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Design Automotive Components by CAD Software; AutoCAD and SolidWorks; a Comparative Study

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ABSTRACT:
Technical Drawing is a drawing, widely presented, used to convey directions and identify details to a group of people who are building something to explain how it is working or how to design and compose products.
In this paper, we compare between the most famous CAD software. Regarding to the specific of the profile of students go through training, the selection of CAD Software is reduced to the most usually used in this field: AutoCAD and SolidWorks.
AutoCAD is a computer-modelling program from Autodesk that can be used to create 3D and 2D models of parts. It is the most popular CAD software (Computer Aided Design) in the world. In fact, it is the program commonly used in the definition of CAD (Computer-Aided Design) for students at high schools, colleges and universities. AutoCAD is the most popular program for drafting Tow-dimensional design but is not commonly used in solid modeling like SolidWorks. Nevertheless, with good dominating, solid modelling by AutoCAD is highly multilateral and can be competitive in average engineering design and consulting firms that lack the financial resources to invest in rapidly changing parametric modellers.SolidWorks is a computer-aided design (CAD) software runs on Microsoft Windows. SolidWorks published by Dassault Systems. SolidWorks appoints a parametric features to model creation. It means designers create models using engineering shapes, such as cams, holes and slots more than using geometric terms.
Keywords: Automotive, Design, AutoCAD, SolidWorks, 2D, 3D, Modelling.

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I. INTRODUCTION

Computer Aided Design (CAD)

CAD is a program which helps users to create Stereolithographic (STL) files. It helps in designing, analyzing and optimizing 3D models. This software helps in design ideas and visualizing the concepts through realistic renderings. They also imitate the showing of the design in the real world. SolidWorks and AutoCAD are famous software used in this research to design of required shape and dimensions.

1.2 History of CAD

In 1883 Charles Barbage developed an idea for the computer. The establishment of CAD returns to the early 1940s when the mathematical description of the curves was developed. In 1963, Ivan Sutherland developed the theoretical basis for CAD drawings in his doctorate. Thesis entitled "sketch pad" Showed that graphical entities can be interactively selected on a computer screen using a stylus (light pen). This was the beginning of interactive computer graphics in engineering where she gave birth to the development of techniques to perform images in digital form. During the seventeenth of the last century, commercial applications of CAD started in 2D drafting. CAD of 2D drawing consists of arcs, lines and so on wireframe graphical models.

In 1964 the first commercial CAD system was produced by IBM. There have been many changes since then, with the advanced of powerful computers, it is possible now to do all sketches using CAD with 2D graphics, 3D modelling, complex engineering analysis, manufacturing and production. The New technologies are permanently created, making this process faster, more multilateral and powerful.

In the beginning of CAD innovating, its systems were run only on mainframes of computer systems Due to memory size requirements for figures, links, and storage of drawing entities. Improvements in the development of computers have made greater memory and greater capabilities possible, allowing CAD systems to upgrade from the mainframe to the microcomputer, then the workstations, desktops, and laptops. Three-dimensional wireframe models have advanced in the late 1960s. Although this has been remarkable advance in 2D CAD systems, it required many practical properties such as surfaces of solid and physical entities. So, three-dimensional surface

modeling techniques shown up in the early 1970s. Surface models are basically wireframe models to completed by encasement body faces, but hollow. The real objects are solid materials, although some may have bores. By the mid-1970s, CAD systems with solid modelling have appeared. The development of 3D solid model abilities brought the engineering analysis of graphical models to the computer screen as technical graphics. Higher processing speeds and smaller sizes of computers with larger memories have made a strong configuration in CAD applications today. Parametric modeling based on parameters and features seems to be improved rapidly. The advancement of automatic technical drawing generation and dimension have improved rapidly.

