COMPARATIVE STUDY OF "REVOLVE" COMMAND IN THE AVERAGE-CLASS DESIGN SOFTWARE TAUGHT IN THE HIGHER EDUCATION

PhD. Assoc. Prof. Adrian Mihai GOANTA
"Dunarea de Jos" University of Galati –
Romania, Faculty of Engineering in Braila,
Research Centre for Mechanics of the
Machines and Technological Equipments

ABSTRACT

The paper aims to present a comparative study of "Revolve" control/command or equivalent controls that are found in the following design software, namely Mechanical Desktop 6, Inventor 2011 and Solid Works 2008. In other words all variants of the command are studied comparatively and the features of each of them are highlighted.

KEYWORDS: CAD, Mechanical Desktop 6, Inventor, Solid Works 2008

1. INTRODUCTION - CURRENT SOLUTIONS AND TRENDS IN HIGHER EDUCATION TEACHING OF GRAPHICS SUBJECTS

Before 1989 few universities had managed to teach only one computer – aided subject.

This was caused by both higher acquisition costs for software and low degree of labour market demand of such skills and competencies. With the international openness in 1989, the computer-aided design software packages for both mechanical field and in other fields of design gradually began to penetrate, first somewhat illegally and subsequently on various commercial licenses. After the software has become part of the industrial design it was necessary for them to break through and extend their applicability to the higher education as well. The main purpose of this action was the preparation of graduates able to face the challenges of the labour market and also to ensure cost savings in implementing this software due to the fact that each company separately would receive ready - trained specialists after having attended free training courses offered to students according to the university curricula. In parallel and as a result of the growing need of computer- aided design,

a number of multinational companies have opened training centres in major cities, intended to prepare engineers with experience in design, but who did not know the new tools of assisted graphics. The first phase of implementation of this design software consisted in moving from the drawing board to the computer, in that it was assimilated a 2D drawing tool without having a 3D design as such.

This stage was absolutely necessary because moving from classic design to 3D Computer Aided design was not possible because both business and academia lacked the financial resources necessary to ensure the related software and hardware. This was exclusively the AutoCAD stage which has expanded in all university centers, due to the following advantages: relatively low performance hardware platform, relatively low cost licenses, extremely high prevalence both in the country and in Europe, the existence of academic teams in major universities who felt passionate to introduce AutoCAD studies in the academic curriculum.

In time, a new trend has emerged, namely the assisted three-dimensional design which offers the advantage of parametric modelling and automatic achieving of the 2D documentation [2]. Basically this type of design allows obtaining the 3D model design based on parametric sketches, for each item separately

and for the whole assembly. This has changed the range of traditional software and also has made expansion a necessity of 3D software. Although these initial costs were higher than the previous stage, they gradually managed to find a place on the market due to the facilities they provided and more specifically due to the model fast changes which were transmitted instantly to the 2D documentation.

Also the 3D model can be exported to the software by the finite element analysis that provides very fast information on the behaviours of parts designed in real conditions, thus replacing traditional resistance calculation which is very time-consuming. Nowadays design is characterized by the concept PLM - Product Lifecycle Management [1] enables organizations to effectively manage in terms of cost, full life cycle of a product from idea to design and manufacture, to service and recycling. Computer Aided Design (CAD), computer aided manufacturing (CAM), computer aided simulation (CAE), product data management (PDM) and converge through PLM digital manufacturing.

This current stage of development of computer assisted design is being implemented in higher education too, but it requires a much larger set of subjects to be included in the academic curricula and additional investment in computing facilities and in purchase of specialized software.

