A new SUV conceived by Stylistic Design Engineering (SDE)

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Abstract

Stylistic Design Engineering (SDE) is an engineered method developed for creating a structured way to realize Car Design Projects. SDE is composed by the following steps: (1) Stylistic Trends Analysis; (2) Sketches; (3) 2D CAD Drawings; (4) 3D CAD Models; (5) Rendering; (6) Solid Stylistic Model (defined also styling maquettes). In the present paper, SDE is applied to a new SUV, in particular to a new possibility of launching a new FIAT Campagnola, an off-roader that was very successful in the 1950s - 1970s. This project deals with the external redesign of Fiat Campagnola. It has been carried out using various design technologies and methodologies that will be further explained in details, such as the Pininfarina method, the QFD (Quality Function Deployment) method, Benchmarking and Top Flop analysis. The work has been organized according to different phases. At first it has been studied the Fiat style, an essential step to understand better the features of the brand and also the main characteristics carried out during the decades. Later we carried on with the phase of the freehand sketches, being inspired by what was previously learned in every single step of study. This phase continued until a satisfactory form was found by analyzing and discarding the various proposals of the various types of style. Once the proposal was choosen, then the three-dimensional shape was obtained and on which it was possible to evaluate proportions and dimensions, also thanks to rendering software. All the analysis methodologies required for the quality of the project mentioned before have been used during all these phases.

Keywords
Stylistic Design Engineering (SDE), Car Design, Design Engineering, SUV, QFD, Benchmarking

1. Research Objectives

The objective of this work is the realization of a car design project for a new version of the Fiat Campagnola; the first version is from the year 1951 (Fig. 1-2).

The reference segment (TARGET) was first identified through a QFD and Benchmarking analysis, and the car was established as belonging to the one of the off-road vehicles (4WD), of medium-high range, with seven seats; a market segment in great demand and today covered, as an example, by the 5th generation Discovery proposed from the Land Rover (Fig. 3-4).
The reason for choosing this project was mainly dictated by having observed an absence in the Fiat proposal in that segment: its only 7-seater and 4-wheel drive proposal is represented by the Fiat Freemont which however belongs to a different segment, much more oriented towards a family target and urban and road utilization (Fig. 5-6).

2. QFD Analysis

Quality Function Deployment (QFD) is recognized worldwide as the most powerful decision support tool in the product and service innovation contexts. The QFD uses calculation matrices, interviews and brainstorming sessions to improve understanding of Client Requests, correlating them with the New Products Development process. But the QFD is also a method of ordering the entire organization in an orderly manner towards the characteristics of the product that are most important for the customer.

Summarizing the definition of QFD, Quality Function Deployment:
- the QFD has as in its objective the excellence in the quality of a product or service, in the broadest sense of the term, assessed in terms of customer satisfaction / interlocutor;
- the QFD uses objective mathematical methods or at least as objective as possible (the subjectivity component is still present in the evaluations of the work team);
- the QFD is deployed throughout the entire process of product development, from market analysis, to design, to industrialization, to pre-production (the method can however and normally undergo variations or interruptions without jeopardizing the results up to that point reached);
- the QFD tries to correlate also and above all non-homogeneous contexts, for example the customer’s needs and the characteristics of the product, defined during the design phase;
- the QFD tries to involve all the company functions at an organizational level;
- the QFD ultimately helps the managers or members of a work team to make operational decisions and adopt the necessary compromises by providing a complete, clear and robust methodological path.

The seven questions through the QFD was developed are:

1) WHO: who uses the car?
User, average motorist interested in a comfortable and versatile means of use. Requirements obtained after the discussion: COMFORT - VERSATILITY - EASY TO USE - ADAPTABILITY.

2) WHAT: what do we need it for?
It serves to transport people; move both in the city and out; carry out daily and long-haul journeys. Requirements obtained after the discussion: CAPACITY - COMFORT - COMPACTNESS - MOBILITY - AGILITY.

3) WHERE: where is it used?
In and around the city, on the road and off-road with ample possibilities for use on rough terrain such as the mountains. Requirements obtained after the discussion: MOBILITY - VERSATILITY - AGILITY.

4) WHEN: when is it used?
In daily activities, work and leisure time. Requirements obtained after the discussion: VERSATILITY - CAPACITY - RELIABILITY - COMFORT.

5) WHY: why is it used?
It is used as a very versatile and polyvalent means of movement. Requirements obtained after the discussion: VERSATILITY - MOBILITY - ADAPTABILITY.

