White Paper on:

Future of Product Design in the era of Smart Connect!

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Preface:

Automotive industry has been facing daunted set of challenges with upcoming trends of connected cars, autonomous driving and electric vehicles. For right set of minds, it's an opportunity to differentiate by bringing right mix of solutions to the customer and enlighten them with smarter products. Following paper highlights association of technology trends to design connected product and build efficient ecosystems for execution. Some of the aspects discussed are

- Anticipate customer needs and move from classical design mindset (collaborative designs)

- Mechanical to mechatronics (CAD to AR)

- How products are used in the field to differentiate and competitiveness of products (Insights)

Trends:

There are various ways technology is changing product outlook, following are some of the interesting trends influencing product design and development cycle:

1. For many years the typical development cycle for automotive was @ 3-4 years. With the advancement of CAD and other related tools the same been reduced to 1.5-2 year. Even In such scenario, the designer still has to wait for actual testing results and production cycle to get the product performance feedback. With advanced software and sensors, the designer can work on live project with feedback loop system. For newly launched car model, the designer will get the feedback swiftly to make optimization changes implemented, while the older model performance can be tuned based upon much realistic availability of load data.

2. The designer will be working to build more customer centric automotive models. He will be able to assess various patterns based upon driving habit. This pattern will help him to adjust, manage and tune various critical auto components to performance needs such as powertrain and engines.

3. Data blending will become one of the greater challenges as the designer receive and review data from various sources. Apart from the traditional data sources such as design, CAD data, validation, he will also collect/collate additional analytical data from sensors towards assembly performance, failure prediction and vehicle running data. The appropriate data analytics tools need to be used for the correct outcome to be incorporated as the design parameters.

Smart Products: 4 promoting factors

Today, Smart Products have become one of the integral parts of our life. It changes the way we use products and generating new type of business model. This paper details layout developed to build smart products and discuss the contribution and trends in each sector. The discussion is limited to product design and development and not extended to manufacturing 4.0

In connected environment, smart products use the basic engineering data in conjunction with loT (Internet of things) / AR (Augmented Reality), embedded systems and data analytics to provide better insight to the user as well as machine manufacturer. It uses operating data from the equipment and uses feedback loop for effectively to predict various functional parameters related to product performance.

1. Designing smart products

As designers works on building smart products, he uses various advanced tools such as MBD (model based engineering), DEM (differential element method) to generate better insight of component behavior.

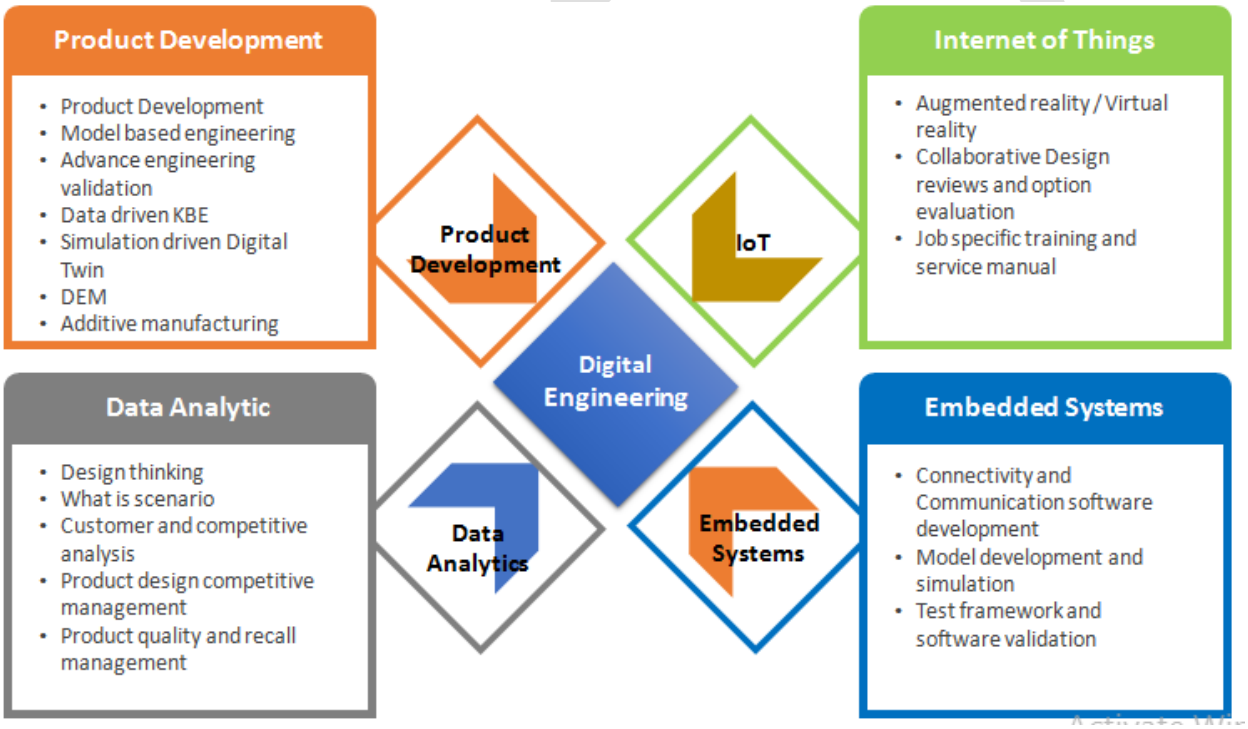
Digital twin which is generating buzz across engineering community, is virtual replica of product containing representative information of mechanical, electrical, electronic and performance configuration. Digital twin is not new considering the design community is already using various CAD, CAE and CAM tools for past few years, but what has been changed is the ability to collect, collate and analyze big data, work towards finding trends, anomalies and use the feedback loop back to design context to make it robust. Building digital twin also leads to monitoring data effectively leading to build newer business models.