2. PRESENTATION OF "REVOLVE" COMMAND IN MECHANICAL DESKTOP 6

The "Revolve" command is similar to the one in AutoCAD but the solid generated is parametrized, which means that, if the sketch sizes initially used for modelling are changed, the solid shall change as well. To benefit from this advantage, compared to AutoCAD, the steps below should be followed:

✓ Introducing into the modelling space the work planes type "Work Plane" (fig. 1).
✓ Declaring the sketch plane area by "New Sketch Plane" command and selecting the orientation of the coordinate system (fig. 2).
✓ Drawing the sketch and defining the closed rotation profile. Possible addition of a construction line acting as rotating axis for the two situations where no profile segment is the rotation axis (fig. 3).
✓ Dimensioning and imposing geometric constraints: (fig. 4).
✓ Performing rotating of the profile around a rotating axis (fig. 5).
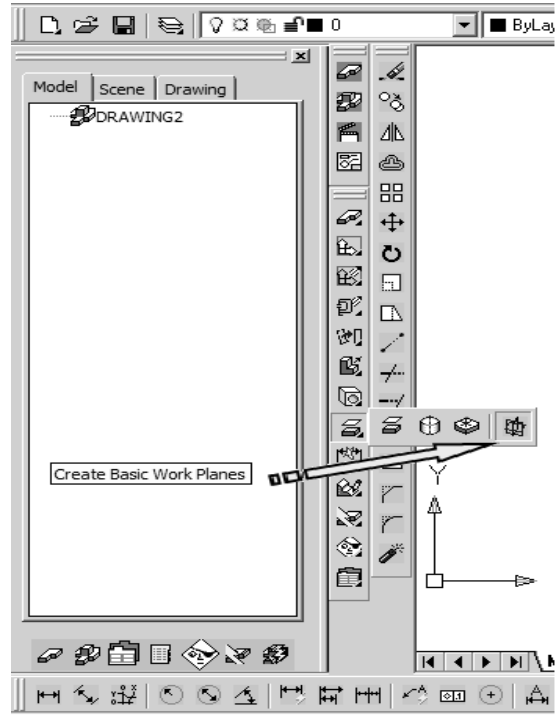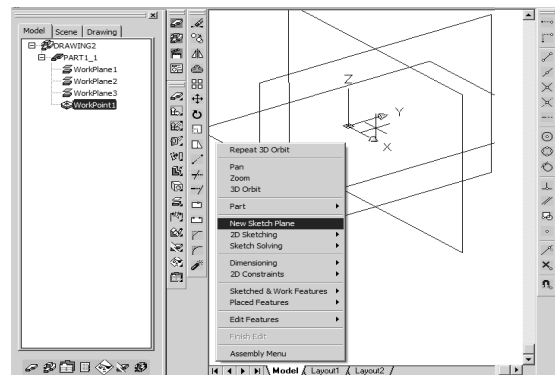

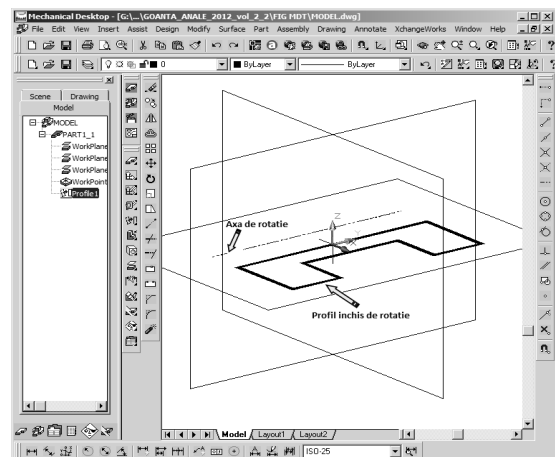Fig. 1 Defining planes type "Work Plane"