6) HOW: how is it used? Like any car. Requirements obtained after the discussion: EASY TO USE - AGILITY - MOBILITY - COMFORT

The QFD analysis is able to guide the design of the product through the choice and definition of the parameters that have been identified through the 6 questions that can be qualitatively discussed and that can guide the designer in his choices for the project of FIAT Campagnola.

In addition to the study of the main characteristics to be considered in the design of the FIAT Campagnola, it is necessary to take into account market competition and to do this we will use the Benchmarking.

### 3. Benchmarking and Top-Flop analysis

The benchmarking analysis was essential to strictly understand the surrounding market environment and to have a precise overview of the number of competitors, their characteristics, their strengths and weaknesses. Also vehicles having other prices and market segments, such as SUVs and crossovers, have been included in order to have a wider view of the current scenario, considering that the off-road vehicles are today a very small number. For this analysis, many parameters have been taken into consideration to get a more complete picture: from the overall dimensions, to the characteristic angles, getting through performance, consumption, height from the ground, fording capacity, up to the presence or absence of characteristics of an off-road vehicle such as the presence of reduced or differential blocks to bridges (Fig. 7).

After that, we passed on the Top - Flop analysis, calculating the resulting delta for each vehicle. The absolute winner of this analysis turned out to be the Land Rover Discovery, thanks to its different points in favor and only one against. According to the procedure, in the column of innovation on the right of the chart must appear the values that we want to assign to our product, and at the end, the result will have to be greater than the best of the competitors, in this case the Discovery. In this case deliberately this does not happen because the analysis is also based on data that we do not care if they are not necessarily on the top for our Campagnola, while innovation remains very high in general, and especially in the areas of our interest.

<table>
<thead>
<tr>
<th>MODEL</th>
<th>Land Rover Defender 90</th>
<th>Jeep Wrangler</th>
<th>Mercedes GLC 250</th>
<th>Bialaise Jimny</th>
<th>Land Rover Discovery 5</th>
<th>Jeep Renegade Trailhawk</th>
<th>Toyota Land Cruiser 5 porte</th>
<th>Fiat Freemont</th>
<th>New Fiat Campagnola</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEIGHT</td>
<td>200 cm</td>
<td>188 cm</td>
<td>164 cm</td>
<td>173</td>
<td>189</td>
<td>166</td>
<td>184</td>
<td>172</td>
<td>-</td>
</tr>
<tr>
<td>WIDTH</td>
<td>179 cm</td>
<td>189 cm</td>
<td>189 cm</td>
<td>163</td>
<td>207</td>
<td>180</td>
<td>188</td>
<td>188</td>
<td>-</td>
</tr>
<tr>
<td>LENGTH</td>
<td>404 cm</td>
<td>433 cm</td>
<td>465 cm</td>
<td>365</td>
<td>497</td>
<td>423</td>
<td>484</td>
<td>491</td>
<td>-</td>
</tr>
<tr>
<td>GROUND HEIGHT</td>
<td>32,3 cm</td>
<td>25,6 cm</td>
<td>18,1 cm</td>
<td>24,1 cm</td>
<td>36 cm</td>
<td>21 cm</td>
<td>21,5 cm</td>
<td>18 cm</td>
<td>36 cm</td>
</tr>
<tr>
<td>ANGLE ATTACK</td>
<td>40°</td>
<td>26°</td>
<td>21,7°</td>
<td>32°</td>
<td>34°</td>
<td>30°</td>
<td>31°</td>
<td>26,2°</td>
<td>40°</td>
</tr>
</tbody>
</table>
From the beginning it was important to highlight how the new FIAT Campagnola should have been a real off-road vehicle, and not simply a SUV (Sport Utility Vehicle), this is for "naming reasons" (the old Campagnola was a genuine off-road vehicle and its memory is still very alive among the fans) and for reasons of market positioning.

