www.arpnjournals.com

METHODOLOGY FOR AESTHETICAL DESIGN IN A CITYCAR

Leonardo Frizziero and Alessandro Freddi
Department of Industrial Engineering, Alma Mater Studiorum University of Bologna, Viale Risorgimento, Bologna, Italy
E-Mail: leonardo.frizziero@unibo.it

ABSTRACT

The present work aims to indicate a methodology of "design for aesthetics", through the realization of a particular city-car body. We should realize a good looking car, without forgetting the importance of mechanical and economical aspects. The result we have got is very interesting; in fact the city-car obtained is a sum of beauty, economics and intelligence. The method followed is very similar to those methods used by the most famous firms of design products, just like Pininfarina, Giugiaro Design, Bertone, etc. This method is illustrated in the paragraphs below.

Keywords: innovative methodologies, car design.

METHODOLOGY ADOPTED IN THE WORK

By analyzing the most famous design firms standard specifications, we have understood what methodology we had to follow to design the body of our city-car [1, 2, 3].

This method is composed by the following steps, normally known as "Pininfarina-methodology":

a) realizing free-hand made sketches of the car: these sketches must represent more kinds of models, not only one. In this phase, it's important using imagination and fantasy and being able to draw very well.

b) transforming the free-hand made sketches into 2D technical drawings, indicating all the measures and the overall dimensions. It's important verifying the compatibility between the chassis, already projected, and the body we are going to project.

c) 2D technical drawings have to be turned into 3D CAD drawings, using a specific program to manipulate surfaces, just like Rhinoceros 3.0, 3dStudio MAX, Cathia, or similar ones. In this phase, we obtain the first tridimensional models of the cars realized before by hand. For this reason, now we are able to choose what car is the best one for us.

d) After choosing the best car and its 3D CAD model, we have to optimize the body of this vehicle considering mechanical and economical aspects. The end of this step is named "Styling Freeze": it means that the aesthetics of the car won't change further.

e) Rendering Pictures: the 3D model chosen has to be placed in a real environment, so we can see how our car is related with real things.

f) Prototyping: the last step of the work is to prototype the car, realizing a physical model.

RESULTS

The starting point was the chassis of City Bumper, already designed by other engineers [4]. It can be viewed below in Figure-1.
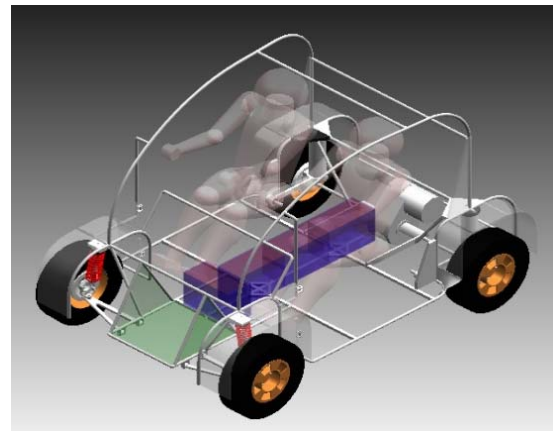

Figure-1. Chassis of the city-car: starting point.

Any activity is completed with starting and ending date, percentage of complement and so on, in order to maintain under control our projects development. This kind of project management (Figure-2 - Gantt Diagram) is very powerful for works like the present one, where some steps of the project needs to be repeated and compared [5].
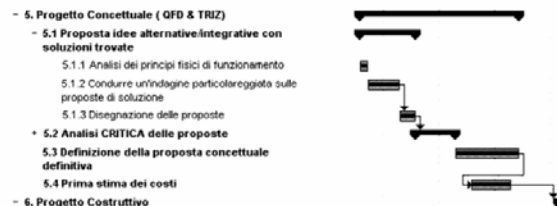
Figure-2. Gantt diagram to control activities.

Basing upon this model, we drew three kinds of city-car: the drafts were made by free hand before and then put on technical tables (you can see them in Figure-3).
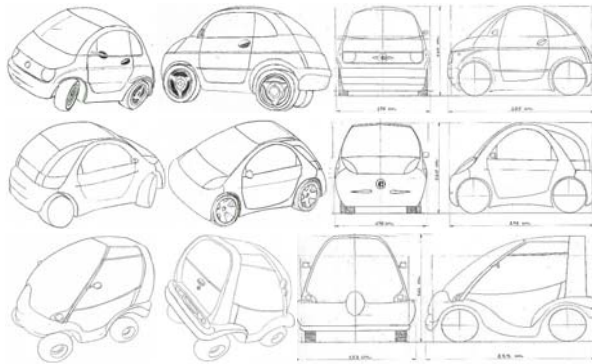
Figure-3. Three kinds of citycar: sketches and 2d drawings.

