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CAD APPLICATIONS IN AUTOMOTIVE INDUSTRIES-A REVIEW

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ABSTRACT

Automotive companies constantly face the challenges to increase their efficiency and improve the quality of their product. In today's competitive and global market, new manufacturing and engineering techniques are being developed .An important role is played by CAD in synergizing knowledge based engineering. In order to face such challenge, all automotive manufacturers are seeking new technology and method to shorten development time, reduce intensity of manufacturing, fully use outside resources, and integrate and cooperate with their global suppliers. These challenges can be faced by combining solutions such as CAD/CAM and 3D technologies with Internet tools to provide optimal solutions for meeting all requirements, from collection design to visual merchandising through production. Computer aided design (CAD) is one of the main roots and plays an important role in knowledge based engineering. Many modern CAD packages include the ability to attach material properties to the model. To survive in the global market we have to keep in pace with the adventures of modern generation which demands for Flexible, Dynamic & Versatile techniques.

Keywords: Applications, Benefits, Automotive Industries, CAD, Challenges.

I. INTRODUCTION

The automotive industry is the industry involved in the design, development, manufacture, marketing, and sale of motor vehicles .The automotive Industry in India is now working in terms of the dynamics of an open market. Indian automotive industry holds significant scope for expansion, both in the domestic market, where the vehicle penetration level is on the lower side as compared to world average, and in the international market, where India could position itself as a manufacturing hub [1].India has become a fast-growing auto market over the past two decades. It has witnessed revolutionary changes in the management systems and manufacturing innovations of the world automotive industry. In all other countries, the Indian automobile industry is one of the key drivers of industrial growth and employment. In addition, the auto industry is linked with several other sectors in the economy and hence its indirect contribution is much higher [2]. The competition environment has been changed greatly in recent years with the increasing globalization of the automotive market and the requirements for the higher quality, lower price and more personalization products [3].Indian automotive industry, needs to be capitalized, so as to emerge as a successful global. The entry of global auto-majors into India has significantly altered the automobile-manufacturing scenario in the country. The changes in design and

adaptation of international technologies have enabled the Indian automotive industry to compete globally [4]. Computer Aided Designing (CAD) has transformed the face of the design industry and has swayed the lives of designers and engineers worldwide. With it, you can revolutionize your work processes, improve your products, grow your business, and even change the world [5]. Complexity is rising everywhere, putting tremendous pressure on engineering organizations to become more effective, more efficient and faster. They also have to become more innovative as they will need to master a broader spectrum of technologies [6]. Therefore it can be concluded that in the automotive industry, technical necessity, political sensitivities and market variation have kept final vehicle assembly, and by extension much of parts production, close to end markets .Automakers everywhere in the world are pinning their hopes on rising demand in the developing nations. Automotive industry is a symbol of technical marvel by human kind. Being one of the fastest mounting segments in the world its active progress stages are enlightened by nature of competition, product life cycle and consumer demand [7]. In concept designing or prototyping, however, at the start of the process, designers are often foot-dragged to commit wholeheartedly to computer use. In particular, 3-D CAD is used for the entire car development process [8]. Application and customization of CAD software can shorten the time, advance the quality, and save much capital of development of automotive product.

II. COMPUTER AIDED DESIGNING (CAD)

Computers have influenced every sphere of our life in one way or other. Computers are making human life easier and comfortable. Computers are helping to design, analyse and manufacture the product with short span of time in engineering applications. One such application is Computer Aided Designing (CAD). CAD may be defined as "A process of use of computers in creating, analysing, modifying, optimizing and drafting / documenting a product data so as to achieve its design goal efficiently and effectively" [9]. Computer Aided Design-CAD is defined the use of information technology (IT) in the Design process. A CAD system consists of IT hardware (H/W), specialised software (S/W) (depending on the particular area of application) and peripherals, which in certain applications are quite specialised. The core of a CAD system is the S/W, which makes use of graphics for product representation; databases for storing the product model and drives the peripherals for product presentation [10].An engineer can manage the components together in virtual 3-dimensional space in CAD systems. It is hard to imagine a modern design process without using a computer. In fact, Computer Aided Design (CAD) is so extensively applied that in many companies all design work is done using CAD systems. The use of computers in modern design process is almost inevitable. Computer Aided Design (CAD) is extensively applied in every company that wants to stay competitive on the market [11]. Especially in automotive engineering processes 3D-CAD design offers a wide spread working field for the geometry creation as well as for the linkage of numerous simulation procedures, customer demands and legislation tasks [12]. Modern CAD systems offer the most simple and natural way to represent complex mechanical structures heavily constrained through a variety of functional, aesthetic, and manufacturing demands [13]. Modern design methodologies make use of advanced computer aided design (CAD) tools in order to shorten the design cycle. CAD has come to replace traditional training in engineering drawing, and is now one of the primary ways in which engineers are expected to communicate their ideas precisely. This software has been sold as a productivity booster and an essential tool for improving design quality [14]. CAD is meant to serve as a tool for supporting the designer's reasoning, but in the first place, it surely is a medium for modeling a

future product. CAD, as the provider of the universal product model, has the most important influence on a future conceptual design medium. It represents the interface to all other design tools and production processes [15].