1.3 Advantages of CAD

(1) Detailed drawings can be composed more quickly and making modifications so efficient more than modifying drawings manually.
(2) CAD allows many views of the same body and 3D graphic views, which grants the best Visualisation of sketches and drawings.
(3) Templates, symbols and designs can be stored for easy retrieval and reuse.
(4) More accurate drawings by using the computer.
(5) Drawings and sketches became more easily filed, restored and transmitted on disks.
(6) Rapid Design Analysis, also testing and Simulation Possible.
(7)When we do the organ implant -In medicine field- the Volumetric imaging data is first processed and constructed to acquire the three-dimensional shape and size of the organ or site, which is then imported into CAD program like SolidWorks or AutoCAD to design the human organs implant.

II. AUTOCAD:

AutoCAD is the First CAD Software for Computers and it was developed by Autodesk that enables computer-aided design (CAD) and drafting. AutoCAD has released for the market in 1982.The program is used to create two and three dimensional drawings. AutoCAD program lets designers and users to visualize ideas, produce designs and drawings to the desired levels of technical rigor, and implement quick calculations and simulations of design; through a wide range of industries.

2.1 Learning curve rate / Ease of use

Bachelors of the Faculties of Mechanical Engineering had some training in AutoCAD. AutoCAD is considerably more ganglion - Unlike SolidWorks - and 40 hours studying is necessary to complete 2D drawing, and 30 hours training to complete 3D drawing. This reveal those 50 hours of practice are necessary; starting with 2D first before 3D modeling. Among the trained students, we have students with previous experience in using AutoCAD. Interestingly, students without more experience mastered the program faster than students with previous practical experience.

2.2 AutoCAD Features:

AutoCAD program is a adaptable CAD that allows users to work in many ways. Firstly, the software was specialized in the editing and creation of 2D geometry. Nevertheless, over time, it developed to involve a number of 3D modelling tasks, including surfaces, meshes, and solids. It's deserved observing, though, that most users mostly use AutoCAD in 2D, rather than 3D modelling.

AutoCAD has other profiles those contain the capacity to annotate drawings, import and attach data from portable document file (PDF), and extract object data to tables. 3D editing also fetch with it the capability to view models in several viewports.

Most engineers and users who use AutoCAD save their files in the drawing (DWG) file format. The format was firstly limited and exclusive to the software, but, given the exigency for designers to cooperate, they create many ways to view DWG files without AutoCAD now exist. Other vector file formats AutoCAD also supports, notably including DXF.

There are little of the **features** below, which bundled to every version of AutoCAD:

1. Extensive library of detail components in Architecture field such as doors, windows, and walls.
2. Design electrical controls system, and helps engineers and users to automate electrical engineering functions and use comprehensive code and symbol libraries.
3. Geographic information system (GIS) analysis and planning by Map 3D, addition to converting GIS data to CAD data.
4. Mechanical template is useful for whom looking to build, modify and save document the mechanical products and designs.
5. (MEP) Mechanical electrical and plumbing helps designers to accurately compose structure documentation of mechanical, electrical and plumbing systems design.

III. SOLIDWORKS:

SolidWorks founded in the late of nineteenth of the last century by Jon Hirschtick who spent the $1 million he made when he was a member of the MIT Blackjack Team to establish

the company. Hirschtick then enroll a team of designers and engineers who shove off with the aim of creating three-dimensional CAD software. It was designed to be affordable, accessible and workable on Windows.

Later on, SolidWorks was released in November 1995. It was the first considerable modeller for Windows. This considered to be an enormous step in the posterior evolution of CAD. In spite of AutoCAD had been released earlier, SolidWorks create something new to the board—3D modelling. Thus, 3D CAD became the Corner stone of the 1990s. During months, SolidWorks developed the way engineers brought their creations to life.

3.1 Learning curve rate / Ease of use

Students classify SolidWorks as easy to use, which was harmonious for adopting from both 2D and 3D CAD. A higher level of satisfaction and Greater ease-of-use are illustrative of more powerful a software design tool. Students were also able to create and manage larger and more complex projects with increased confidence as much time as needed for a smaller project in their previous systems. They were able to design products as easily as they had imagined, while before designs were compromised because of the CAD system. They were also able to produce useful graphics within two weeks. All changes are instantly reflected in the parts and assemblies.

