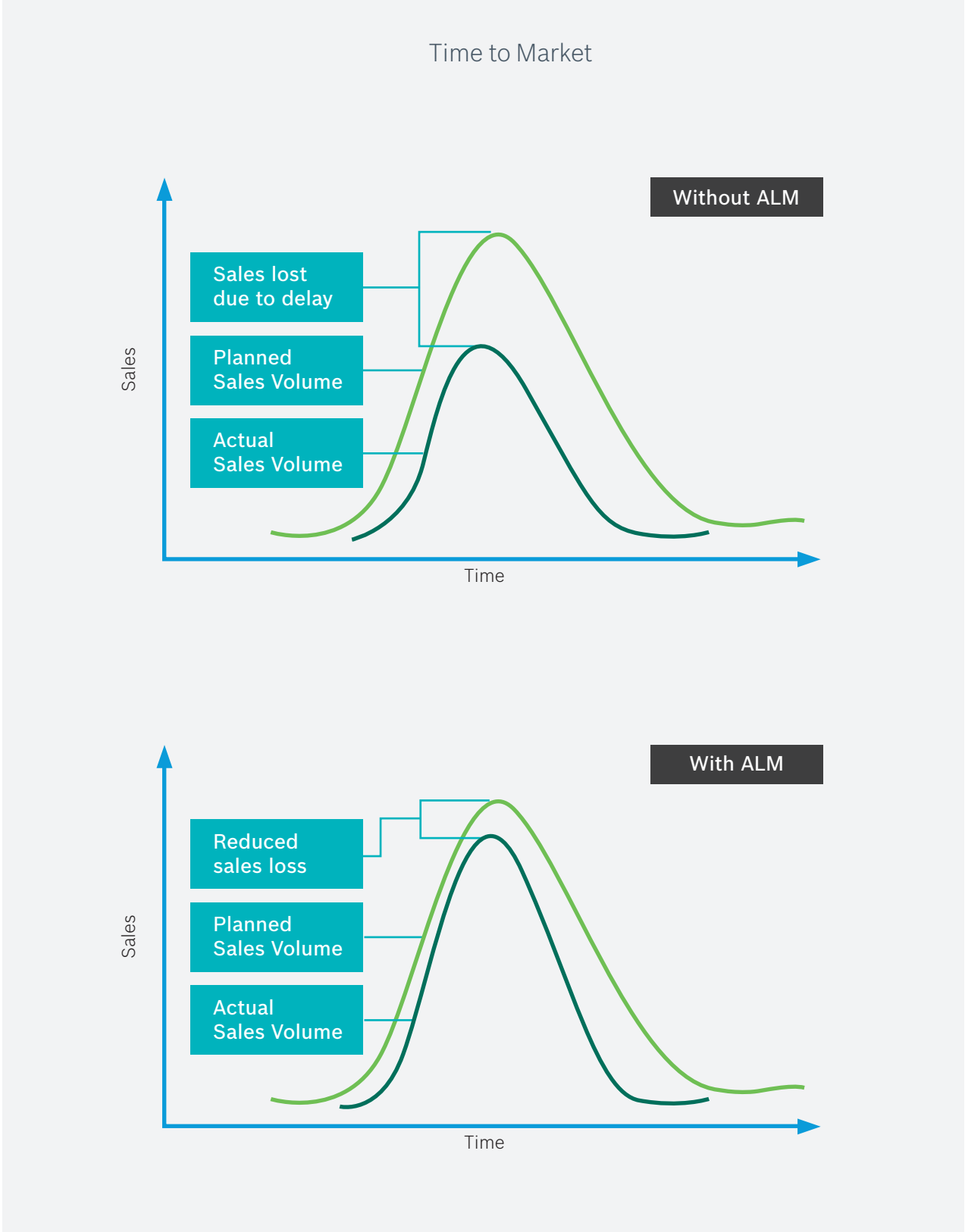
To ensure that the journey is successful, it is imperative that two aspects are considered by any organization- **“managing the change for people”** and **“solution rollout”**.