Fig. 2 Declaring the sketch plane

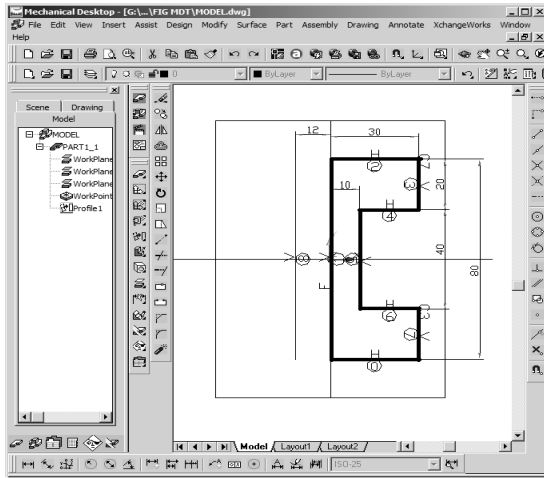Fig. 3 Defining the rotating axis and profile
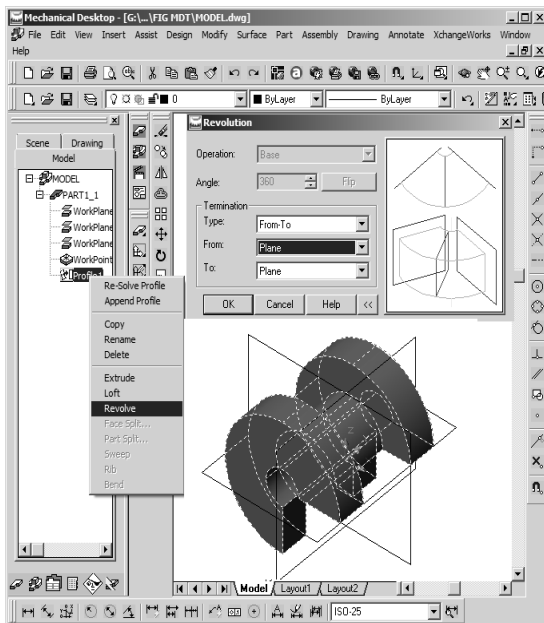
Fig. 4 Geometric constraints and sizes

Fig. 5 Result of Revolve command

3. PRESENTATION OF "REVOLVE" COMMAND IN AUTODESK INVENTOR 2011

Inventor 2011 software package is developed by the same company which designed and Mechanical Desktop to except that it is released on the software market by its manufacturer as a revolutionary product in design. In other words it is the follower of the Mechanical Desktop software which was produced in parallel with Inventor until 2009.

Returning to the theme of this paper, the following aspect should be mentioned:

✓ The sketch planes are inserted while opening the file type *. ipt. In addition to the technical possibilities of Mechanical

Desktop, Inventor inserts the three lines/axes of work, the reference system is invisible and therefore it requires to be led to the state of visibility (Fig. 5);
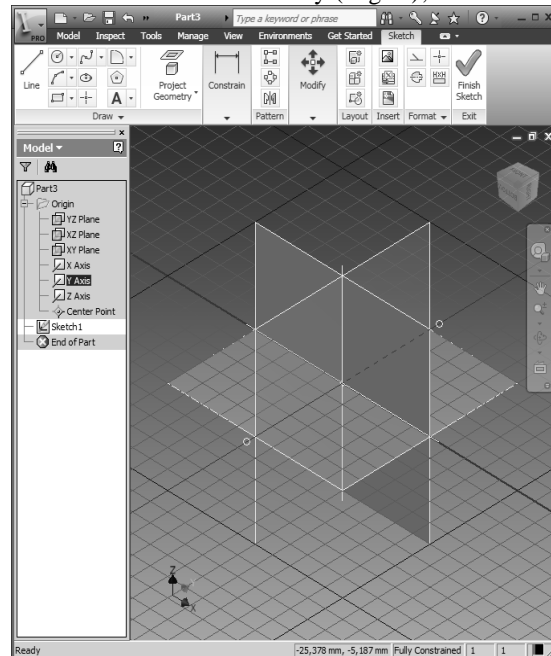

