THE ANNALS OF "DUNAREA DE JOS" UNIVERSITY OF GALATI
FASCICLE XIV MECHANICHAL ENGINEERING, ISSN 1224-5615
2012

TECHNOLOGICAL OPTIMIZATION PROCESS FOR "DIFFERENTIAL TRUNK" COMPONENT

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ABSTRACT

This study aims to optimize the technological process of manufacturing the „differential trunk" component with NX7.5 software. Modelling the component was made in „ 3D" CAD, simulation was achieved with CAE finite element as well as using the CAM execution technology where aspects related to sequence of processing operations and process parameters were highlighted.

KEYWORDS: CAD, CAE, CAM, technological optimization process

1. INTRODUCTION

NX 7.5 is the CAD/CAM/CAE ultimate technology complex software produced by Siemens PLM.

In Figure 1 is the "2D" drawing of the differential trunk.

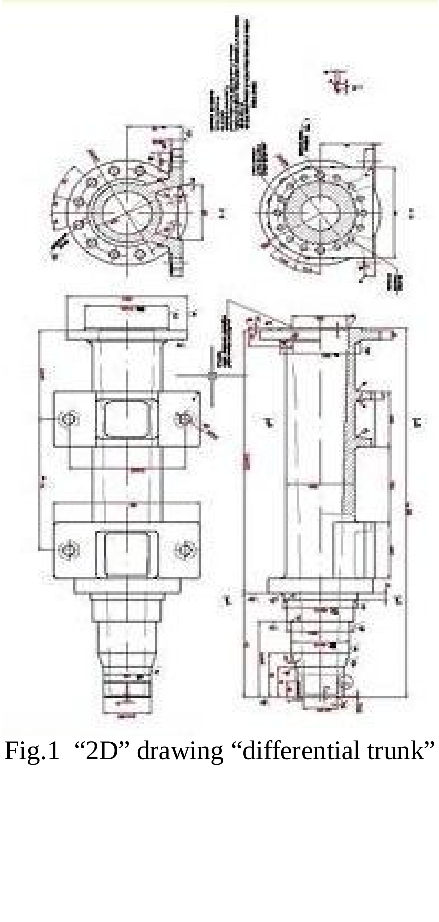


Fig.1 "2D" drawing "differential trunk"

2.ELABORATION OF VIRTUAL TECHNOLOGY

The elaboration of virtual technology for the differential trunk component is presented in Figure 2 and includes the following:

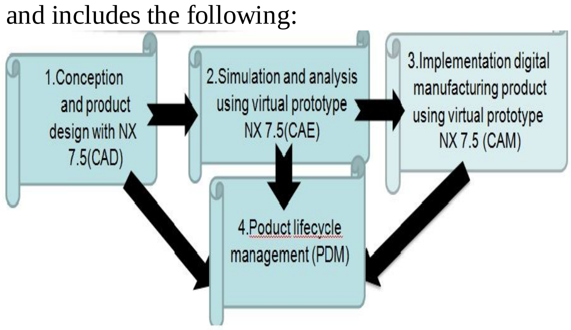


Fig.2 Virtual technological phases

In Figure 3 differential trunk component is presented as a 3D drawing**.**

Fig.3 "3D" drawing for differential trunk component

Sketches for the "differential trunk" were created by using the following tools: Sketch, Profile (Line), Arc, Circle. When modeling the "differential trunk", there may be used other commands such as: Chamfer, Rotate, Mirror curve, Offset curve, etc.

After completion of sketches, these shall be dimensioned and extruded by using the commands: Extrude, Revolve, Hole, Trim, etc (Fig 4).