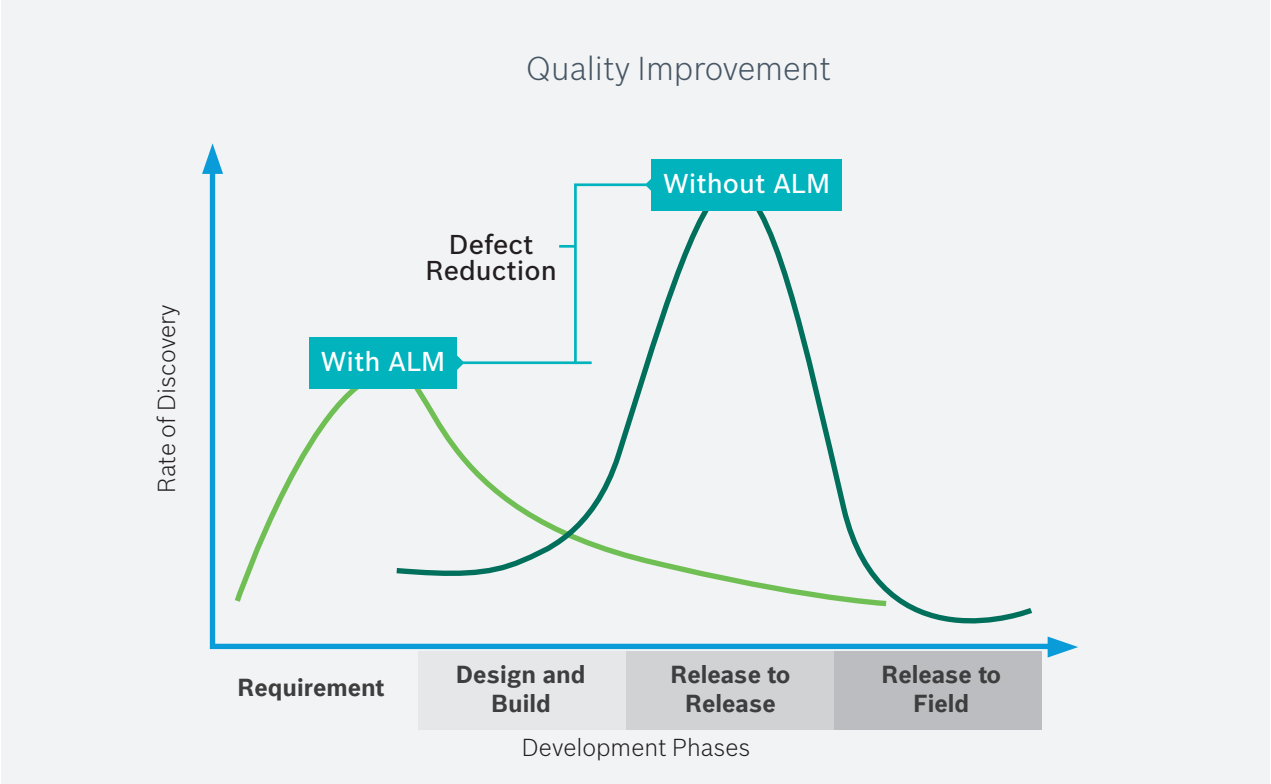
How ALM is Modernizing the Engineering Organizations

Moving away from poorly coupled tools and disparate user experiences requires a well governed execution. As devices project data by the second, testing automation has alleviated much of the cost associated with digitizing manufacturing businesses. Data from systems also helps in the execution strategy and design. Thus, along with interactive capabilities, engineering transformation brings cross-domain and collaborative development.

Based on recent industrial outcomes, about 20% percent improvement in objective-based progress, and 15% decrease in effort through lower latency in communication have proved why ALM is suitable for advanced requirements. It makes the seemingly daunting task of engineering transformation smooth and efficient.

Benefits seen by organizations using ALM are:





The Way Forward

Combining the features of ALM & applying it to system engineering as well could lead to a development environment that not only connects various disciplines in an organization, but also enables smooth communication that breaks all the process barriers. Hence with this approach organizations could move from engineering to a more collaborative and smart engineering. At Bosch, we have been embracing this new perspective of operations and hope to maximize improvements in efficiency, and reduce the communication barriers across all business units.

About the Author

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Veena BM is Head of Engineering at Robert Bosch Engineering and Business Solutions. She leads the strategy & enterprise wide rollout process for the Engineering lifecycle tools required to develop various ECUs across automotive BUs of Bosch. Veena possesses strong product management skills combined with deep technical experience and critical leadership elements needed to fuel growth and meet increasing demand from Bosch's customers for Systems Engineering & Application Lifecycle Management (ALM) and platforms that are pervasive, integrated, and open.

Veena is a dynamic leader, building strong, diverse, and motivated teams that continually excel through a relentless focus on execution. A Business leader with an in-depth understanding of technologies and their commercial applications, Veena is focused on innovation and inspiring her team to build remarkable products and solutions.

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