Fig. 6 Inventor 2011 reference system

✓ Drawing the sketch involves automatic generation of the parameterized profile, but the dimensional restrictions such as sizes should be imposed separately.
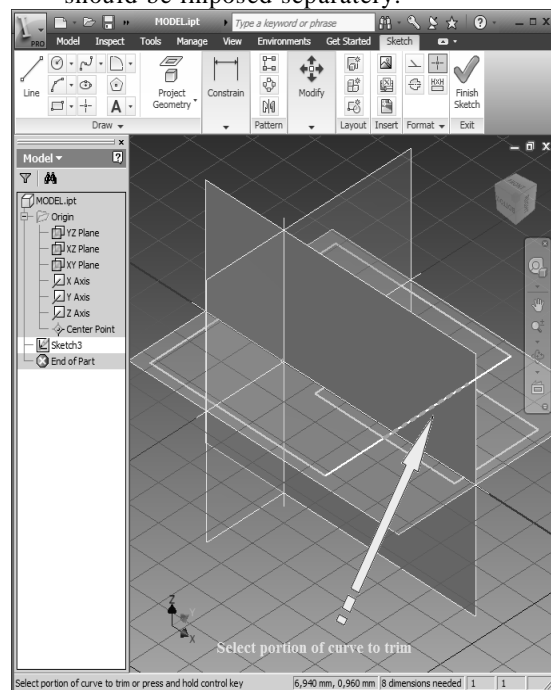

Fig. 7 Applying edit command "Trim"

✓ The sketch viewing is performed isometrically by a GRID and the sketch

plan is assigned the axes OX and OY respectively. Cutting command of TRIM type is perhaps the most ergonomic as compared to the competing software studied in this work, because by simply walking the mouse over the sketch, are automatically selected portions of the segments between the intersection points or between the intersection points and the end points, which can be removed with a single click. (Fig. 7).

✓ The constraints automatically applied to the sketch are initially invisible, but by command "Show All Constrains" it can be seen that the symbols used are highly suggestive (Fig. 8).
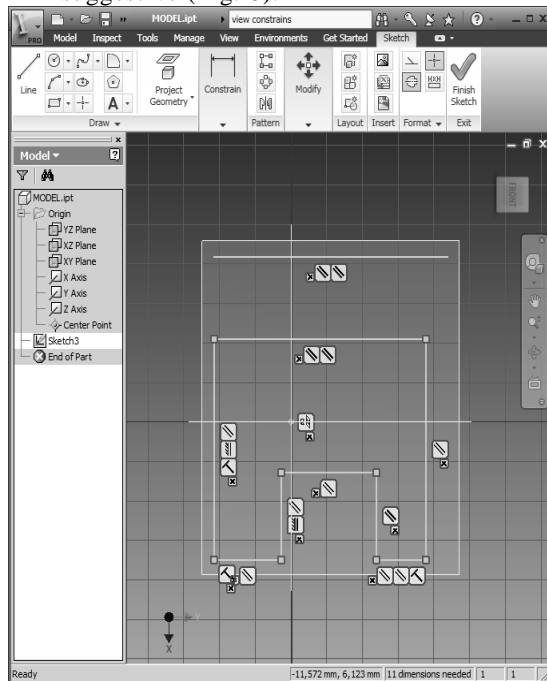

Fig. 8 Symbols of the geometric constraints

✓ If the profile sketch in Inventor is edited after its initial generation, it gets automatic constraints, unlike Mechanical Desktop, where the new graphical entities drawn must be added by adding to the initial sketch and then imposing new constraints on the overall result. This shortens the design time when using Inventor 2011.