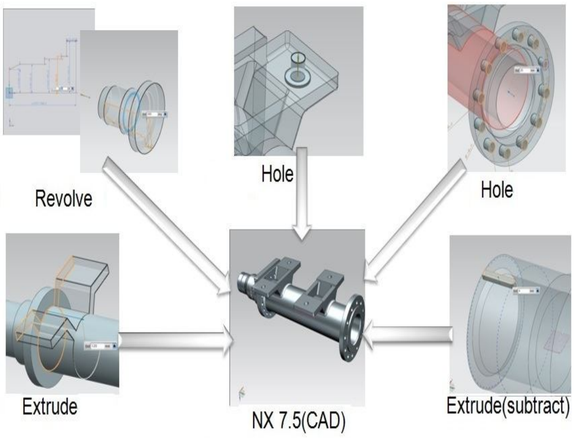


Fig.4 Stages in modelling the differential trunk

The measurements of the component, volume, surface, as well as mass that is strictly required for casting, painting and technical offers areshown in Figures 5÷7.

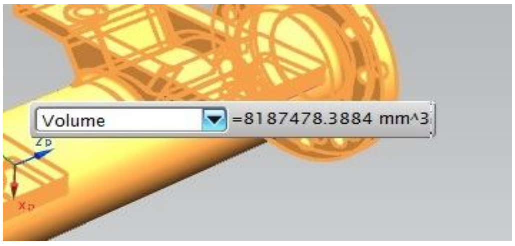


Fig.5 Volume

Fig.6 Surface

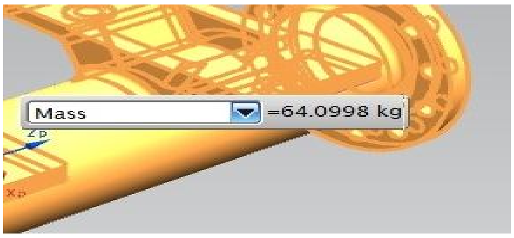


Fig.7 Mass

Static Analysis was made using the Femap software 10.1.1.

The component was digitized by using a number of 145228s nodes and 31938 elements.

Embeddings were made on the 2 sides of the flanges and then a force of 10000 N was loaded on mounting outersoles holes (Fig.8.)

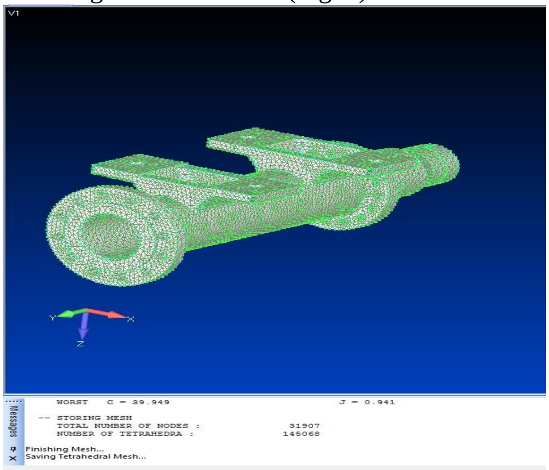


Fig.8 Digitization of "differential trunk"

After the simulation (Fig.9) it is observed that maximum distortion appears on the mounting outersoles having the value of 0,203 mm and maximum stress of approx. 120N/mm^2 after applying the force.

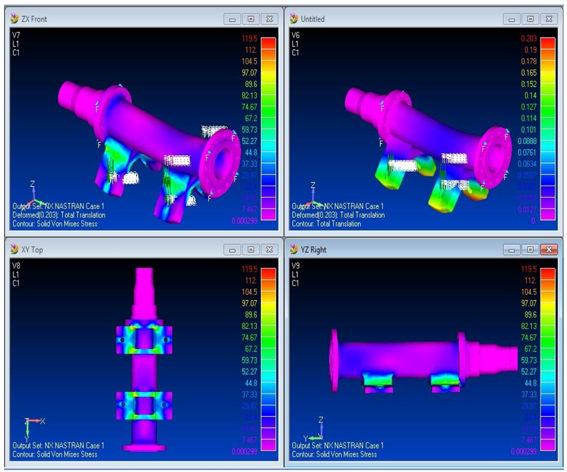


Fig.9 Component's Analysis with Finished Elements

In order to achieve the mechanical processing operation, the finished and semi finished pieces of the components are selected

Machine tools are selected from the Library by using the command (Create tool), guiding direction (CREATE GEOMETRY-AVOIDANCE for the turning operation) as well as for processing operation (CREATE OPERATION).

