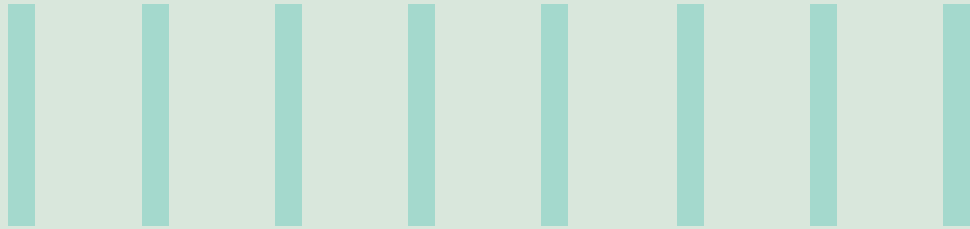




THE PLM DOMINO EFFECT

- Jagmeet Singh and Jeff Kavanaugh



Summary

When we were children, we all played dominos. We may have played the formal numeric alignment version, but another variant is the physical (and fun!) sequential toppling of slabs. After lining up the dominos, you tip over the first one; and then one by one, like a wave, the rest fall over too. This is the domino effect: one event triggers a series of other events.

In the grown-up world of business, the domino effect usually has a negative connotation. It's associated with a triggering action that causes secondary and tertiary responses. However, the domino effect can also be positive, and exciting advances

in technology have enabled Product Lifecycle Management (PLM) to generate positive, domino-like opportunities for product effectiveness.

Today's products are stirring the imagination and changing at a pace beyond our comprehension. With the 'smart' tag now applied to many products, traditional boundaries are being challenged for new product innovation and development.

What seemed to be terra firma for mechanical product designers and engineers has now been invaded by electrical and electronic integrated components. These sensors and devices are integrated components that require more than a mechanical

function, and are making products more user-interactive, with capabilities to capture and analyze multiple data types generated during product usage.

As this shift has occurred, product lifecycle management has started to experience the impact of integrated products and components [1]. PLM is a backbone technology for product development and innovation, and in the near future PLM is expected to play an even larger role beyond product data management. In addition to accelerating new product development, PLM will evolve to support and manage remote product monitoring, operation, and optimization.



Smart, Connected, and Immersive

Product innovation has traditionally been based on customer input and feedback that was collected via disconnected, disparate, and nonintegrated systems. Until now, no mechanism has existed with the capability to fully capture, comprehend, and convert real-time customer insights into meaningful problem statements. If a customer complained about a product being 'poor quality,' 'too slow,' 'below expectations,' 'not user friendly,' and so on, there has been limited capability to directly extract accurate insight from such feedback. Interpretation of each complaint would vary by customer, so each complaint and feedback often required detailed analysis.

Product innovation is a hard thing to control, because while part of the process is internal, many significant and important elements – like consumer complaints – are external. This control gap is illustrated in Figure 1. As a result, products have been periodically revised based on static data rather than continually improved based on rapid customer feedback.

What if this analysis could be done without human intervention, aided by software, data, and artificial intelligence? Enter the Internet of Things, and the Wild West of sensors and devices that are starting to provide the capability to fill in the gaps needed for customer insights.

As with most grand challenges, the obstacle or problem has actually paved the way for the solution. In the words of Marcus Aurelius, "The obstacle has become the way." Disparate, disconnected, and vague customer insights require new technologies and collaboration, and this necessity has sown the seeds for the creation of the next generation of customer-focused product development. To capture the voice of customer, sensors and devices, integrated into a network with predictive analytics and inferential algorithms, will evolve to replace field surveys, dealer feedback, and manual polls.

Opportunities are rapidly emerging to address this sweet spot – a completely new world of components which are smart, connected, and have the capability to provide immersive customer experience. Such

components become an integral part of product development. Smart defines the capability to execute actions independently or interactively, resulting in the generation of data that can be stored internally or communicated via external means. Connected defines the capability to communicate with other sensors and devices that are part of same ecosystem or different. Immersive defines the state when one does not feel the presence of an external object or component intruding in their space or daily usage behavior.

For the product designer or manager, the big question is, "What does all this mean for PLM?" This emergence of the sweet spot revolutionizes the feedback loop for product development. PLM will evolve to go beyond traditional product lifecycle management and take a central seat at the leadership table to readily digest different types of customer and product information generated by the smart, connected, and immersive devices.