✓ The "Revolve" command from Inventor is more powerful than the similar performance of the Mechanical Desktop because it allows the designer under the same commands to choose between generation of a solid and generation of a surface (Fig. 9). Also the selection options of the spatial expansion of the solid to be generated are better defined. For example, if in Mechanical Desktop 6, one needs to

define in advance the two plans between which the rotation of the generating profile takes place, in Inventor the method is much simpler because one can choose the "Angle" with "Asymmetric" option that allows defining angles to the sketch plane between which the rotation of the generating profile takes place (Fig. 10).
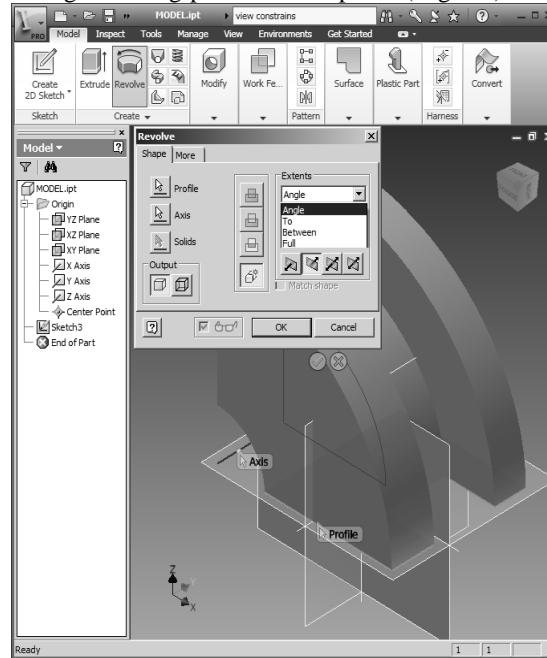
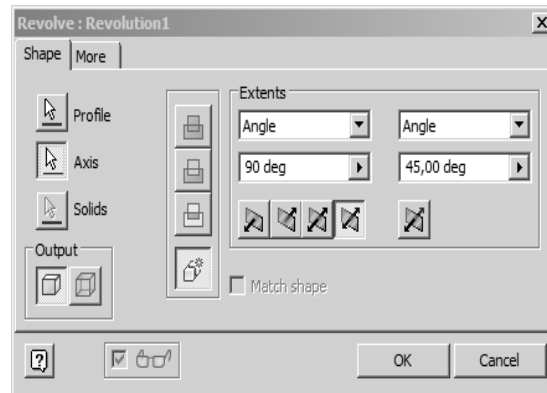

Fig. 9 "Revolve" command in Inventor 2011

Fig. 10 Asymmetric generation option

4. PRESENTATION OF "REVOLVE" COMMAND IN SOLID WORKS 2008

From the very start of Solid Works, it is found an optimized layout of the commands like the Inventor's, meaning that all controls of a certain type are grouped unitarily, forming a ribbon-type [3] disposition specific to the years after 2010. Returning to our comparative analysis, one can note these features in the

14

application of command "Revolve":

✓ The sketching plans exist since the opening the file type *. sldprt, but they are not visible that is why the visibility property must be assigned to them or to set it for all files to be opened further (Fig. 11). In addition to the other two studied software, the sketching plans have visible names allowing the designer a better spatial orientation.
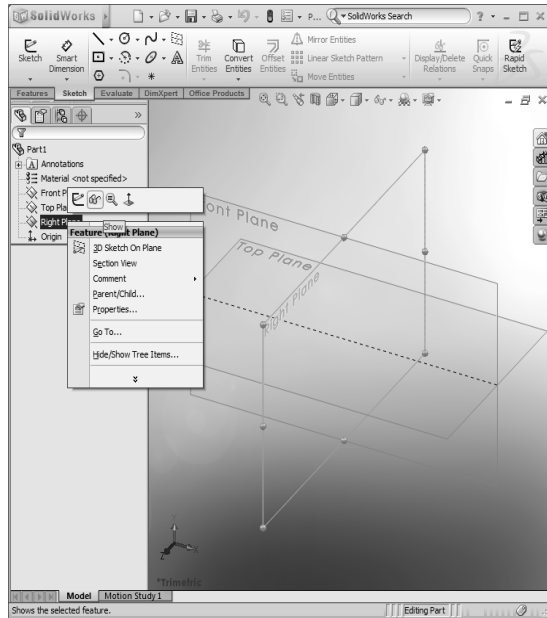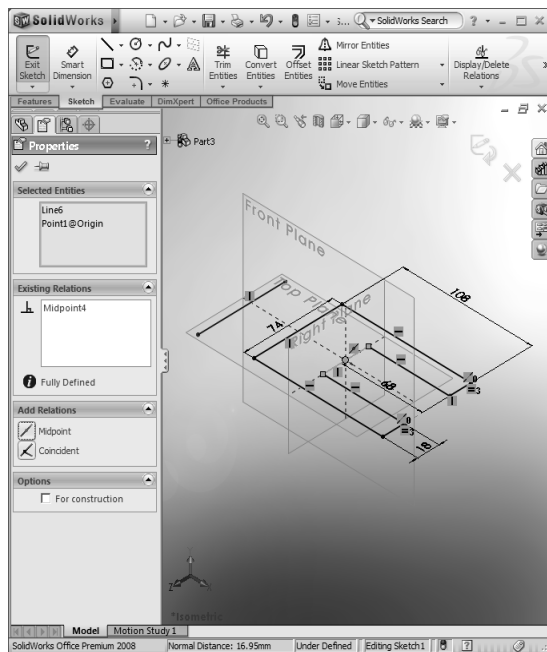