In Fig.10÷17 the operations and phases of the mechanic processing process are selectively presented.

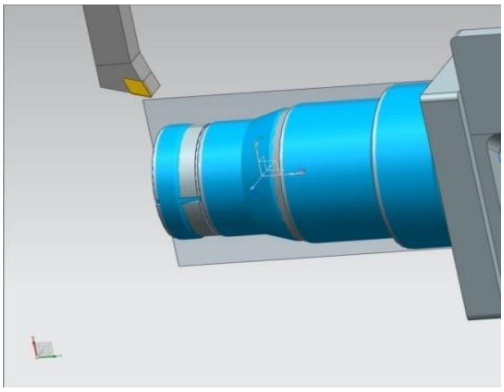


Fig.10 External Turning – Finishing

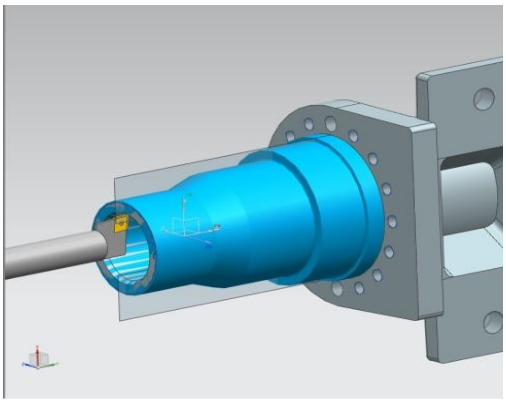


Fig.11 Internal turning

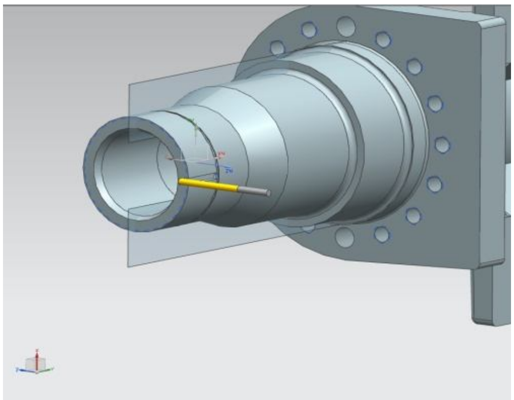


Fig.12 Key Milling