Third step was to transform these drawings into CAD models. The CAD models have been made using Auto Cad (for the first one) and 3dS Max (for the others). It's possible observing them in Figure 4-5-6.


Figure-4. First idea: retro model.

**Figure-5.** Second idea: new edge model.

Figure-6. Third idea: futuristic model.

Once we have realized CAD models, we have had to make some considerations about the costs of these cars for choosing the best one. In fact, studying the complexity of these prototypes bodies, we were able to know how expensive could be each one of them [5].

So we traced the following graphics about technical and cost characteristics of the three models, in order to choose the best solution; here the summarized results (Figures 7-8-9):
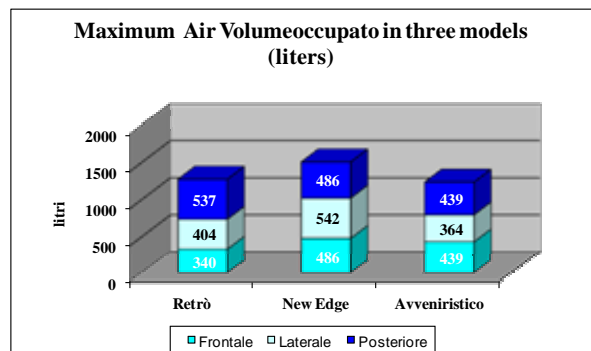
Figure-7. Comparison among maximum air volume contained.
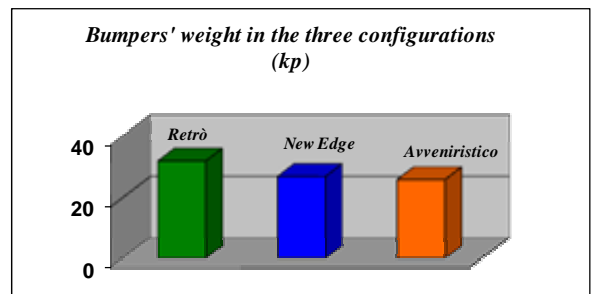
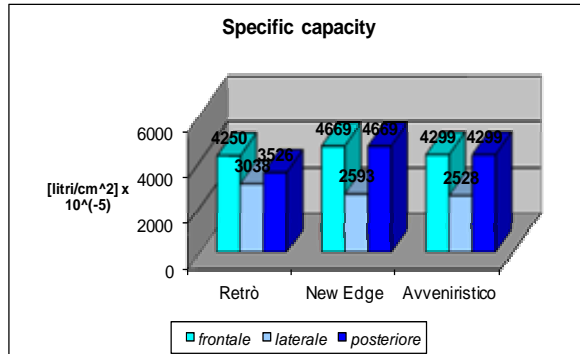**Figure-8.** Comparison among bumpers' weight.

www.arpnjournals.com
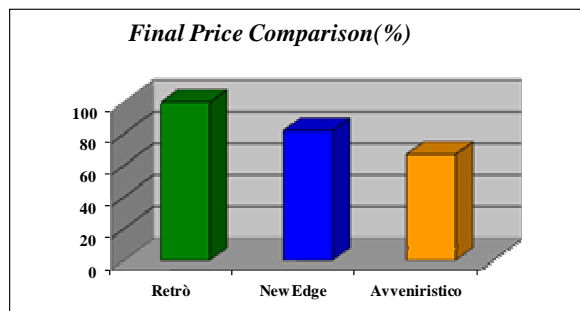

Figure-9. Comparison among specific capacity.

Figure-10. Comparison among final prices.

Referring to Figure-10, the graphics are in direct relation with the pictures (Figures 4-5-6): the first column on the left side matches the first car (Retrò model, Figure-4); the column in the centre matches the second car (New Edge model, Figure-5); third column matches the last car (Futuristic model, Figure-6).

So we can see that Futuristic model is the cheapest one and it is the model to choose.

Before starting with rendering and prototyping phases, it is necessary introducing other *costs optimizations* in the car chosen.

These optimizations are about *aesthetic and mechanical aspects* and can be summarized as you can see below [6-7]:

a) **doors removal:** in fact in car costs, the most relevant one is that of the doors;
b) **car windows with only one curvature:** more curvatures there are, higher the cost is;
c) **less curved panels**;
d) **no nose in the front side and symmetrical bumpers**;
e) **no differential gear:** we must move posterior wheels closer;
f) **no rack in steering system:** our city car has not to mimic a real car and so this cost is unusable.