Fig. 11 Solid Works sketching plans

Fig. 12 Insertion of point constraints

✓ Sketch editing by "Trim" command cutting is more powerful than its counterpart in

Mechanical Desktop but less selective than in that of Inventor 2011.

✓ The constraints applied to the graphical entities are particularly powerful because they allow the imposition of constraints including on selected segments and points. Figure 12 illustrates the constraint window type "midpoint" where the origin of the axes becomes the midpoint for the segment of 74 mm length. Also it is found that visualization of constraints is implicit, which do not require some additional settings. In this chapter of geometric and dimensional constraints mention should be made that the Sold Works, by simply selecting a geometric element of the parameterized sketch component, allows viewing in a separate window of information such as: dimensions, constraints, slope angle, etc.

✓ In the application of command "Revolve", Solid Works has some features in that rotation surfaces are generated by a specialized command, which is not a disadvantage in relation with Inventor, but allows achieving of thin-walled solid, without subsequent application of "Shell"-type command (Fig. 13).
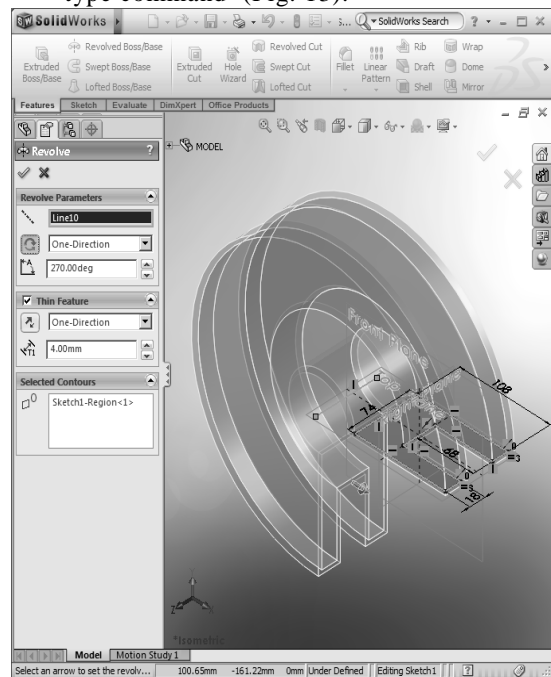