3.2 SolidWorks Features:

SolidWorks program supports the import of data in the DWG and DXF formats addition to AutoCAD blocks, facilitating the creation of 3D models from 2D data. SolidWorks has adorable tools to hasten design and build 3D models including a tool called Design Clipart that lets you to drop and drag drawing views from DWG files into SolidWorks software models, and another operation called View Follding can help for automate the building of a 3D model by control and manipulating the views of imported 2D drawing. As well as, SolidWorks supports the import of 2D "blocks" from AutoCAD as the basis for sketching new 3D features in SolidWorks program.

3D CAD functionality is known for SolidWorks, SolidWorks also helps designers to sketch 2D accurately. SolidWorks models In fact, typically start life as 2D drawings and sketches. Then, users can extrude their products into 3D using a number of available stuff and tools.

SolidWorks has aimed to be more than a simple drafting application. As mentioned before, the software has included simulation tools, allowing designers to test their parts by simulating conditions of real world. Those tools contain computational (calculations) fluid dynamics (CFD) tools, the ability to imitate and simulate heat transfer, fluid flux, and fluid forces, and life cycle assessment (LCA) countenances and features.

Besides, the software includes robust rendering features, which help users to see realistic photos of the parts they inspire; we will show the reality for both software at the comparison part of that thesis.

SolidWorks has other tools represent extensive arsenal include Product data management (PDM) packages, and a range of electrical solutions that make it simple to create schematics and circuit data accurately.

With such a wide range of different countenances, it leads to know that SolidWorks has designers and users across numerous and abundant industries. At first, this includes a numerous of businesses in commercial industries that depend on SolidWorks for their daily operations. Here, Key sectors include automotive industries and the aerospace, including major clients such as "The National Railroad Passenger Corporation" (Amtrak) and "British multinational defence, security and aerospace company" BAE Systems.

SolidWorks uses both traditional industries, such as construction, oil and gas, and emerging sectors, including robotics and alternative energy. With too much on offer, a range of SolidWorks packages are available to meet diversity of industry requirement, there are little of the bundled **features** for each version of SolidWorks:

1. 3D CAD: the "classic" solid modelling program that allows designers to inspire and create parts rapidly, drawings and assemblies.
2. Simulation: a wide range of options for designers who looking to build products faster with less waste.
3. PDM: to enable teams to cooperate more effectively when creating new parts; to help all members to access securely to documents and files.
4. CAM (Computer-aided manufacturing): This is resolution for any work looking to merge design and manufacturing processes.
5. Electrical Design: where packages that make it fast to create electrical plans and schematics and combine them within mechanical designs and three dimensional models—all while decreasing the need for physical modelling and prototyping.
6. Visualization: originate photos of projects which realistic, comprising both static and animated or moveable content.
7. 3D Experience: work with teamwork in a

cooperative milieu to build new parts.

IV. CRITERIA FOR COMPARING AND CONTRASTING BOTH APPLICATIONS

As discussed before, these comparing will be done with the usage of certain parameters or standards to create clear pathways which will make understanding what each program application has to offer. Here are the chosen criteria:

A. Industry: It is very important to use the specific industry of CAD software, due to the fact that CAD applications are usually developed with some industries in mind.

B. File types: Various file types that the application supports are also a standard that should be considered if the user intends to use CAD mercantile. This is because the user may be asked to send projects in specific formats to different clients.

C. Functionality: Where, different types of tools and features used in drawing and modeling will be debated in conjunction with the way that the task is made simple for designers. Those standards will go in depth to cover all the features of both CAD applications such as architectonic features, electrical design and modeling.

D. Learning curve: To learn how to apply CAD couldn't be seen as an easy task, but features embedded in specific design applications make this mission too hard. This standard will try to cover learning curves related to each.

4.1 Comparing AutoCAD and SolidWorks

First, the comparison will explain the general characteristics of each of the applications using our criteria.

A. Industry

SolidWorks and AutoCAD have many likeness and industrial sectors are applied for each. AutoCAD is mostly built for construction and architectural design but its 3D modeling capacities also make it a perfect tool for engineering design. SolidWorks also does these roles and it can be used to design 2D architectonic designs and other construction projects and drafts while using 3D modeling in the engineering society to design three-dimensional mechanical parts. Finally, all CAD software can be used by almost anyone to draft or use public characters.