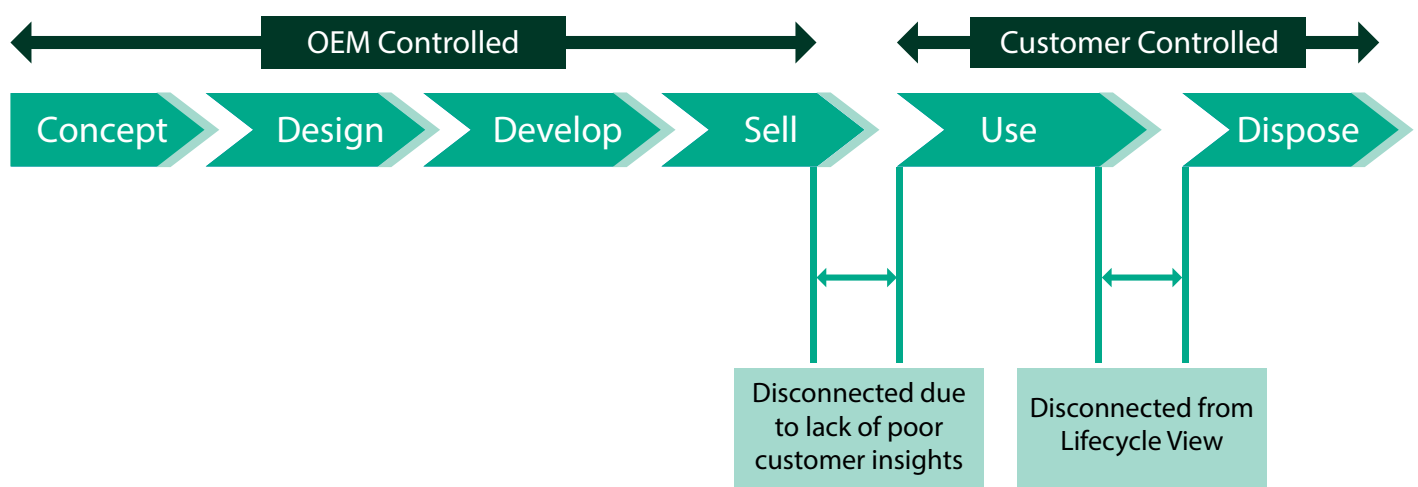


Figure 1

The Domino Effect – Evolution of PLM

Information on customer behavior has been important to every major product evolution and innovation. Such information has been compiled over time – weeks, months, even years – and then used to make product revision decisions. Today, smart and connected devices are providing never-before-available agile analysis on customer behavior, usage patterns, and social connectedness. This is causing a fundamental shift in the way products are being created and launched. The extent of this shift can be illustrated by the fact that one action by a single user may trigger a chain of similar actions to create a cumulative effect. Each action can be recorded separately for insights into usage behavior and areas of evolution.

As illustrated in Figure 2 below, the basic action of starting an automobile

activates many embedded sensors (optimally specified during product design and development), where each sensor has a specific role and pre-defined data gathering mechanism. Once the user starts driving the vehicle, additional sensors come to life and start recording or transmitting data based on instructions and computational algorithms. The type of data created by each sensor is unique and available for consumption by different stakeholders, and perhaps even monetized. The combination of sensors, analytics, and feedback creates a cascading set of communications between the Original Equipment Manufacturer (OEM) and vehicle – mostly machine to machine – that allows secondary and tertiary responses based on the initial input.

This domino effect is not only manifested in vehicle operation. Much of the data will also be useful for product design, launch, and support.

No longer will product designers have to rely on hypothetical ideas or wait for anecdotal evidence for input into new products. The combination of this sense-response domino effect, closed-loop feedback, and more sophisticated simulations are spurring exciting advances in product development. In fact, the PLM Domino Effect has the potential to redefine product design and create the next wave of advances in product lifecycle management.

In the real world, multiple partners like insurance providers, dealers, and subscription service providers can be part of the same ecosystem. What's important is unimpeded data availability to the automotive OEM, who now has the capability to assimilate, analyze and synthesize this data and feed into its product development system. The data will come from several sources and in different formats. If OEMs take proactive steps and redefine their