Simulation is also one of the data driven tools been extensively used for analysis of components; from simple durability to complex crash simulation. With higher computing power the data handling capacity has been increased, as it can handle full vehicle analysis as compared to component level validation. Today, ROM (reduced order method) based models has been used which are machine learning solutions for reducing the size of a data set while preserving the most important parts of the information

contained within that data. Such approach now supports the user to analyze the components for rapid execution reducing total number of runs. There are various methods for which data analysis techniques are used such as fault detection, predictive maintenance, statistical monitoring, real time crash and safety.

2. Designing connected products: AR/VR

Today AR/VR is playing major role in automotive product design and development. Typically, AR/VR can be extensively used for design and development, manufacturing, marketing, training and servicing. It seems that the more usage of these techniques is applied towards manufacturing and marketing but the practice towards product design is on the rise. These techniques can be effectively used for design reviews and revision comparison. With latest external devices such as hololens available in the market, the user can get an immersed view of design for detailed assessment.



3. Designing Embedded products: ADAS

It's very interesting to note that how these four verticals complement each other for product feature enhancement. Let's take example of embedded system / ADAS (advanced driver assisted systems). We have seen that typically engineering simulation has been used for product development and digital twins but the usage can be extended towards ADAS development. Some of the scenarios where validation tools can support to improve product performance understanding are semiconductor simulation (reliability analysis of Printed circuit board, energy consumption), sensor simulation (radar

pattern simulation, placement of sensors compared to signal integrity) and driving scenario (software algorithm modeling simulation)

4. Designing insightful products:

We know that Data analytics tools are effectively used for supply chain optimization, marketing mix analysis, user and dealer satisfaction and customer behavior analysis. How it can be effectively used for designer to view insight at an early stage?

Today product designers are facing challenges towards converting data to actionable insights. The designer will work on three type of data, design data (based upon engineering calculations), test or proving data (standard vehicle test data) and real life running data (received via various sensors loaded at designer vehicle test points). Various data analysis tools/algorithms will support to decode the data effectively and will support designer to take early decision such as component failure prediction, feature management (leads to customization of platforms)

Getting Act Together:

As mentioned in above said column, various technologies are working seamlessly to build better and smarter product. Let's discuss few examples of how companies are using combination of technologies to build newer customer experience.

1. Design proposal selection:

Today Tier1 suppliers are interacting with OEM for selection of their various design proposals. Now with AR/hololens, the supplier can offer better immersive experience to the customer. This also helps end customer to select design proposal much swiftly, saving time and money. For example, automotive interior tier 1 supplier can envision and demonstrate "Instrument panel" fitments within car environment to OEM's. With changes in color scheme, shading, feature recognition, the end customer will be able to envisage effectively for better selection.

In summary:

Automotive product design has been expanded beyond CAD and effective usage of advanced tools been implemented in early stage of design cycle. This assures various benefits to designer such as better understanding of product behavior, customer centric innovative design and shortens design cycle saving time and money. Considering the paradigm shift, we definitely will be having interesting times ahead!!