

# Application of Computer Aided Engineering in Reducing the Product Development Life Cycle

**Vishwas M**

*Assistant Professor*

*Department of Industrial Engineering & Management  
Siddaganga Institute of Technology, Tumkur, Karnataka,  
India*

**Vinyas M**

*Research Scholar*

*Department of Mechanical Engineering  
NITK Surathkal*

**Puneeth K**

*Assistant Professor*

*Department of Mechanical Engineering  
Sri Siddhartha Institute of Technology, Tumkur, Karnataka, India*

## Abstract

Computer Aided Design (CAD) and Computer Aided Engineering (CAE) is the most important and essential tool in product development process. Huge challenge is faced by the companies while integrating CAD and CAE in their design process. The previous studies do not clearly give the impact of CAD and CAE on product development process and particularly its impact on cost and time of development. The study is carried out to show the importance of CAD and CAE as a tool of product development and its effect on the development cost and time when implemented early in the process.

**Keywords: Computer Aided Design (CAD), Computer Aided Engineering (CAE), Product Development, Upfront CAE, Finite Element Analysis (FEA)**

## I. INTRODUCTION

In today's turbulent economy and global market, companies are striving hard to maintain their competitive edge by developing innovative designs. In a world economy of radical change, product innovation has emerged as a key market differentiator across nearly all industries. The emphasis is to create a whole new class of products and emerge as a market leader.

Past initiatives aimed solely at product cost, quality, or time – to – market are no longer sufficient to gain market advantage in today's highly competitive market. The focus today is on innovation: products that clearly differentiate themselves from others while also being affordable, reliable and fast to market.

Design innovations alone do not guarantee market success but products need to satisfy customer expectations. With customer tastes more discerning and their demands changing more rapidly than ever, customers increasingly are now the focal point in product development with this "voice of customer" now a key element in product development process.

Most companies consistently launch innovative winning products through a combination of people, process and technology to translate knowledge of customer requirement into variable products. In today's competitive markets, companies that want to stay in business absolutely must know their customers, develop ideas through sound engineering fundamentals and rely on computer based tools such as CAD, CAE to evaluate and refine designs as quickly and accurately as possible.

Companies are finding that such tools can be used most effectively to facilitate design innovations within product development cycle. Simulation performed as an integral part of this process continuously verifies the design and guides the configuration of product.

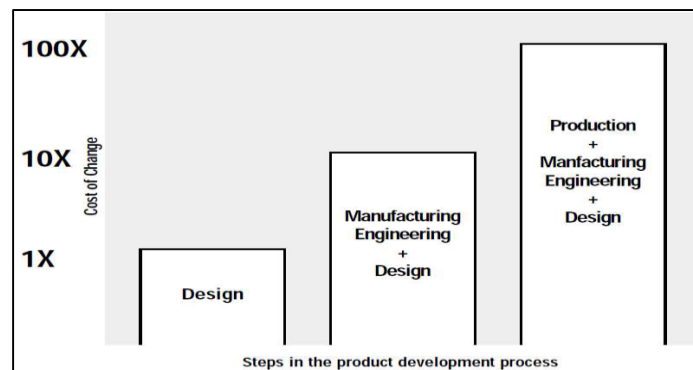


Fig. 1: Steps in Product Development Process

Simulations approach is replacing the historic “build-test-redesign” problems by evaluating designs through computer simulations and analysis, earlier in the product development process and reducing reliance on validation testing late in the cycle. The use of Computer Aided Engineering (CAE) is critical in reducing reliance on physical prototypes, reducing cost and shortening the overall product development process.

Studies have shown that the cost of change exponentially increases with each stage of development as shown in figure 1

By using analysis as a part of design process in early stage of product development, when concepts are just starting to take shape, engineers avoid difficulties later in cycle by exploring various product configurations, evaluating different part geometries and materials, and examining all the many tradeoffs inherent to product development.

This can result in significant time reductions, cost savings, quality improvement and product design innovations. By shortening the cycle needed for physical testing near the end of design, virtual prototyping gives engineers added time earlier in development to explore and investigate innovative concepts.

One of the driving forces in companies is the continuing demand for reduction on product development time and cost to maintain profitability and competitiveness.

Over the years, this requirement has prompted organizations in a wide range of industries to find different ways to make product development more efficient.

Advancements in entire spectrum of computer aided design; manufacturing and engineering (CAD/CAM/CAE) tools in particular have automated many design, engineering and analysis tasks to shorten development cycles, mostly as labor savings to minimize overhead costs

## II. CAD AND CAE IN PRODUCT DEVELOPMENT

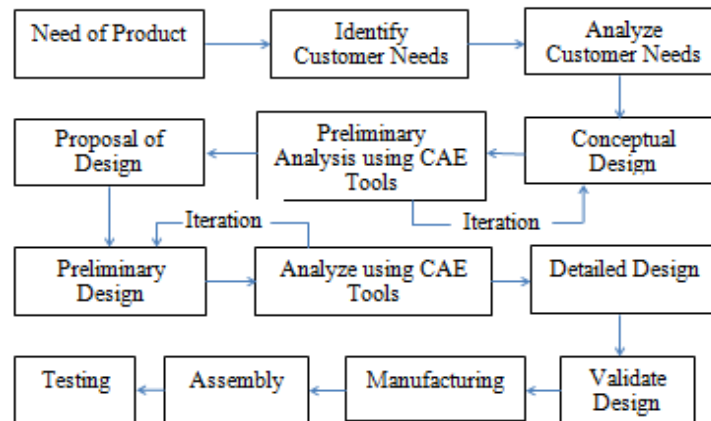


Fig. 2: CAD and CAE in Product Development Cycle

Manufacturers have wide range of computer based tools available to support the product development process. Rapid prototyping, knowledge based engineering, solid modeling and CAE are some of them. CAE utilizes simulations and analysis technologies such as Finite Element Analysis (FEA) used to study stress, strain, deformation, vibration. Each has individual tasks and defined areas, but all are necessary for total product development.

