SOLIDWORKS SUSTAINABILITY ANALYSYS ON A DESIGNED PART

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ABSTRACT: In this paperwork are presented the SOLIDWORKS analysis steps to be taken in order to study sustainability of a designed part. There are presented the software capabilities and the settings that have to be done for such analysis and the results shown by software. The elements that are taken into account are ore extraction, material processing, part manufacturing, assembly and transportation needed, product usage and end of life disposal mode (landfill, recycling or incineration).

KEY WORDS: SOLIDWORKS, sustainability, lifecycle, assessment, carbon footprint.

1. INTRODUCTION

In [1], it has been presented that SOLIDWORKS Sustainability Module has the capability of evaluation of environmental impact of a design throughout the life cycle of a product. Thus it can be compared results from different designs to ensure a sustainable solution for the product and the environment.
Two modules are available: SOLIDWORKS *SustainabilityXpress* that handles parts (solid bodies only) and is included in the core software, and SOLIDWORKS *Sustainability* that handles parts and assemblies, which is available as a separate product. The second module includes configuration support, expanded reporting, and expanded environmental impact options [2].

By integrating Life Cycle Assessment (LCA) as seen in figure 1, into the design process, you can see how decisions about material, manufacturing, and location (where parts are manufactured and where they are used) influence a design's environmental impact. Therefore one can specify various parameters that SOLIDWORKS Sustainability uses to perform a comprehensive evaluation of all the steps in a design's life. Life Cycle Assessment (LCA) includes:

- Ore extraction from the earth;
- Material processing;
- Part manufacturing;
- Assembly;
- Product usage by the end consumer;
- End of Life (EOL) – Landfill, recycling, and incineration;
- All the transportation that occurs between and within each of these steps.

SOLIDWORKS Sustainability assesses all the life cycle steps based on your material, manufacturing, and location input. SOLIDWORKS Sustainability Module reports the results to environmental impact factors, which it measures and totals.

Figure 1. Diagram of Life Cycle Assessment

2. SUSTAINABILITY STUDY ON DESIGNED PART

The part taking into account is a spacer flange made of OL 52- STAS 500/2- international equivalent St-52-3[3]. The geometric modeling is not raises any issues.
In figure 2. is shown the Sustainability manager interface applied on flange model.

When you have a part open, the Sustainability Task Pane appears with the Material section at the top to let you begin by selecting or modifying the part's material, as it shown in figure 2.