B. File Types

Autodesk constantly at the top of the pyramid design for decades will be valuable when saving files. AutoCAD DWG and AutoCAD DXF formats have been used as an industrial location for standard industrial file types, but both SolidWorks and AutoCAD support the use of various file types on their interface. These file types include: DWG, DWF, DWT, DWS, DXF, SAT, PLT, and SolidWorks.

C. Functionality

As mentioned before, CAD software are perfect tools for creating two-dimensional creating and drawing 3D models. Those CAD software applications are engineering tools for driving and come equipped with a variety of tools to accomplish design tasks. User interfaces from both applications are also very axiomatic and are simply created for basic design tasks for designers. The use of customizable command lines and shortcuts as auxiliary tools is another likeness that is shared together because they are designed for axiomatic task.

The function of customizable command lines and shortcuts as auxiliary tools is another similarity that is shared together because they are designed for axiomatic work. AutoCAD and SolidWorks, used to assemble parts, simulate designs, estimate costs, and provide authentication and presentation models based on what the user wants to achieve. Finally, capabilities of cloud storage are combined into both software to help designers to save and share drawings easily.

D. Learning Curve

The learning process associated with each CAD application cannot simply be compared to how well a person can draw on each platform, but how easy it is to use these programs to handle hard tasks or projects. In this context, the learning curve liege the accuracy of two-dimensional graphics using either AutoCAD or SolidWorks is very sharp for first-time users, but it is very easy for everyone with some computer-aided design expertise.

This is certainly the most important way both applications are similar and can be said that have the ability to create similar design projects. It was said that the differences between each of the software applications are what makes them all prominent and those Differentiated features must play a more effective role in the user's choice of design software when choosing.

4.2 Contrasting AutoCAD and SolidWorks:

A. Industry

Even if program can generally be used as design applications in many industries, the truth still stays that both software have been improved for some industry sectors. For AutoCAD; construction, architectonic design, automotive industries, and education are unrivaled developed and employed to serve it; it comes with

comprehensive features to support design projects which mentioned above.
Furthermore, for a larger number of users, SolidWorks is designed, and can be reversed through the drawing, drafting and modeling countenance that the user shall find on his interface. Local métiers include use: aviation, rapid prototyping, computer design, electronics, biomedicine, energy, and technology building.

B. File Types

As noted and mentioned before, Autodesk products have determined the speed of using DXF and DWG files in CAD, but with the emergence of different software of design applications that showcase their file formats, the value of an interface that supports the use of each type of file is important for users. So, for AutoCAD, it supports the following files: ACIS SAT, ACIS, HOOPS META FILE, HPGL / PLT, JPEG, IGS, IGES, Parasolid, XT, PROE, PDF, STL, STEP.

While, the various file types that support SolidWorks are very bounded, where AutoCAD already employs most of the files it prop. About file support, SolidWorks works with the most common files which most CAD applications and includes: PDF, DWG, DXF, and SLD. For that, AutoCAD considered to be in the front where the user can import the designs, regardless of their formatting in their worksheet, to save or edit in a different format.

C. Functionality

Although both applications share many similarities in many aspects, some major differences are common. SolidWorks and AutoCAD have a lot of variances that will be shown in details here because the ability of CAD applications to work is the most significant part of their employ.

Cooperation aspects: AutoCAD is accommodated to support the conversion of 2D drafts into 3D models, while SolidWorks does not have the ability to handle the file conversion. And so, while models of AutoCAD can be used with a 3D printer conjunctionally, models of SolidWorks are commonly loaded into a sectioning program before being used in 3D printing.