CAD tools are the most common class of computerized tools used in the engineering and design process today. Introduced in the 1960s and much improved since then, these tools have replaced many of the drafting tables and machines used to generate engineering drawings. Early CAD tools were designed to produce a 2D representation of an item to be manufactured; many current CAD tools capture a 3D representation. CAD tools capture a geometric model of the product to be built. The latest generation of 3D CAD tools is particularly well suited for the development of three-dimensional geometric models with all of the detail needed for manufacturing. From this model, the CAD packages can then produce the documentation needed for procurement and manufacturing. These CAD tools also include some capacity for the capture of material data, and the calculation of mass properties, although these capabilities may be limited.

Of all the tools used in product development process, FEA is one of the most widely used valuable tools in analyzing products. In an effort to shorten the product development cycle, many manufacturers are re-orienting the design process itself so that analysis is performed much earlier in product development.

This moves CAE forward into conceptual design, where changes are much easier and more economical to make in correcting poor designs earlier. The experience of manufacturers in many industries has shown that 85% of total time and cost of product development is committed in the early stages of product development when only 5% of project time and cost have been expended. This is because in the early concept stages, fundamental decisions are made regarding basic geometry, materials, system configuration and manufacturing process. Further along in the cycle, changes get harder to make.

Essentially, the time and cost of correcting problems increases tenfold with each step forward in product development cycle: concept definition, detailed design, prototype manufacturing, prototype testing and production. The use of up-front CAE

supports the compression of product development cycle by changing the manner in which errors are found and the design refined as shown in figure 3

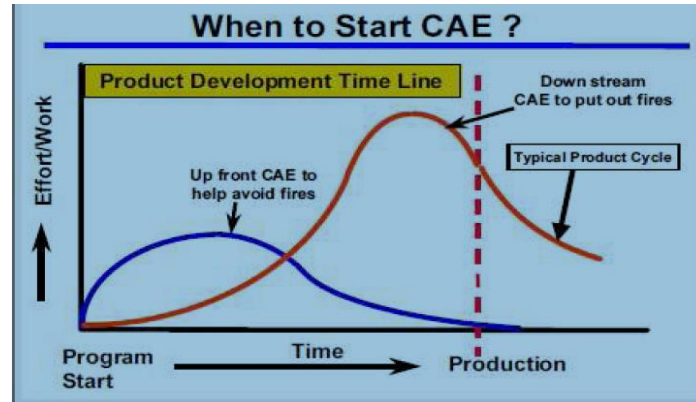


Fig. 3: Upfront and Downstream CAE

A typical effort without CAE is an iterative cycle in which the design is created, prototypes are made through soft tooling and tests are run as shown in figure 4

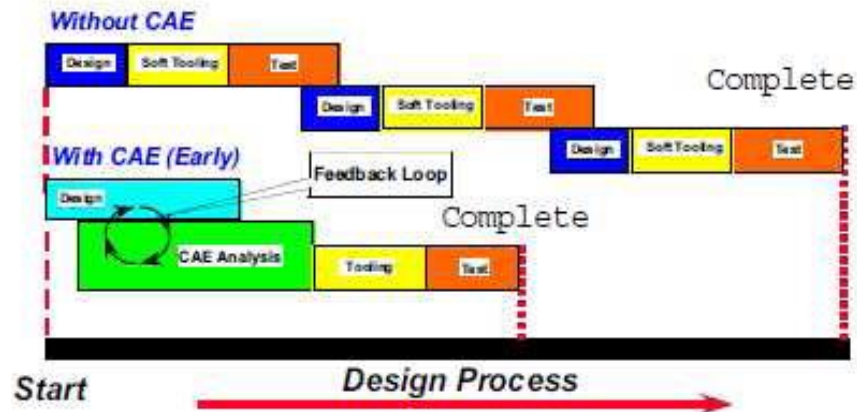


Fig. 4: Design Process with and without CAE

In using up-front analysis, CAD and CAE are jointly conducted in an iterative feedback loop, up-front in product development. As soon as a basic CAD model is configured, a preliminary analysis is run and the CAD model is modified and re-analyzed until it performs optimally.

### III. CONCLUSION

This paper briefly explains the role of CAE in the product development process and the way it affects the cost and time of development process. This insists the necessity of research focusing on CAE to understand the benefits of and obstacles for advanced product development process since there lies an enormous opportunity for reducing the development cycle time and the cost of development and also to enhance the quality of product. Use of CAE also helps in bringing out the better innovations in the product. As a result of these studies, the productivity can be enhanced and superior designs could be obtained by integrating analysis and design process in product development at the earlier stages of conceptual and preliminary design.

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