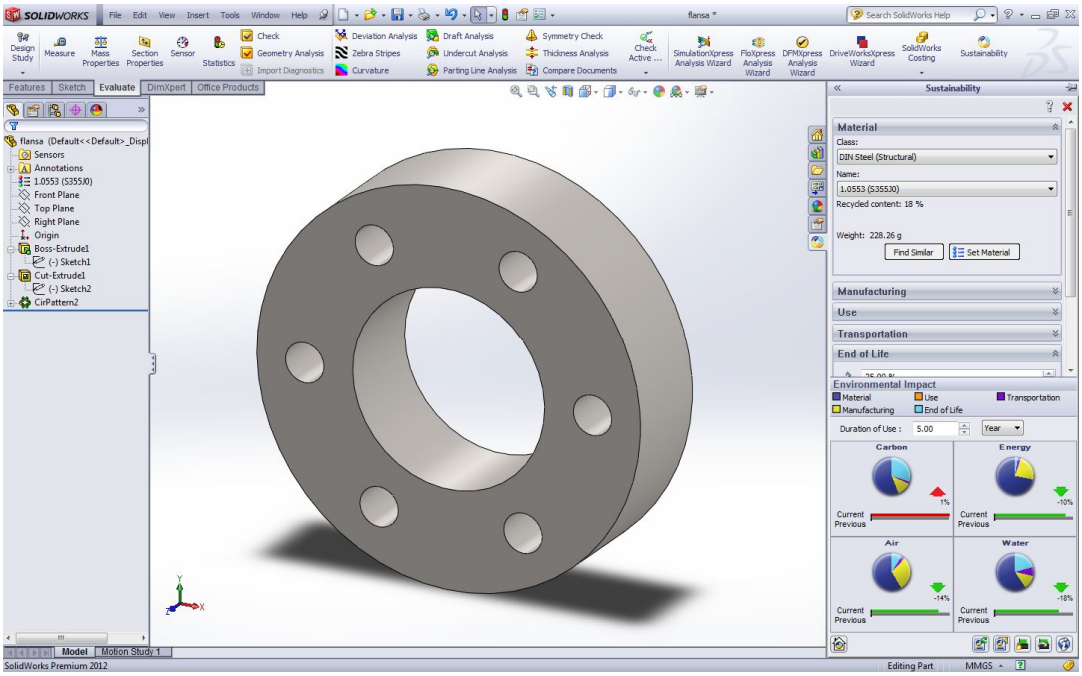

Figure 2. Sustainability manager interface

2.1. Defining material

The materials that are available include Sustainability data, but you can add a custom material to this list by linking it to a material with similar characteristics in the default SOLIDWORKS Materials database.

Class DIN Steel (structural).

Name 1.0553 (S355J0).

Recycled content 18%.

If the sustainability database contains primary (virgin), secondary (recycled), and trade mix (default mix of virgin and recycled content) values, the percentage of recycled content is shown.

If these values are not available, the recycled content is 0%.

Weight 228.26g.

Find Similar Opens the Find Similar Material dialog box, where one can compare similar materials to a baseline of environmental impacts for the selected material, as seen in fig.3.

Set Material Assigns the current selected material to the active configuration of the model in the Feature Manager design tree. This material is then applied to all other aspects of the SOLIDWORKS software, such as mass property analysis, rendering, and so forth.

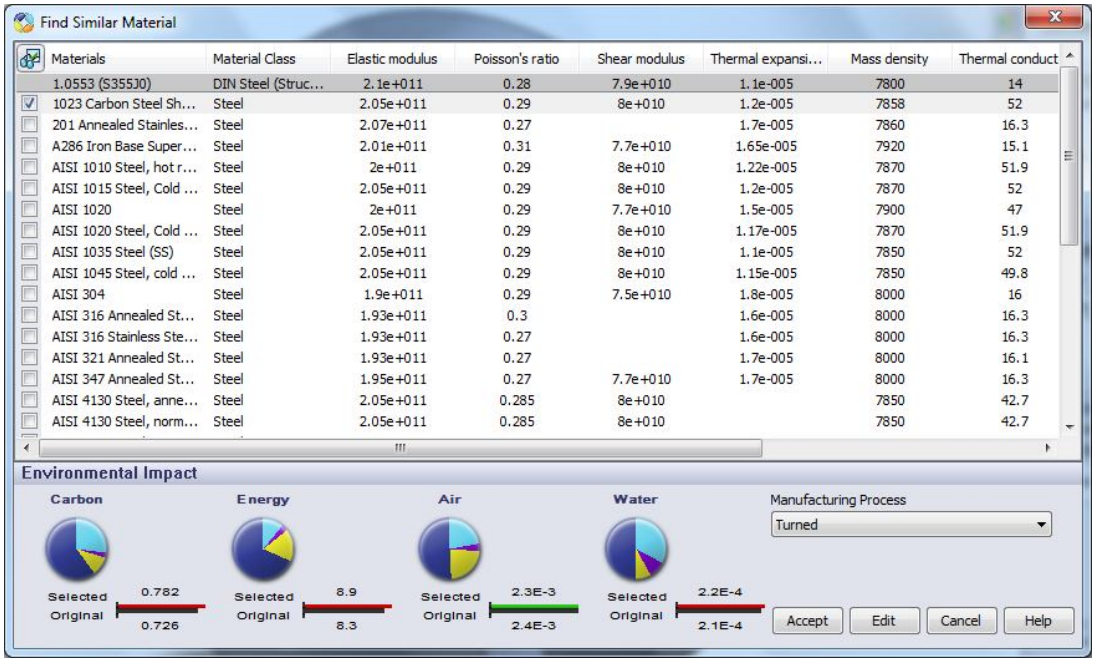

Figure 3. Find similar dialog window

2.2. Manufacturing

Region Europe.