Advanced Profiles of Modeling: It is important to remember that AutoCAD is basically a two-dimensional drawing application unlike SolidWorks Before discuss in depth the contrast features between both software. So, SolidWorks came with many advanced aspects and features that make 3D modeling easy and simplified for each user of CAD.
Some of the advanced features of SolidWorks include: the ability to create organic shapes, flat surfaces, the creation of radiation-free surfaces, healing or coherent models, facial replacement, stylize shapes, surface filling and conduction analyze; thickness analysis; symmetry analysis; Gaussian analysis, gradient and many more advanced functions. Furthermore, AutoCAD is not prepared to deal with these creations or analyzes, but for those seeking for an Autodesk product it can be a look at the Inventor is worth it.

Architectural Profiles and Features: On the one hand, architectural draft features contained in both programs, is the case of the opposite of what happened in the "argument on advanced modeling features". AutoCAD is mostly an architectonic design program whereas SolidWorks is not; it is tied up with extensive aspects and features to deal with such layouts.
Through AutoCAD, layouts and designs involving landscape, alignment of walls and stairs, merging survey design and results of doors, walls, and windows into floor layout can be easily achieved. On the other hand, while SolidWorks can be used to design building components and structures, they do not come with tools for drafting and documenting basic architectural structures.

Characteristics of electrical design: Designers also benefit from CAD to draft more advanced schematics, electrical systems and circuits as analyze how they work finally. SolidWorks was fully stuffed to handle electrical design tasks whereas AutoCAD is very finite in this denomination.

Design of Sheet Metal: working on Metal projects depends to a certain extent of CAD. This is due to the fact that CAD provides realistic simulation tools and tools help users to draw layouts for the situation and also experiment with new connotations. For SolidWorks, infer bending allowance can be calculated, handle placement sketches, flat display switches, use modulation tools, bend tables, weld table also. When working with metal sheeting and structure.
AutoCAD unfortunately lacks all of these aspects because of its status only. Therefore, another look at “Inventor” should be seen as an option for Autodesk to deal with metal work, those hell bent on endure with their AutoCAD expertise.

D. Learning Curve

We have discussed-previously- the likeness between the ease of use associated with each application. With regard to the disparities between the learning curve, it is important to distinguish that SolidWorks comes with both integrated training features and training programs that help us easily identify the use of its own interface as a modeling workspace and layouts. AutoCAD also comes with training programs,

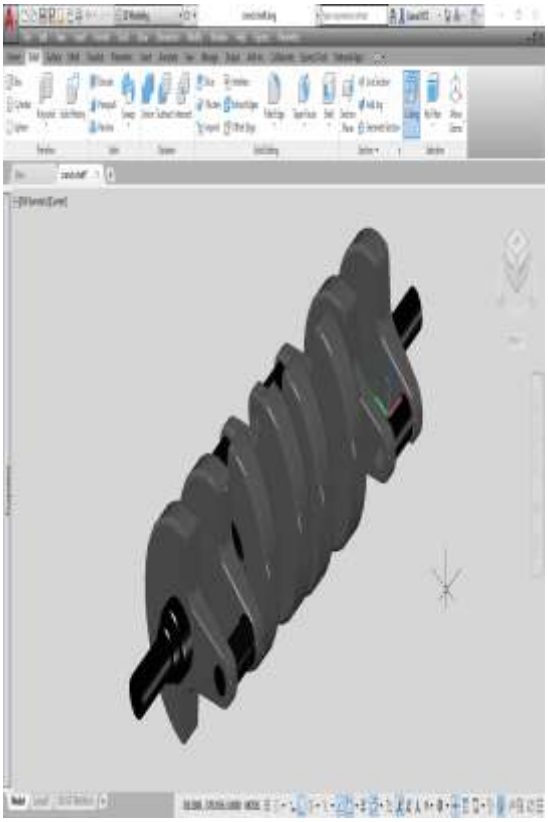
without training features incorporated with workspace.

Although, this does not make obstruction for students' training. There are many online materials to help us find way around AutoCAD to learn the perfect places to take advantage of the comprehensive features.