PLM - The Domino Effect

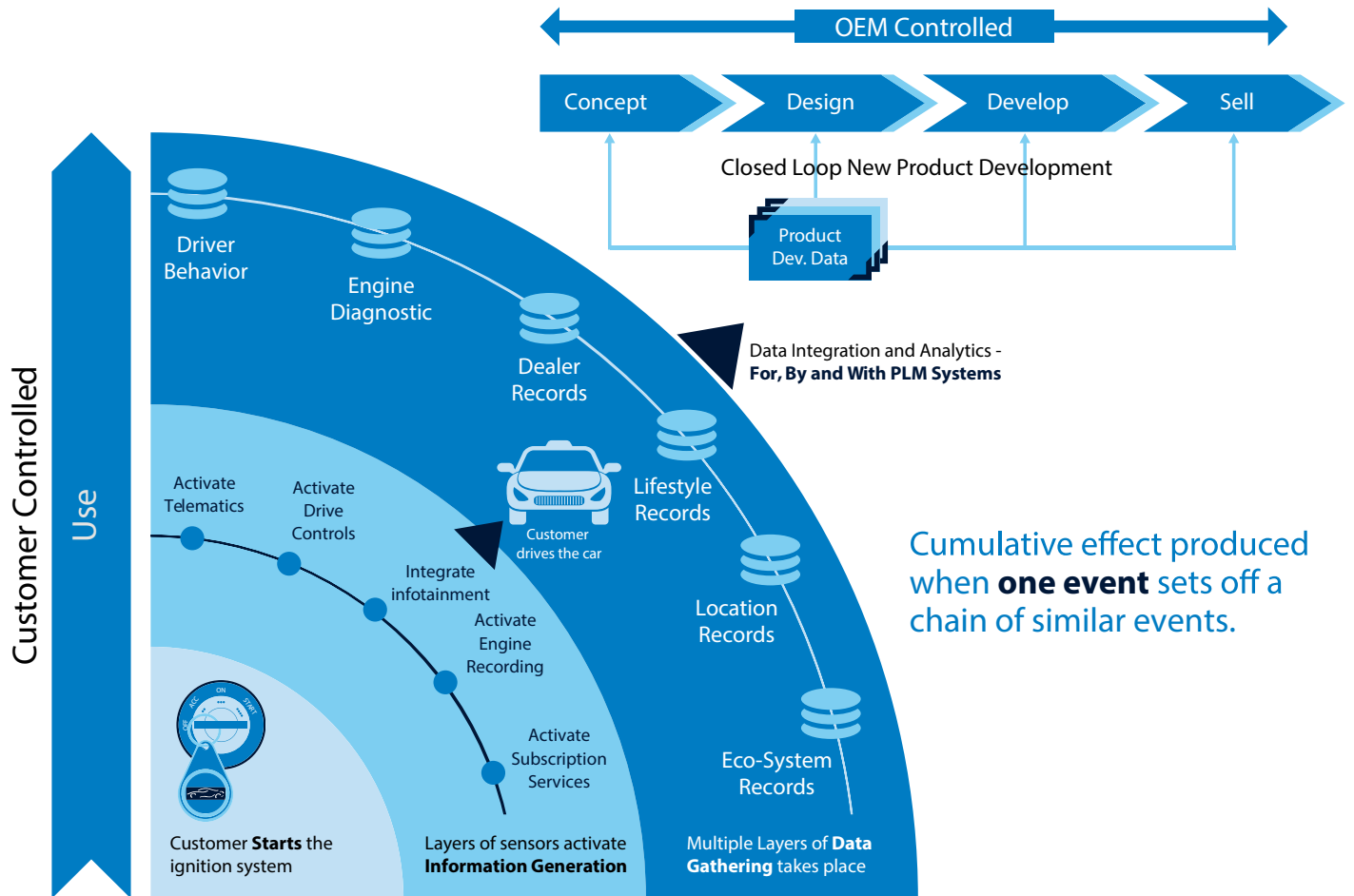


Figure 2

approach to product development, they can create an opportunity to utilize this rich information to their advantage.

For example, if a driver is involved in an accident, the sensors used for telematics will be able to tell whether it was the driver's fault, an engine component failure, or an external event. In an event of internal component fault, the OEM can analyze the data to determine root cause, and make a correction before the next model release. Also, sensors can be installed to predict engine or component failure based on driving behavior or maintenance habits, with notifications sent to the

driver proactively to take corrective and preventive steps. This will not only close the feedback loop between OEM and vehicle, but also drive the development of better products.

PLM systems will play a significant role in the collection of this massive data set. However, not all data management will be the responsibility of PLM systems. It will become a PLM multi-governance model where:

- **For.** Data available for direct consumption by PLM systems. (Example: engine performance and diagnostics.)
- **By.** Data that needs to be filtered and then created to be consumed

by PLM systems. (Example: location data is first filtered, and then can be used to identify which area reports a high number of accidents and what caused them.)

- **With.** Data that is integrated with PLM systems. (Example: lifestyle data, which will be stored in customer databases and then filtered to exchange specific insights to help develop new products.)

Looking Ahead

Integration of vehicle mobile operating systems has received significant attention recently. It has been stated that by the end of 2015, it will be possible “to control not just the infotainment system but also have access to a car’s camera, GPS, diagnostics and telematics, and every other piece of data that a car can provide about its driver” [2]. This is an indirect endorsement of the Domino Effect and implications for PLM.

The Domino Effect has the potential to go beyond what has been discussed here and could redefine the future of product development. In the near future, PLM systems will need the capability to accommodate, analyze, and synthesize data and information generated as a result of the Domino Effect. In addition, the customer value generated by smart and connected devices will close the customer communication feedback loop and provide a platform for designers and engineers to get closer to customer insights. To realize this potential, solutions will be required for the inevitable data management challenges to come. PLM scope will expand, especially in the areas of product innovation and information management.

The PLM Domino Effect will inspire the evolution of more customer-centric products – and this is one domino effect we can look forward to.

A white laptop is open on a desk. The background is a bright, out-of-focus room with a white cup and saucer on a table. The laptop's keyboard and ports are visible.

References:

1. <http://www.engineering.com/PLMERP/ArticleID/9148/Why-PTC-thinks-that-Smart-Connected-Products-will-transform-your-business-and-your-PLM.aspx>
2. <http://arc.applause.com/2014/12/19/android-auto-integration/>

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