Built to last 5, in years.

Process Sets a manufacturing process. If we select **milled** instead of **turned**, we observe a decrease on all environmental impact factors the selected material class, from 3 to 7%, as seen in figure 4.

Total electricity usage – 0.14 kW

Total natural gas usage - 0

Scrap rate (amount of the material discarded as scrap) – 10%

2.3. Use

Region Sets the region where the product is transported to and used, for example, Europe.

2.4. Transportation

Shows the default mode of transportation and distance traveled from the Manufacturing region to the Use region. Let's presume that we export this product to Munchen in Germany, by truck – 1269 km. We still left a decrease on all environmental impact factors from 3 to 7%, as seen in figure 5.

Train
Truck
Boat
Plane

In full Sustainability, you can edit these values by clicking a transport mode's button and typing in the field that is enabled.

When you change a transportation mode or modify the default mode, the field turns yellow and a Reset to Defaults button appears so you can discard your changes.

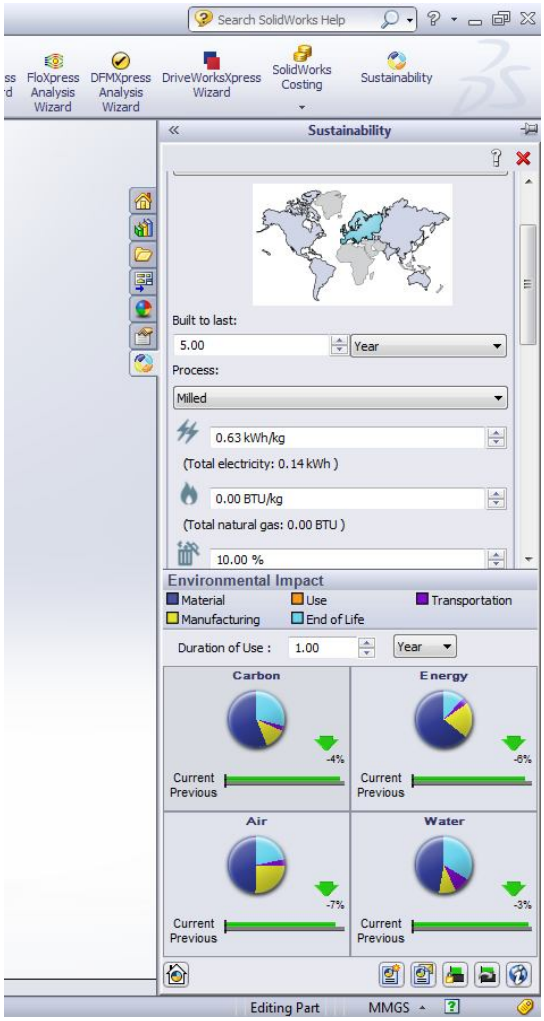

Figure 4. Manufacturing

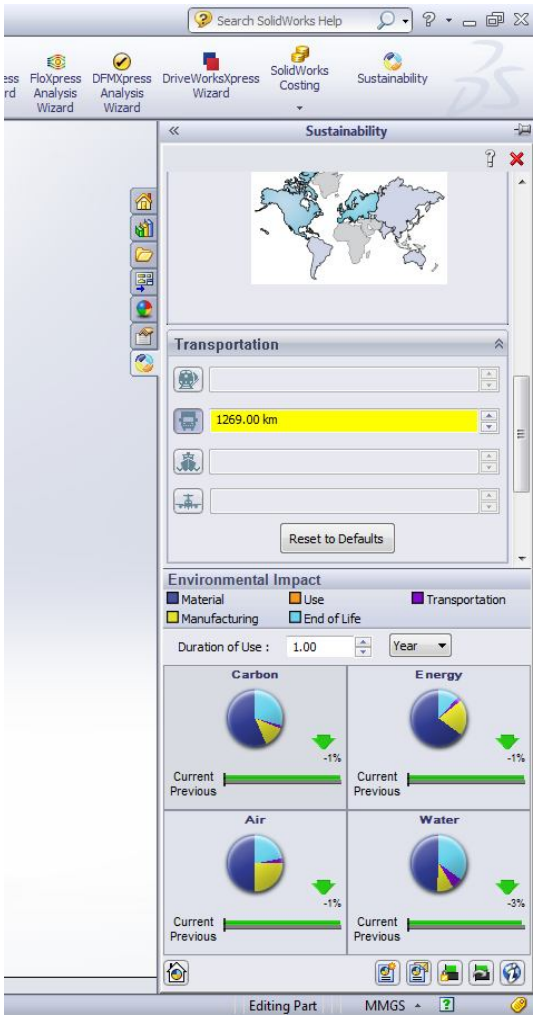

Figure 5. Transportation

2.5. End of Life

Shows default percentages for end of life disposal of the part. Default values are based on the part's material in the sustainability database.

Recycled - 25%
