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Changing Paradigms in Automobile Engineering

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From their inception most automobile engineering processes have been immersed in the physical build paradigm of "Build them and test them". In addition, the lack of fast and reliable modeling and simulation tools did only add to the separation between design and manufacturability but also between design and analysis for many decades. These factors combined with the multitude of engineering knowledge and skill sets needed to create an automobile caused automotive design and development processes to be costly and lengthy. In today globally competitive economy, however, it is becoming clear that these traditional design and development processes cannot meet the needs of a rapidly changing automobile market. Improving product attributes such as quality, safety, performance, and fuel efficiency while reducing the development process time and cost are not only becoming the key factors for success but also for survival. In addition to customer demands for continuous product improvement, competitive pressures are forcing automobile manufacturers to constantly strive for minimizing the product development process time and number of development and validation physical builds. Therefore, in today practices, advances in automobile engineering do not only pertain to continuously improve the products but also to continuously advance and refine the processes by which these products are produced.

While advances in automobile attributes such as styling, performance, quality, and efficiency are relatively fast and noticeable over the years, advances in automobile design, development, and production processes have been slow and incremental. The automobile production process, for example, moved from craft to mass production, through the introduction of standardized parts and assembly lines by Henry Ford, then to lean production by TOYOTA Motor Company over several decades. The automobile design and development processes have been even slower. The physical build paradigm has constrained the automobile design and development process causing very slow advancement towards full utilization of virtual modeling and simulations. In fact, companies who have succeeded to reduce the design and development time and cost have done so through the slow and gradual injection of virtual modeling and simulation in the design process. While the rates of these injections have increased from very limited utilization, in the late seventies, to considerable utilization today the design and development processes themselves are still immersed in the physical build paradigm. So far, these slow virtual injections have not been sufficient to cause the needed change in the foundation of the design and development process for maximizing the time and cost savings. It should be realized that full benefits will not be achieved as long as virtual modeling and simulations are injected to support the traditional design and development processes. Therefore, a paradigms shift from the traditional physical build design and development thinking is needed. In addition, fully integrated and balanced design processes utilizing correlated virtual models and simulations with minimum physical build, to validate the outcomes of key process phases, must be developed.

While traditional physical build paradigm may be hard to replace in the minds of many manufacturers, the evolution from the build and test thinking of the traditional automotive design and development processes have already started. For the last few decades, terms like architectural integration, performance integration, concurrent engineering, and virtual validations are shaping a new paradigm. This evolution process while steady is slow. Therefore, there is always a need for process engineers to get back to the drawing board and redesign the automotive product development processes based on the new realities. The rapid development of reliable virtual modeling and simulation tools could enable the development of these new design and development processes. Also, with continuous correlations, between the physical and virtual outcomes, the resulting increased confidence in virtual development and validation would assist in speeding up the paradigm shift. However, expanding the role of virtual modeling and simulation will require innovations of new tools and continuous improvement of the existing tools. Equally important are the knowledge and skills of the individuals involved in the virtual design and development processes. Sharing of advanced knowledge and experience in the rapidly developing virtual world is not only the key for being current in the field but also a major factor for building the confidence needed to cause the desired paradigm shift in automobile engineering. To participate in facilitating this paradigm shift the OMICS Group is introducing the Open access journal of advances in automobile engineering.

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