Fig. 13 "Revolve" command work window

A real advantage of solid works compared with inventor is the ability to instantly switch from modern form of grouping ribbon controls to the classical menu of "pull down" (fig. 14).
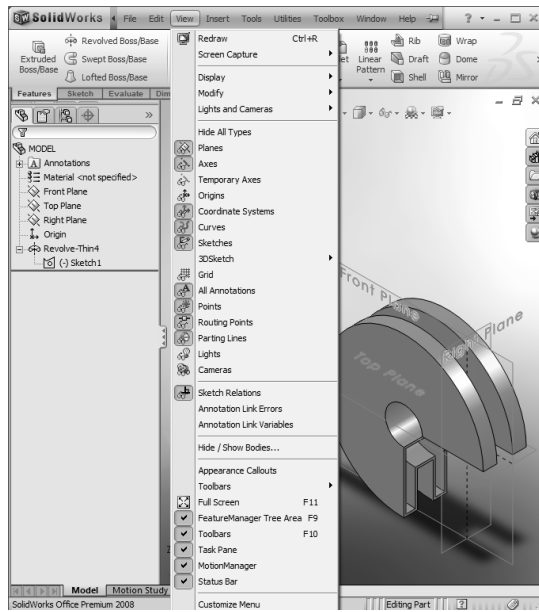
Fig. 14 Classical menu viewing

5. CONCLUSIONS

The comparative analysis of the "Revolve" command for solid generation by rotating a generating profile around an axis of rotation, it is quite obvious that the variants of Inventor and Solid Works respectively dispute their primacy.

If we try to restrict the analysis only, to these, two software, neglecting Mechanical Desktop 6, the analysis becomes very complicated because each of the two versions simultaneously shows both strengths and weaknesses, as follows:

   a. Inventor 2011 is of high performance in terms of the actual command "Revolve" due to the two options to generate "Solid" and "Surface".
   b. Solid Works allows that, by a single command, so full of solids and those with thin walls.
   c. Both software do not allow by editing, the transition from solid to surface in case of Inventor and from thin-walled solid to filled solid in case of Solid Works.

   d. Solid Works has greater ability to impose geometric constraints at sketch level, meaning that allows constraints applied between points or between points and segments.
   e. In terms of memory consumption it can be seen from Fig. 15 that the highest consumption is found with Inventor and the lowest with Mechanical Desktop while Sold Works is in second place.
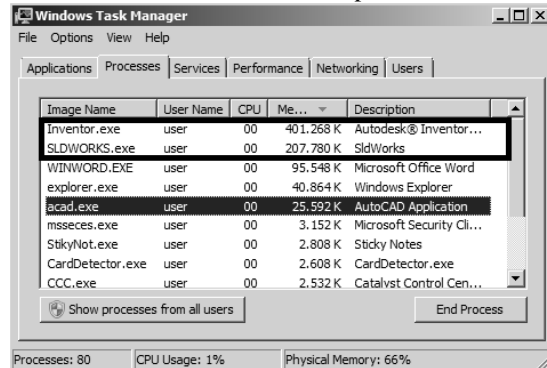

Fig. 15 Memory consumption

Given the above analysis it should be mentioned that the analysis remains open for other specific mechanical design controls, and will be continued in other works, which ultimately will bring about a personal, general and final viewpoint.

REFERENCES

[1] **Goanta A.M., Daschievici L., Ghelase D.** „*Modern PLM Integrated Design Tools that Meet the of Principles of Concurrent Engineering*" . **Proceedings of 9th WSEAS International Conference on SYSTEM SCIENCE and SIMULATION in ENGINEERING (ICOSSSE '10), Iwate Prefectural University, Japan October 4-6, 2010,** ISSN: 1792-507X , ISBN: 978-960-474-230-1, pp 143-148

[2] **Haraga G.** *"Applications of CAD systems"*, ICEGD 2009 - International Conference on Engineering Graphics and Design, Series Applied Mathematics and Mechanics 52, Vol.Ia, ISSN 1221-5872, pp.291-294, Technical University of Cluj-Napoca, Acta Technica Napocensis, 12-13 June 2009.

[3] http://www.solidworks.com/sw/training-support-cad.htm   Accesed: 11.08.2011