Incinerated - 0
Landfill - 75%

The total of the values always equals 100%. If one changes the recycled or incinerated value, the landfill value updates.
When you edit a value, the field turns yellow and a Reset to Defaults button appears to let you discard your changes.

If we manage to recycle 25% of these part types we observe an important decrease environmental impact factors from 10 to 18%, except carbon footprint which increase by 1% as seen in figure 6.

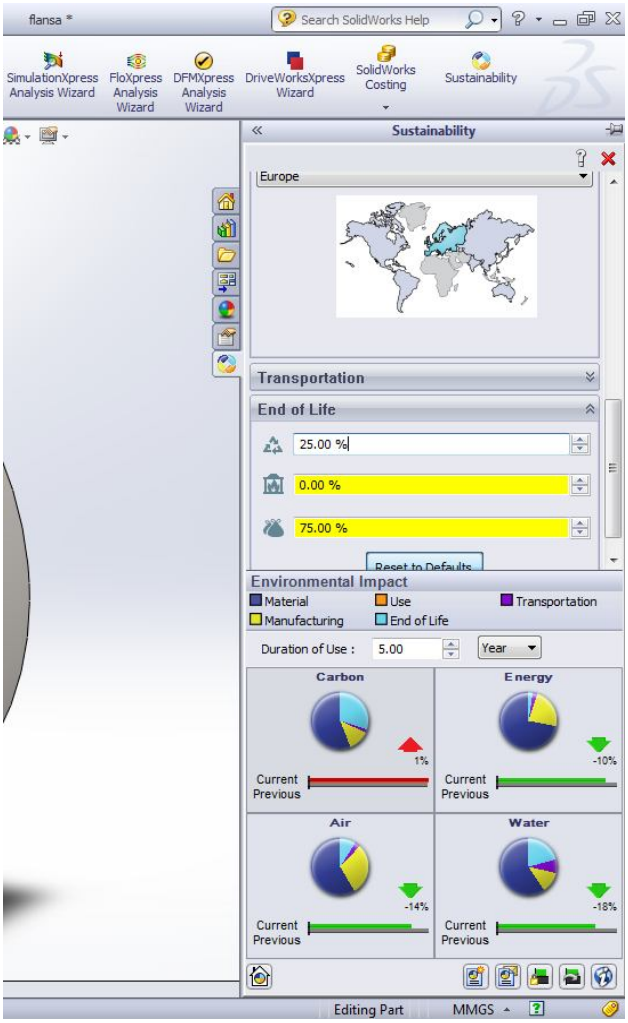

Figure 6. End of life

2.6. Environmental Impact

The Environmental Impact dashboard (figure 7) provides real-time feedback about the environmental impact of the design. SolidWorks Sustainability products use the CML environmental impact assessment methodology to calculate the environmental indicators (global warming, eutrophication, and acidification) [4]. This methodology is frequently used in life cycle assessment (LCA) studies worldwide.
The environmental impact factors used by that methodology are:
Carbon Footprint - A measure of carbon dioxide and equivalents, such as carbon monoxide and methane that are released into

the atmosphere primarily by burning fossil fuels.

Energy Consumption - All forms of nonrenewable energy consumed over the entire life cycle of the product.

Air Acidification - Acidic emissions, such as sulfur dioxide and nitrous oxides, which eventually lead to acid rain.