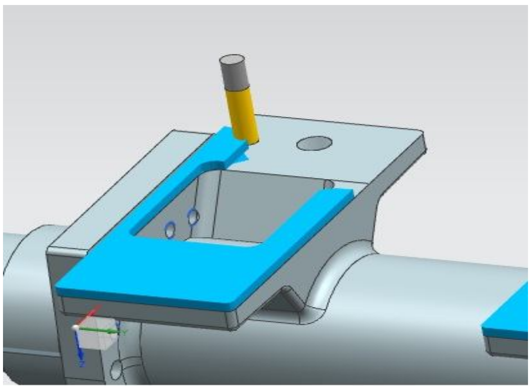


Fig.13 Surface Milling

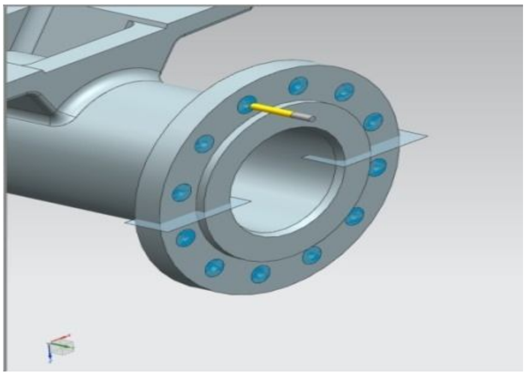


Fig.14 Centre Punching

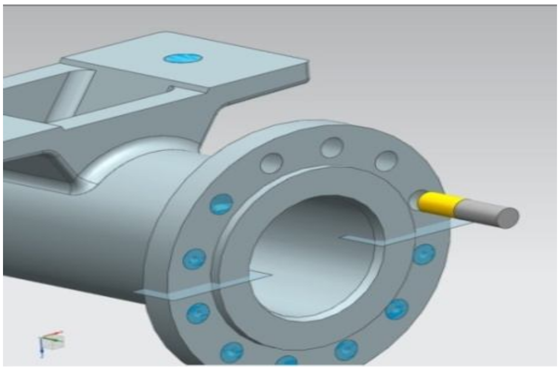


Fig.15 Drilling D18

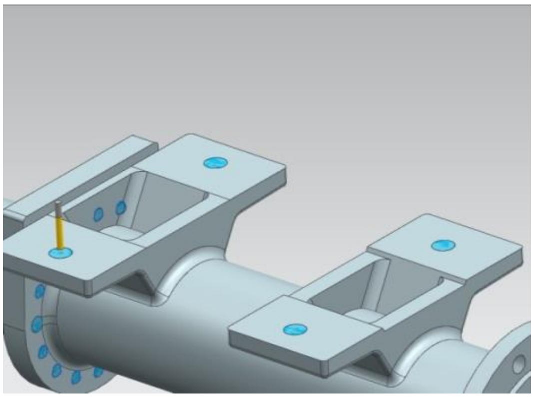


Fig.16 Centre Punching

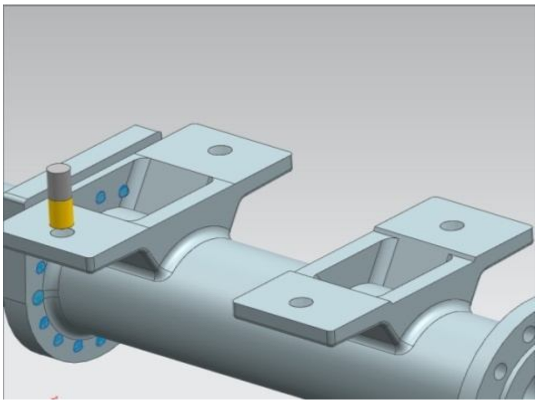
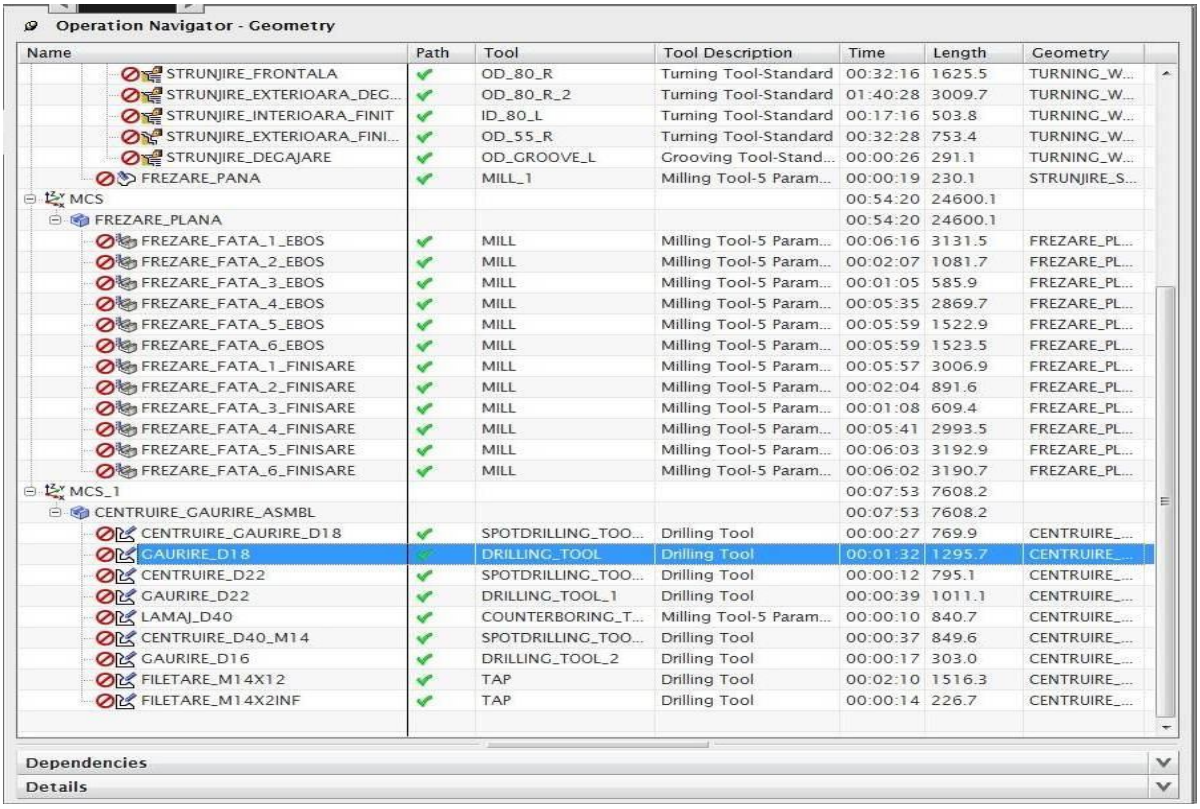