### 4. Materials & Methods

<table>
<thead>
<tr>
<th>OUTPUT CORNER</th>
<th>47,1</th>
<th>51°</th>
<th>22,1</th>
<th>24,8</th>
<th>40</th>
<th>27,5</th>
<th>34°</th>
<th>25°</th>
<th>38,5</th>
<th>31°</th>
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<td>DOSE ANGLE</td>
<td>31°</td>
<td>36°</td>
<td>36°</td>
<td>38°</td>
<td>38°</td>
<td>38°</td>
<td>34°</td>
<td>32°</td>
<td>-</td>
<td>31°</td>
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<tr>
<td>POWER (CV)</td>
<td>122</td>
<td>200</td>
<td>211</td>
<td>102</td>
<td>306</td>
<td>170</td>
<td>177</td>
<td>170</td>
<td>200</td>
<td>200</td>
</tr>
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<td>TORQUE Nm</td>
<td>260</td>
<td>450</td>
<td>350</td>
<td>110</td>
<td>700</td>
<td>350</td>
<td>450</td>
<td>350</td>
<td>450</td>
<td>450</td>
</tr>
<tr>
<td>Motor RPM (MAXIMUM TORQUE)</td>
<td>2000</td>
<td>2000</td>
<td>1200-4000</td>
<td>4000</td>
<td>1500/1750</td>
<td>1750</td>
<td>1600-2400</td>
<td>1750/2500</td>
<td>2000</td>
<td></td>
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<tr>
<td>FULL SPEED</td>
<td>145 km/h</td>
<td>180 km/h</td>
<td>222 km/h</td>
<td>140 km/h</td>
<td>209 km/h</td>
<td>196 km/h</td>
<td>175 km/h</td>
<td>184 km/h</td>
<td>190</td>
<td></td>
</tr>
<tr>
<td>ACCELERATION</td>
<td>15,6 s</td>
<td>9,7 s</td>
<td>7,6 s</td>
<td>12,2 s</td>
<td>7,5 s</td>
<td>8,9 s</td>
<td>12,7 s</td>
<td>11,1 s</td>
<td>9,5 s</td>
<td></td>
</tr>
<tr>
<td>ACCELERATION</td>
<td>-</td>
<td>16,9 s</td>
<td>15,9 s</td>
<td>18,3 s</td>
<td>15,3 s</td>
<td>17,6 s</td>
<td>18 s</td>
<td>16,1 s</td>
<td>-</td>
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<tr>
<td>BRAKING 100 - 0</td>
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<td>48 m</td>
<td>37,7 m</td>
<td>51,6 m</td>
<td>45 m</td>
<td>38,4 m</td>
<td>49,5 m</td>
<td>-</td>
<td>40 m</td>
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<td>CONSUMPTION</td>
<td>18,1 l/100km</td>
<td>7,4 l/100km</td>
<td>7,5 l/100km</td>
<td>2,1 l/100km</td>
<td>6 l/100km</td>
<td>11,97</td>
<td>25 l/100km</td>
<td>87</td>
<td>-</td>
<td></td>
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<tr>
<td>LUGGAGE VOLUME</td>
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<td>193/587</td>
<td>550</td>
<td>58</td>
<td>1137</td>
<td>351/1297</td>
<td>87</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>DIAMETER OF STEERING</td>
<td>14,3 m</td>
<td>12,5 m</td>
<td>11,3 m</td>
<td>10,6 m</td>
<td>12,7 m</td>
<td>12 m</td>
<td>12 m</td>
<td>11,2 m</td>
<td>11 m</td>
<td></td>
</tr>
<tr>
<td>MAX SUPERBLE SLOPE</td>
<td>100%</td>
<td>100%</td>
<td>75%</td>
<td>100%</td>
<td>100%</td>
<td>75%</td>
<td>95%</td>
<td>100%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>STEP IN FEET INCH</td>
<td>50</td>
<td>76</td>
<td>50</td>
<td>50</td>
<td>90</td>
<td>48</td>
<td>70</td>
<td>-</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>REDUCED GEARS</td>
<td>SI</td>
<td>SI</td>
<td>NO</td>
<td>SI</td>
<td>SI</td>
<td>NO</td>
<td>SI</td>
<td>NO</td>
<td>SI</td>
<td></td>
</tr>
<tr>
<td>DIFFERENTIALS FRONT and REAR LOCKABLE</td>
<td>NO</td>
<td>SI</td>
<td>NO</td>
<td>NO</td>
<td>REAR</td>
<td>NO</td>
<td>REAR</td>
<td>NO</td>
<td>SI</td>
<td></td>
</tr>
<tr>
<td>MAX TRAILER WEIGHT</td>
<td>1600 kg</td>
<td>1500 kg</td>
<td>2500 kg</td>
<td>2200 kg</td>
<td>3500 kg</td>
<td>1500 kg</td>
<td>3000 kg</td>
<td>1100 kg</td>
<td>2500 kg</td>
<td></td>
</tr>
<tr>
<td>STEP in cm</td>
<td>236</td>
<td>246</td>
<td>287</td>
<td>225</td>
<td>293</td>
<td>257</td>
<td>279</td>
<td>289</td>
<td>246</td>
<td></td>
</tr>
<tr>
<td>APPLE CARPLAY</td>
<td>NO</td>
<td>SI</td>
<td>SI</td>
<td>SI</td>
<td>SI</td>
<td>SI</td>
<td>SI</td>
<td>SI</td>
<td>SI</td>
<td></td>
</tr>
<tr>
<td>BLUETOOTH</td>
<td>NO</td>
<td>SI</td>
<td>SI</td>
<td>SI</td>
<td>SI</td>
<td>SI</td>
<td>SI</td>
<td>SI</td>
<td>SI</td>
<td></td>
</tr>
<tr>
<td>PNEUMATIC SUSPENSIONS</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>SI</td>
<td>NO</td>
<td>SI</td>
<td>NO</td>
<td>SI</td>
<td></td>
</tr>
<tr>
<td>PERMANENT INTEGRAL TRACTION</td>
<td>SI</td>
<td>SI</td>
<td>NO</td>
<td>SI</td>
<td>SI</td>
<td>NO</td>
<td>SI</td>
<td>NO</td>
<td>SI</td>
<td></td>
</tr>
<tr>
<td>NUMBER OF POSTS</td>
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<td>6/4</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>7</td>
<td>5</td>
<td>3</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>WEIGHT kg</td>
<td>1870</td>
<td>2044</td>
<td>1735</td>
<td>1203</td>
<td>2236</td>
<td>1460</td>
<td>2205</td>
<td>1874</td>
<td>2000</td>
<td></td>
</tr>
<tr>
<td>N. CYLINDERS</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>6</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>TRANSMISSION</td>
<td>6 gears</td>
<td>8 gears</td>
<td>9 gears</td>
<td>5 gears</td>
<td>8 gears</td>
<td>9 gears</td>
<td>6 gears</td>
<td>6 gears</td>
<td>9 gears</td>
<td></td>
</tr>
<tr>
<td>PRICE</td>
<td>32,000</td>
<td>46,790</td>
<td>49,000</td>
<td>22,500</td>
<td>69,800</td>
<td>35,550</td>
<td>55,000</td>
<td>35,000</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