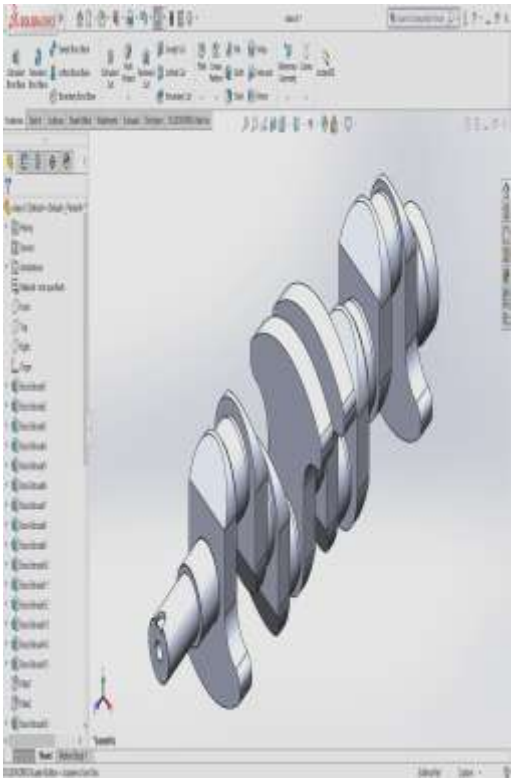
Finally, cost aspects of both CAD program wouldn't considered to be cheap, both costing over $ 1,000, making it hard for the many student to obtain. Autodesk and Dassault, Understanding these difficulties, have made "educational version" for teachers and "student versions" for student of all their CAD software free of charge for registered teachers and students who are looking for an advanced software application to work with.

4.3 Reality

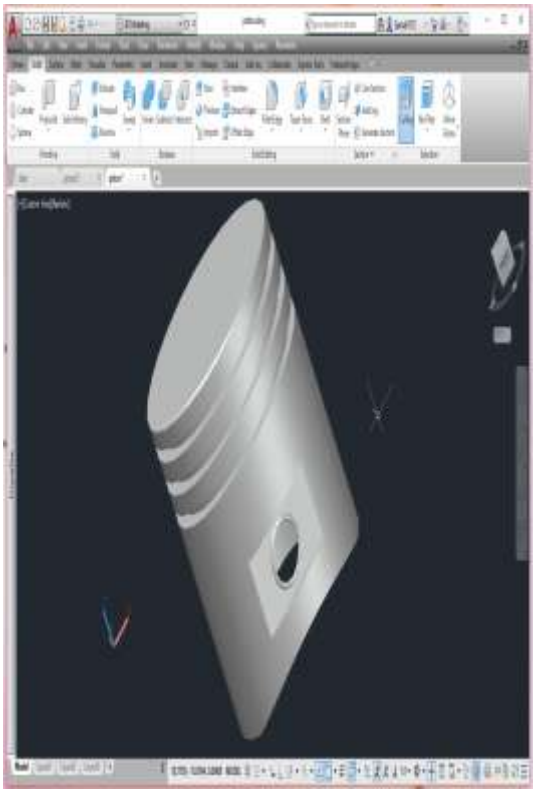
There are some different in Reality between AutoCAD and SolidWorks, in the next pages some Drafts for Automotive parts done by the Researcher with both Programs show that different.



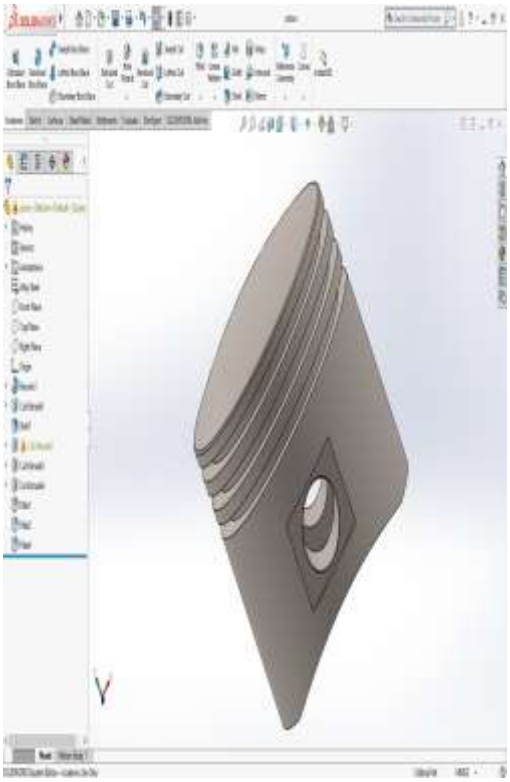
(1)Screenshot of Designing Crankshaft by AutoCAD.