III. LITERATURE REVIEW

A rich body of literature exists on CAD and its related automotive aspects. CAD is an influential tool in engineering and configuration of intricate structures and designs. However, lengthy and multifaceted design activities determine the product development process in the automotive industry [16]. Over the last three decades CAD tools have evolved as sophisticated analysis and optimization programs. Also, the mechanical computer aided design (CAD) industry has experienced some major technological modernizations and paradigm shifts. Namely, in a collaborative CAD system, designers and engineers can share their work with globally distributed colleagues via the Internet/intranet. Furthermore, these systems degenerated the gap between designers, suppliers, manufacturing partners, vendors and customers, to get valuable input into the design chain [17].Although automotive industry is no stranger to change, Indian industry is growing rapidly as the country makes deeper inroads in the global engineering space [18].CAD systems are evolving dramatically and are updated frequently. CAD tools continue to evolve in their ability to handle ever-larger designs as well as incorporate more comprehensive models and simulations. They emphasize the increasing size and complexity of the largest feasible designs and help designers work at the upper limits of complexity [19]. It has broaden the aspects of drafting and designing, making it more easier and accurate than the conventional engineering drawing on paper .One of the most popular CAD software is AutoCAD which has been used widely in multi-disciplines all around the world. Keeping model features intact between CAD programs preserves design intent and maintains quality [20]. Automotive industry today faces a social change. Thus, challenging the car markets with luxury brands that seem different and exclusive. Nevertheless, CAD allows the generation, representation and alteration of product features. Most stages of the automotive design process use computer-aided design to some degree, and some now rely wholly on it [21].Automotive designing entered a new era with the advent of CAD. Increasing demand for new car models arise a need for some form of assistive means so as to fulfill several requirements, such as those of the users, those related to market and sales, technologies changes. Yet ,CAD possess a challenge to create emotionally appealing designs[22].Today's industry believe in optimizing sophisticated automated design in very short time. The development time of new vehicle models has been shortened rapidly in the recent years. Today's automotive industry is determined by ever shorter development times and an increasing accuracy of data quality already in early design phases provided, geometry-oriented CAD environment is maintained [23].CAD systems is a key in the development of drafting automation at an accelerating rate. CAD technology makes it cheaper to improve on products and design and introduce new ones more often [24].

IV. BENEFITS OF CAD

CAD offers ample of benefits in the automotive designing sectors. It provides great opportunities for regenerating the quality and efficiency of a design. CAD programs offer many advantages over non-digital processes, such as the ability to easily change and refine a design, as well as a high degree of precision in defining all of the features and dimensions of the design. Once created, CAD files function as digital

"blueprints" that can be used by manufacturers to make products to exact specifications in a factory setting [25]. In complex designs such as that of engines, metal sheet bodies, streamlined bodies,etc. where there are dozens or hundreds of surfaces, the commercial CAD systems run with interactive speeds, for most types of design operations, on typical personal computers[26].Along with increasing the productivity of the designer CAD systems reduce the time required in the installation and analysis. It improves the quality of the design as it allows the designer to a deep and accurate analysis of the design as well as provides a large number of alternative designs that can be tested, and the design errors less because of the high precision provided by the system. In engineering drawing, it serves as an international language as it transcends the barriers of translator with standard specifications of designs leaving less room for errors. CAD benefits are reflected on the improvement of the quality of work. Although its benefits are intangible, its advantages are enjoyed best in the production-stages [27].

V.CHALLENGES FACED BY CAD

The automotive industry is facing new and pressing challenges. Globalisation, Individualization, digitalization and increasing competition are changing the face of the industry [28].This paper predominantly acmes two of the CAD related challenges. Firstly, Challenges related to customer requirements. And secondly, challenges related to automotive designing.