Fig.17 Drilling D22


Operation Navigator - Geometry

Name	Path	Tool	Tool Description	Time	Length	Geometry
STRUNJIRE_FRONTALA	✔	OD_80_R	Turning Tool-Standard	00:32:16	1625.5	TURNING_W...
STRUNJIRE_EXTERIOARA_DEG...	✔	OD_80_R_2	Turning Tool-Standard	01:40:28	3009.7	TURNING_W...
STRUNJIRE_INTERIOARA_FINIT	✔	ID_80_L	Turning Tool-Standard	00:17:16	503.8	TURNING_W...
STRUNJIRE_EXTERIOARA_FINI...	✔	OD_55_R	Turning Tool-Standard	00:32:28	753.4	TURNING_W...
STRUNJIRE_DEGAJARE	✔	OD_GROOVE_L	Grooving Tool-Stand...	00:00:26	291.1	TURNING_W...
FREZARE_PANA	✔	MILL_1	Milling Tool-5 Param...	00:00:19	230.1	STRUNJIRE_S...
MCS				00:54:20	24600.1	
FREZARE_PLANA				00:54:20	24600.1	
FREZARE_FATA_1_EBOS	✔	MILL	Milling Tool-5 Param...	00:06:16	3131.5	FREZARE_PL...
FREZARE_FATA_2_EBOS	✔	MILL	Milling Tool-5 Param...	00:02:07	1081.7	FREZARE_PL...
FREZARE_FATA_3_EBOS	✔	MILL	Milling Tool-5 Param...	00:01:05	585.9	FREZARE_PL...
FREZARE_FATA_4_EBOS	✔	MILL	Milling Tool-5 Param...	00:05:35	2869.7	FREZARE_PL...
FREZARE_FATA_5_EBOS	✔	MILL	Milling Tool-5 Param...	00:05:59	1522.9	FREZARE_PL...
FREZARE_FATA_6_EBOS	✔	MILL	Milling Tool-5 Param...	00:05:59	1523.5	FREZARE_PL...
FREZARE_FATA_1_FINISARE	✔	MILL	Milling Tool-5 Param...	00:05:57	3006.9	FREZARE_PL...
FREZARE_FATA_2_FINISARE	✔	MILL	Milling Tool-5 Param...	00:02:04	891.6	FREZARE_PL...
FREZARE_FATA_3_FINISARE	✔	MILL	Milling Tool-5 Param...	00:01:08	609.4	FREZARE_PL...
FREZARE_FATA_4_FINISARE	✔	MILL	Milling Tool-5 Param...	00:05:41	2993.5	FREZARE_PL...
FREZARE_FATA_5_FINISARE	✔	MILL	Milling Tool-5 Param...	00:06:03	3192.9	FREZARE_PL...
FREZARE_FATA_6_FINISARE	✔	MILL	Milling Tool-5 Param...	00:06:02	3190.7	FREZARE_PL...
MCS_1				00:07:53	7608.2	
CENTRUIRE_GAURIRE_ASMBL				00:07:53	7608.2	
CENTRUIRE_GAURIRE_D18	✔	SPOTDRILLING_TOO...	Drilling Tool	00:00:27	769.9	CENTRUIRE_...
GAURIRE_D18	✔	DRILLING_TOOL	Drilling Tool	00:01:32	1295.7	CENTRUIRE_...
CENTRUIRE_D22	✔	SPOTDRILLING_TOO...	Drilling Tool	00:00:12	795.1	CENTRUIRE_...
GAURIRE_D22	✔	DRILLING_TOOL_1	Drilling Tool	00:00:39	1011.1	CENTRUIRE_...
LAMAJ_D40	✔	COUNTERBORING_T...	Milling Tool-5 Param...	00:00:10	840.7	CENTRUIRE_...
CENTRUIRE_D40_M14	✔	SPOTDRILLING_TOO...	Drilling Tool	00:00:37	849.6	CENTRUIRE_...
GAURIRE_D16	✔	DRILLING_TOOL_2	Drilling Tool	00:00:17	303.0	CENTRUIRE_...
FILETARE_M14X12	✔	TAP	Drilling Tool	00:02:10	1516.3	CENTRUIRE_...
FILETARE_M14X2INF	✔	TAP	Drilling Tool	00:00:14	226.7	CENTRUIRE_...