**Fig. 7 Fiat benchmarking and Top – Flop analysis**
The study of this off-road model is based on the SDE = Stylistic Design Engineering, a design technique long used successfully in the industrial field, and in particular in the field of car design. SDE is based on a series of steps to be performed in sequence and that lead the designer to obtain a product with the best possible features and fully corresponding to the project objectives.

The SDE methodology is born from the union of the work of the engineer Lorenzo Ramaciotti and of the Pininfarina design company; let's see now the different steps of the SDE methodology.

**4.1 Stylistic Trends Analysis**
SDE methodology starts with an analysis of stylistic trends, which studies the trend of the company's style throughout its history.

**4.2 Sketches**
After the Stylistic Trends Analysis, follows the sketching phase, which is essential for putting the first ideas and forms of the product on paper, up to satisfactory sketches.

**4.3 2D Drawings (Orthogonal Tables)**
Proceed with the 2D drawings of the best sketches, in order to best evaluate the dimensions and proportions of the individual parts and assemblies.

**4.4 3D CAD Models**
Subsequently the 3D models of the parts and assemblies are realized on the basis of the 2D drawings.

**4.5 Rendering**
3D models are rendered through appropriate software.

**4.6 Solid Stylistic Model**
At the end, we proceed with the realization of a Solid Stylistic Model (normally called Maquette), which allows us to evaluate the model's lines and proportions in a tangible manner.

All the steps to follow of the SDE methodology are summarized in fig. 8

![Fig. 8 summary diagram of SDE methodology](image)

**5. Application of the SDE to the new model of the FIAT Campagnola**
The different steps of the methodology will be illustrate through the development of a new model of the FIAT Campagnola
5.1 Stylistic Tendency Analysis

The work begins with the study of corporate stylistic trends. It is one of the most important phases of the whole process, because its bad or partial success will irreparably damage all the phases that will follow in the design process. The study is carried out taking into consideration the stylistic path of the car company of the model that it intends to develop, the key moments both positive and negative and that act as a common thread in its evolution, and in general all the steps that led it to conceive your own "company style" to the present day. In this first phase, the second phase of the study (that of sketching), can be partially anticipated (Fig.9).