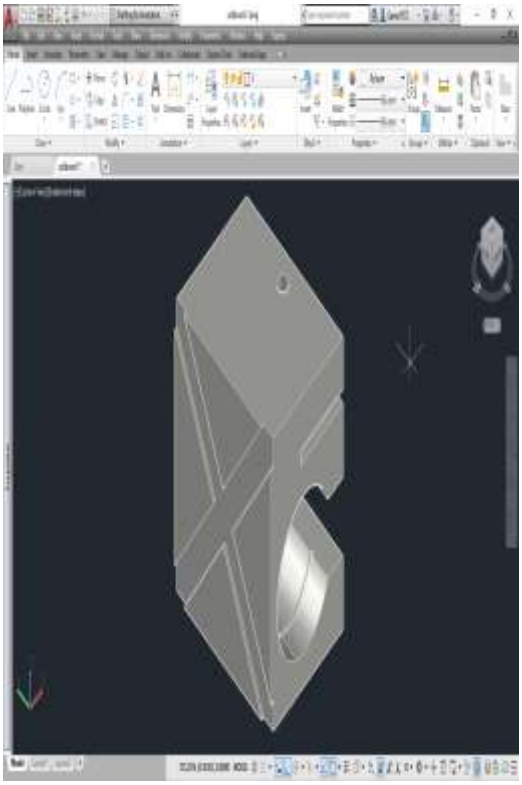
(2)Screenshot of Designing Crankshaft by SolidWorks.



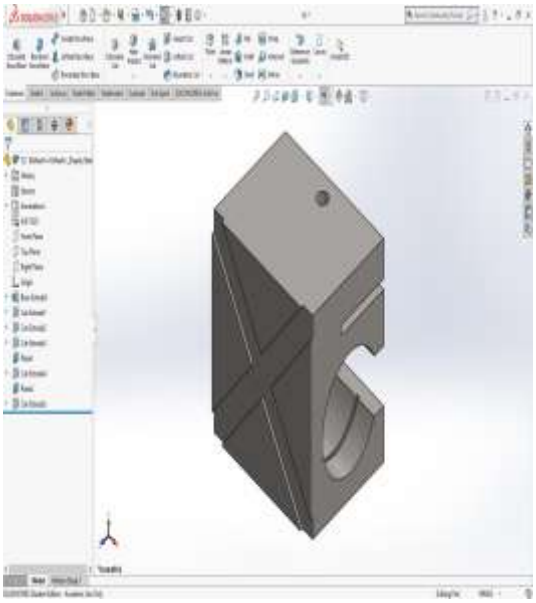
(3)Screenshot of Designing Piston by AutoCAD.



(4)Screenshot of Designing Piston by SolidWorks.



(5)Screenshot of Mechanical part by AutoCAD



(6)Screenshot of Mechanical part by SolidWorks

V. CONCLUSIONS

Finally, the thesis put the next table to conclude the comparisons between tow software:

	AutoCAD	**SolidWorks**
1	Ideal for tow-dimensional (2D) drafting	Somewhat 2D drafting tools contained
2	Three-dimensional modelling tools included, but not advanced like its 2D tools	Advanced 3D and Parametric tools
3	Available for both Microsoft Windows and apple Mac	Windows-harmonious only
5	Users are primarily in the sectors of architecture and design	Users are primarily in aerospace, automotive, engineering and design
6	Perfect for architectural creation and MEP	Lesser useful in the architectural design sector
7	Simulation tools not included	Simulation tools included
8	Help for create electrical plans	Sheet metal design tools included
9	Innovate parts with CNC machines	CAM and design process Integrated
10	Realistic photo is about 86%	Realistic photo is about 94%

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