Water Eutrophication - Contamination of water ecosystems by waste water and fertilizers, resulting in algae blooms and the eventual death of plant and animal life.

In the end we create a Microsoft Word document that summarizes the results of the current and baseline environmental impacts, as seen in figure 8.

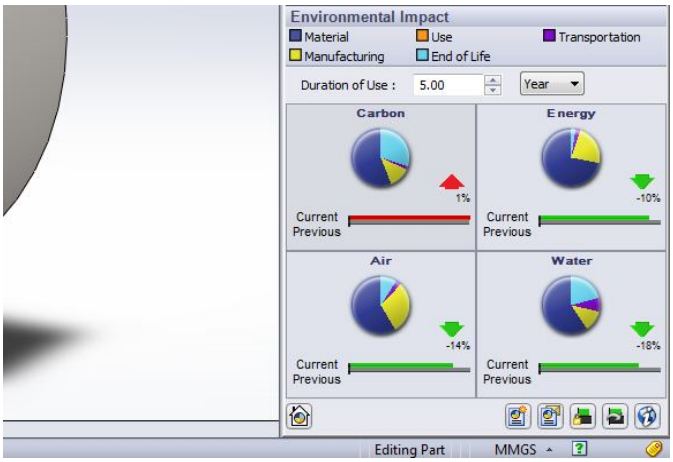

Figure 7. Environmental impact dashboard

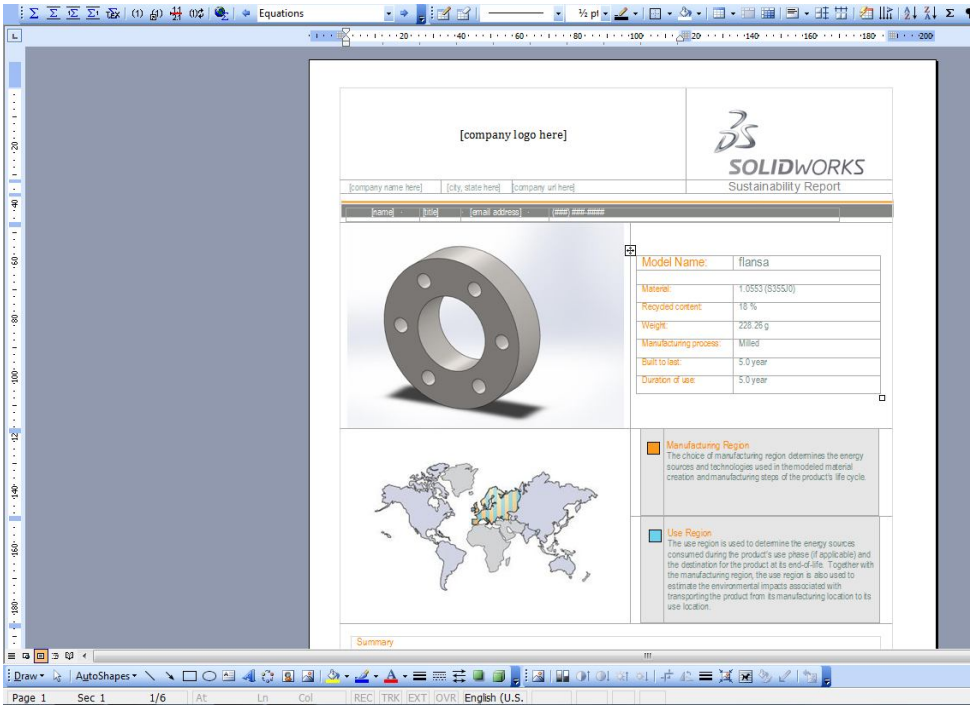

Figure 8. Sustainability report

3. CONCLUSIONS

As it was presented, SOLIDWORKS Sustainability provides real-time feedback on environmental impact factors. Results appear in the Environmental Impact Dashboard, which updates dynamically with any changes.

By following the steps and the settings described in this paper, we have performed a study of sustainability of a designed part, and by various modifications of options we have checked the global impact. This is useful to compare with experimental results or for better sustainability of products we have designed.

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