In fact, during the analysis of the style of the cars considered historical and more important for the car company, it is helpful to redesign these models by performing sketches with different views and placing particular attention to the lines and to the elements that they made them significant. In Figure 10 - 13 the stylistic evolution of FIAT car models has been described and the most significant lines and features were highlighted.
Fig. 11  stylistic evolution of FIAT car models

- tense but soft lines
- imposing front with double round headlights

Fig. 12  stylistic evolution of FIAT car models

- strong lines, reduced volumes
- front and back with particular cut
- contrast of round lines (headlights) with tense and decisive lines

- vertical back cut
- rectangular front with rectangular headlights

- vertical back cut
- rectangular front

- sharp lines
- front with rectangular elements
5.2 Sketches

The purpose of this work phase is to provide new stylistic ideas for the product. It is precisely at this stage that the designer analyzes the type of stylistic trends that the customers address themselves. Today it is possible to say that the main stylistic trends can be summarized as:

- Advanced Design
- Natural Design
- Stone Design
- Retrò Design

Style trends can keep separate or merge into a mix of different styles simultaneously present. An example of the different stylistic trends relating to a common element such as a chair is shown in Figure 14.

In the study of the new FIAT Campagnola, the following sketches relating to the different trends can be considered (Fig. 15 – 18):
Fig. 15  sketches FIAT Campagnola: Advanced Design

Fig. 16  sketches FIAT Campagnola: Natural Design

Fig. 17  sketches FIAT Campagnola: Stone Design
The sketches are drawings that point to the creative aspect of Design and do not care about the dimensional and technical aspect. The Tools used in sketches are sheets of paper and pencils. Various sketches are then made for each of the different stylistic proposals, Advanced, Natural, Stone and Retrò, up to having a rather complete picture of the innovative product model (Fig.19 - 23).
Fig. 20 sketches FIAT Campagnola: Proposal 3 and 4

Fig. 21 sketches FIAT Campagnola: front view

Fig. 22 sketches FIAT Campagnola: rear view
The proposals considered less suitable for the model are discarded, and only the sketches of two remaining style competitors remain. These two competitors are then developed and carried forward to the point of discarding one (Fig.24).

The model that remains is modified and perfected until reaching a stylistically consistent and satisfactory level (Fig.25).
5.3 2D Drawings (orthogonal tables)

After selecting the sketch of greatest interest, it is time to transform it into a rigorous 2D computer drawing. This is a very important step because in freehand sketches often the forms tend to be very "emotional" and obviously out of proportion. The 2D drawings (orthogonal tables), being very rigorous, makes the lines much more realistic and allows you to check the proportions, so as to judge the model for what it really is. Consequently, compared to the sketches, the wheels will be smaller and narrower, the windows wider and in general the line less stringy. In this way, being able to have a clear overview, it will be very easy to understand the possible weaknesses of the product and which are the disproportionate elements.

The appropriate changes are then made in the necessary areas and the 2D drawing is updated and meticulously observed again. This procedure goes on many times (iterative process) until complete satisfaction is reached in terms of lines, proportions and dimensions. When the 2D drawing, seen from all angles, is satisfactory, we begin to see the final aspect of the product and then move on to the next phase, the 3D modeling.

The Tools used in 2D drawings are, for example, the software Autocad from Autodesk (Fig. 26).

5.4 3D CAD Models

At this point we move from the 2D drawings to a 3D model of the project. Exactly as it happens when sketches are transformed into 2D drawings, even in the transition from 2D drawings to the 3D model, the shapes of the model will appear not completely coincide with the lines of the 2D drawings. Then completed the 3D model, the proportions will be evaluated from every possible point of view, and any dimensional and stylistic weaknesses. Also in this case, therefore, the 3D model will undergo several transformations (iterative process), both to restore the correct proportions, and to make the style concepts born in the sketching phase clear and that are often lost in the rigorous stages of 2D drawings. In this phase, the model is also detailed, with the forms that are increasingly refined (Fig.27 - 28). The Tools used in 3D CAD models are, for example, the software CATIA from Dassault or NX from SIEMENS.
5.5 Rendering

At this point the important phase of communication takes place, that is the transmission of the coherence, organicity and beauty of the lines drawn also to those who did not take part in the project. The rendering is the digital representation that simulates the material of the various components of the product, thus making the three-dimensional models realistic and also simulating the insertion of the new 3D model in one or more real environments; in this way it is possible to make color choices and appropriate color combinations, also taking into account the scenarios of use of the product in question (Fig. 29 - 33). The Tools used in Rendering are, for example, V-red, 3D Studio Max, Cinema 4D.
5.6 Solid Stylistic Model

Thanks to 3D modeling, it has been possible to have a realistic form of the project in the realistic digital environment. However, the display of the 3D model on the monitor has some limitations, such as the correct display and definition of the curvature of the surfaces and the always very difficult management of the proportions.