Dependencies

Details

Fig.18 Component’s Technological Process presented phases and operations with normalization technique based on cutting tools conditions

The table is presented in Figure 18 with synthetic data related to machining behaviours and technical standardization on process phases and operations of the components.

In Figure 19 the differential trunk is presented in “3D” with references to mechanic processing precision.

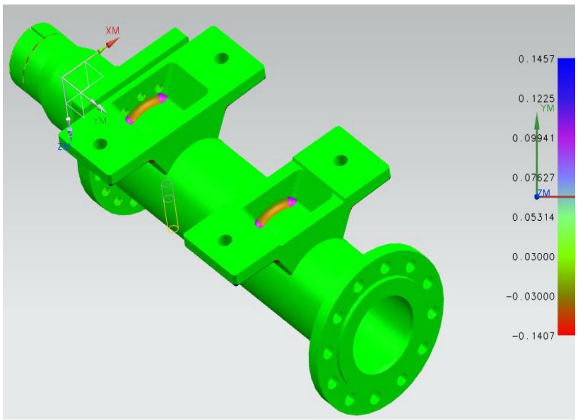


Fig 19 Component’s “3D” drawing related to mechanical processing precision

3. CONCLUSIONS

The paper has presented the “differential trunk” component starting from the optimization of design, analysis and process manufacturing stages.

By successive iterations, there may be obtained virtual interactive information that can be of great help for designing and manufacturing highly reliable component with minimum costs

By extension, this process optimization may be considered as another step ahead in the manufacturing of different components

REFERENCE

[1]. **PLM ADAPTOR (2011)** – *Conception and Designing using the Virtual prototype* Module I, “Dunarea de Jos” University Galati, Engineering Faculty -Braila

[2] **PLM ADAPTOR (2011)** – *Simulation and analysis using the virtual prototype* Module II, “Dunarea de Jos” University Galati, Engineering Faculty -Braila

[3] **PLM ADAPTOR (2011)** – *Manufacturing using the virtual prototype*, Module III, “Dunarea de Jos” University Galati, Engineering Faculty -Braila