5.1. Challenges Related To Customer Requirements

Understanding the mutable mind of today's customers is a really crucial task. Challenged by economic upheaval and an increasingly competitive market, Indian automakers face an uncertain future. Indian consumers are growing more affluent and developing higher expectations. Their needs and expectations have become more sophisticated [29]. Now-a-days, customers demand more and more on one hand and on other hand look for everything at a very attractive price. Conversely, new cars that initially sell well may lose ground very soon. They not only expect higher quality, lower price and higher performance ,but also the earliest delivery of products [30].Fluctuating market demand and escalating customer requirements is a key challenge in the automotive industry . Shifts in customer demand—from product to product, from brand to brand, and from segment to segment—are accelerating. Customers have more choices than before, want more personalization, and, in general, enter the showroom better informed. As a consequence, customer loyalty is decreasing [31]. The growing role of innovation in the strategy of car manufacturers leads them to relentlessly look for new sources of differentiation .One of the strategic challenges in the realm of automotive service innovation is, the establishment of a positive and more continuous sales relationship with the customer [32].This can be achieved by meeting their demands for styling, safety, and comfort. The auto industry is a fierce competitive place. Consuming automobiles depend heavily on consumers' personal tastes, favors and of course wallets. If the consumers are not satisfied with their products or services, the auto makers might risk losing them to other competitors [33].Customers are demanding more voice in their choices. The consumers are very conscious about branded and unbranded cars because they have the view that branded cars are more reliable than unbranded car. Loyalty and trust of the customers is very important for a company because it reduces the chance of attack from competitors [34]. The automotive industry in India is one of the largest in the world and one of the fast growing globally. Customer satisfaction and loyalty are the most important factors that affect the

automotive industry. On the other hand, Customer service can be considered as an innate element of industrial products. Product quality influences customer satisfaction in the automotive industry [35].

5.2 Challenges Related To Designing

While modern design practices have improved the nature of the products being developed, they have also increased the administrative and management burden arising from increased complexity. These complexities are not product complexities but, rather, complexities of design and designing [36]. Growing complexity of contemporary cars is considered as one of the prime challenges in the automotive industry. Product design is a highly involved, often ill-defined, complex and iterative process. An effective computer support tool helps the designer make better-informed decisions [37]. However, creation of CAD models is not a simple job for industrial designers because current CAD systems require accurate 3D inputs for surfaces such as a set of 3D characteristic curves or a range of 3D points [38]. The design of an automotive structure is critical to the overall performance of a vehicle. Due to the structural design complexity, the design process is traditionally conducted by trial and error and is subjected to numerous changes even in the latest stages of the design process. However, some of the changes in the design of structure may cause significant re-design of the other vehicle components and this process may become very costly. However, employing a very comprehensive and detailed process of analyses at the conceptual design stage, when a greater range of design choices is still available, may become very time consuming and computationally expensive [39]. The onus is on the CAD operator to skillfully minimize the modeling time as vehicle design and development are a notoriously difficult set of tasks [40].Nowadays companies are faced with constantly increasing requirements for quality conditions which have to be realized in even shorter development cycles. The huge product diversity, permanent changing boundary conditions and the high complexity of products represent an additional challenge in the automotive industry. In order to meet the desire for better quality and still to achieve competitiveness, development cycles have to be augmented [41].

VI. APPLICATIONS OF CAD

CAD technology has been applied in various ways to automotive engineering works .It is considered as an important industrial art extensively used in many applications [42].CAD has boosted productivity and made the markets faster. Although the first CAD applications were inherently difficult to use owing to the text-based input systems and the extremely slow computational equipment, their successors have become more than necessary in today's manufacturing companies, regardless of their size [43].CAD helps in replication, translation, scaling, rotation, and transformation of graphical images. As such, CAD operators manipulate images in moments that used to take hours and days with paper and pencil [44]. One of the advanced applications of CAD is the analysis of stresses and deflection of the part using finite element analysis techniques. The generic functions of a CAD system may include geometric modeling, engineering analysis, and automated drafting, as well as kinematics analysis [45].Also, CAD technology possess the ability to study the mechanical action of the user designed 3D part through simulation. Dimensional inspection of engineering components comprising free-form surfaces demands accurate measurement of a large number of discrete points, such that the actual shape may be fully characterized. By employing the CAD model at every step, the implemented methodology maximizes the measurement accuracy [46].More accurate representations of

sculptured surfaces and more advanced calculation of mass and FEM mechanisms, robotics analysis and simulation injections moulding designs and analysis, front-end tools to automate conceptual designs are some examples of CAD development at this time [47].

VII. CONCLUSIONS

CAD applications have brought tremendous innovation in automotive industries. With the advent of CAD systems consistency, predictability, and performance of conventional designing processes has increased. CAD has totally optimized the industrial outlook. Implementation of CAD has helped to synchronized 2D and 3D designing ideas. It is extremely reliable for applications of designing and virtual visualization of auto-parts and auto-components .The bottomline is that CAD is an asset to the automotive industries and designing technology.

Acknowledgements

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