It is necessary to realize a physical model of the project, first in scale, then in reality (scale 1:1). For the realization of the scale model in recent years, thanks to the growing diffusion of rapid prototyping, many technologies are available to designers, among which 3D printing stands out in all its possible technological variations.

Once the model is in your hand, you can confirm the goodness or otherwise of the shapes drawn, and changes and corrections can be made until the desired shape is reached (Fig.34).

The Tool used in Solid Stylistic Model is, for example, the 3D printing.

Once the definitive forms of the product have been obtained, a full-scale model (scale 1:1) can be made of Clay (synthetic clay), Ureol (epoxy resin), Polyurethan or Wood to assess the true shapes and proportions.

Thanks to the workability of the material, changes can be made directly to the model on a real scale, even with complex geometries, and its effectiveness can be assessed immediately. These changes can then be scanned and imported directly into the 3D file, greatly speeding up the workflow and its effectiveness. At the end of all this procedure, we therefore have the certainty of having created a model with coherent shapes and proportions and in line with what we had imagined.

6. Future Developments

- Switch from Sketch to Sheet of Paper with Pencil to Digital Sketching (2.5 D), for example, U-Make, a 3D Modeling CAD for tablet (Fig. 35).

- Switch from Solid Stylistic Model created with Polyurethan, Ureol, Clay and Wood to 3D Printing, Augmented Reality and Virtual Reality (Fig.36).
7. Conclusions

Stylistic Design Engineering (SDE) applications reached the given targets:

- The analysis of the most convincing stylistic trends was performed.
- A new stylistic idea for a off-road vehicle has been provided.
- As a final result, a Solid Stylistic Model (Maquette) was created.

Also, new development perspectives for Stylistic Design Engineering (SDE) have been provided.

References


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Biography / Biographies

Leonardo Frizziero is a Senior Assistant Professor of the Department of Industrial Engineering, at Alma Mater Studiorum University of Bologna. He promotes the scientific issues related to the Mechanical Design and Industrial Design Methods (CAD 2D, 3D, Advanced Design, QFD, TRIZ, DFSS, DFD, DFA, ecc.). In 2005, he was recruited by Ferrari Spa, as project manager of new Ferrari cars projects. In 2009 he came back to University, obtained the Ph.D. degree and started collaborating with the Design and Methods Research Group of Industrial Engineering.
becoming Junior Assistant Professor in February 2013 at DIN of AMS University of Bologna. He teaches and follows researches in the design fields, participating at various competitive regional, national and international research projects. Since 2018 he has been a Senior Assistant Professor. Since 2017 he is qualified Associate Professor of Design and Methods of Industrial Engineering (ING-IND/15). Prior to the role of university professor, he held relevant positions for some industrial companies.

Giampiero Donnici is a Ph.D student in Mechanical Sciences and Advanced Techniques at Alma Mater Studiorum University of Bologna. In the academic field he deals with scientific issues related to Design Methods (CAD, QFD, TRIZ, 3D Printing). From 1999 until today he has worked as a mechanical designer, particularly in the sectors of agricultural machinery and automatic machines. He also worked as a consultant in the fields of PLM and CAD-CAE systems. Companies where he worked: Orsi Group s.r.l., O.A.M. S.p.A., Sacmi Imola s.c. Companies for which he has worked as a consultant: Pet Projecta s.r.l., Sacmi Verona S.p.A., Sacmi Filling S.p.A., Sacmi Packaging S.p.A., Protesa S.p.A., Tonelli Group S.p.A., Tiesse Progetti s.r.l., Compomac s.r.l. From 2013 he has held teaching tutor positions in Mechanical and Automatic Design courses at the University of Bologna.

Alfredo Liverani is a Full Professor and Chief of Mechanical Engineering Degree Course at the Department of Industrial Engineering of Alma Mater Studiorum University of Bologna. Prof. Alfredo Liverani is a member of CbEM (Computer-based Engineering Methodologies) research group and he is involved in several activities related to Computer Aided Design (CAD), Computer Graphics, Virtual and Augmented Reality. In detail he focuses on real-time visualization and interaction with particular attention to mechanical, aeronautical applications and also Industrial Design. Surface modelling, reverse engineering, mesh generation (FEM) and manipulation, virtual prototyping and live simulations are fields investigated in the several publications available at http://diem1.ing.unibo.it/personale/liverani.

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