



#### UNIT-1- INTRODUCTION

##### What is meant by virtual prototyping?

Virtual prototyping, often known as VP, is a software-based engineering discipline which involves modeling a system, simulating and visualizing its behavior under real-world operating conditions, and refining its design through an iterative process. VP is increasingly used as a substitute for rapid prototyping.

**Virtual prototyping** is a method in the process of product development. It involves using computer-aided design (CAD), computer-automated design (CAutoD) and computer-aided engineering (CAE) software to validate a design before committing to making a physical prototype.

This is done by creating (usually 3D) computer generated geometrical shapes (parts) and either combining them into an "assembly" and testing different mechanical motions, fit and function. The assembly or individual parts could be opened in CAE software to simulate the behavior of the product in the real world.

The product design and development process used to rely primarily on engineers' experience and judgment in producing an initial concept design. A physical prototype was then constructed and tested in order to evaluate its performance.

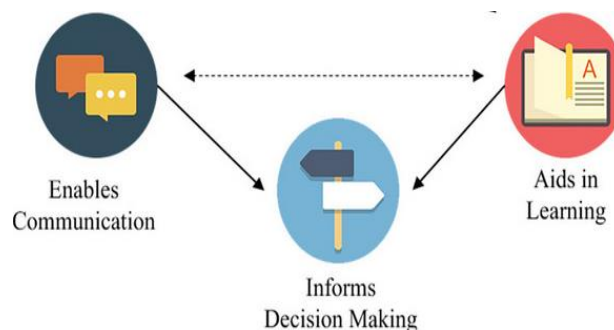
Without any way to evaluate its performance in advance, the initial prototype was highly unlikely to meet expectations. Engineers usually had to re-design the initial concept multiple times to address weaknesses that were revealed in physical testing.

##### End-to-End prototyping

End-to-end prototyping accounts fully for how a product or a component is manufactured and assembled, and it links the consequences of those processes to performance.

Early availability of such physically realistic virtual prototypes allows testing and performance confirmation to take place as design decisions are made; enabling the acceleration of the design activity and providing more insight on the relationship between manufacturing and performance than can be achieved by building and testing physical prototypes.

The benefits include reduced costs in both design and manufacturing as physical prototyping and testing is dramatically reduced/eliminated and lean but robust manufacturing processes are selected.



### **How Does Virtual Prototyping Work?**

A virtual prototype abstracts away hardware details that are irrelevant to software developers. Using instruction set simulators, the virtual prototype executes embedded target code on standard PCs. System peripherals are modeled at the transaction level with just enough detail to run unmodified software images; for example, register behavior is accurate, whereas timing is not.

The simulation speed is very high to enable the interactive execution of large software stacks, such as applications running on top of AUTOSAR or Android OS. Virtual prototypes use virtual and real-world I/O to connect to real-world interfaces like USB, PCIe, Ethernet, and serial devices.

## The Advantages and Benefits of Virtual Prototyping

Early availability, binary compatibility, and high performance enable virtual prototypes to be used to develop, debug, integrate, and validate system software long before actual physical hardware is available, and in many cases even before the chip design is complete.

- **Early Software Development.** Virtual prototypes enable early software development, reducing the total time necessary to develop and test new products in what is now known as a “shift left” approach.
- **Hardware/Software Integration.** From a software perspective, virtual prototypes allow the hardware/software integration that has traditionally relied on FPGA prototypes to start earlier.
- **Global Development.** As no physical hardware is required, virtual prototypes can be shared and accessed among teams globally, increasing software team development efficiency and throughput.
- **Debug ability.** Unique, correlated visibility of system software and hardware; access to hardware internals for visibility and fault injection; and compatibility with software design paradigms such as CI and TDD facilitate debugging.
- **Compatibility.** Can be used with your existing set of software tools – compilers, debuggers, and simulators.

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- Debugging and test
- Validation and verification
- Regression set-ups
- Hardware prototyping for a speed boost.

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### **What is 3D virtual prototype?**

Virtual prototyping refers to the process of constructing and testing a realistic and interactive virtual prototype, that is, **a 3D digital representation that can perform various types of simulations iteratively about product performances**

### **Difference between virtual prototype and physical prototype**

**Virtual Prototyping (VP) and Physical Prototyping (PP) are two techniques that have many similar goals, but which achieve them in very different ways.** With VP, the approach is to create as precise a numerical model as possible in the easiest possible way, whereas PP creates a physical model.