We can observe these modifications in Figure-11:

Figure-11. Optimized model through costs and technical issues.

Our work can be concluded with the following steps:

a) Rendering Picture;
b) Prototyping of the model using CAM technology.

Rendering picture: It means to put our object designed (i.e. citycar) inside a real environment, in order to see how it is related with real things (Figures 12-13):

Figure-12-13. Rendering of the citycar.

CAM prototyping: Using a CAM software, i.e. Cimatron, together with a work-station composed by a personal computer and a milling machine (for example controlled by Fuzzy Logic System) [8, 9, 10, 11], we could realize a little polyurethane model (Figure 14-15), in order to better understand the actual proportions of the forms designed.
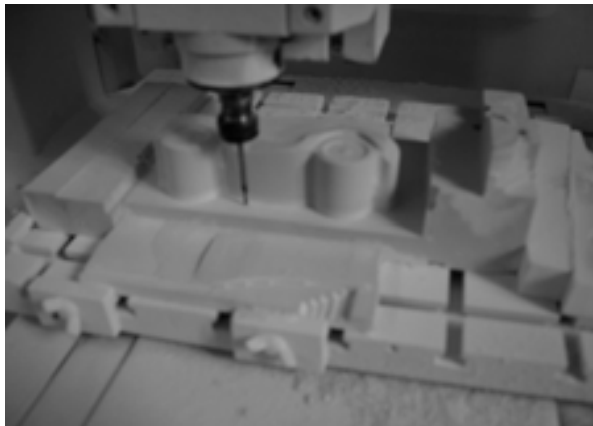
Figure-14-15. Prototyping of the model chosen.

CONCLUSIONS

A methodology [12-16] for car body design and its application has been developed. This methodology is based upon precise and well-defined steps that we have seen in the previous paragraph. These phases have shown us as we can obtain a good-looking, cheap, useful and "intelligent" vehicle.

REFERENCES

[1] M. Turinetto. 1991. Automobile: le Forme del Design. Progetto Leonardo, Bologna. [in Italian].

[2] M. Tovey and J. Owen. 2000. Design Studies. Elsevier Science Ltd, Great Britain.

[3] J. Pawlowski. 1969. Vehicle Body Engineering. Tidbury, London, UK.

[4] F. Cordella e G. Galeotti. 2002. City Bumper: da un'idea avveniristica allo studio di fattibilità. Tesi di Laurea, Bologna. [in Italian].

[5] Antony R.N., Hawkins D.F., Macri' D.M., Merchant K.A. 2001. Sistemi di Controllo, analisi economiche per le decisioni aziendali. McGraw-Hill, MILANO [in Italian].

[6] L. Piancastelli, L. Frizziero, G. Zanuccoli, N.E. Daidzic and I. Rocchi. 2013. A comparison between CFRP and 2195-FSW for aircraft structural designs. International Journal of Heat and Technology, ISSN 0392-8764. 31(1): 17-24.

[7] L. Piancastelli, L. Frizziero, N.E. Daidzic and I. Rocchi. 2013. Analysis of automotive diesel conversions with KERS for future aerospace applications. International Journal of Heat and Technology, ISSN 0392-8764. 31(1): 143-154.

[8] L. Piancastelli, L. Frizziero, E. Morganti and A. Canaparo. 2012. Fuzzy control system for aircraft diesel engines" edizioni ETS. International Journal of Heat and Technology, ISSN 0392-8764. 30(1): 131-135.

[9] L. Piancastelli, L. Frizziero and I. Rocchi. 2012. An innovative method to speed up the finite element analysis of critical engine components. International Journal of Heat and Technology, ISSN 0392-8764. 30(2): 127-132.

[10] L. Piancastelli, L. Frizziero, S. Marcoppido, A. Donnarumma and E. Pezzuti. 2011. Active antiskid system for handling improvement in motorbikes controlled by fuzzy logic. International Journal of Heat and Technology, ISSN 0392-8764. 29(2): 95-101.

[11] L. Piancastelli, L. Frizziero and E. Pezzuti. 2014. Aircraft diesel engines controlled by fuzzy logic. Asian Research Publishing Network (ARPN). Journal of Engineering and Applied Sciences. ISSN 1819-6608. 9(1): 30-34, EBSCO Publishing, 10 Estes Street, P.O. Box 682, Ipswich, MA 01938, USA.

[12] L. Piancastelli, L. Frizziero, S. Marcoppido and E. Pezzuti. 2012. Methodology to evaluate aircraft piston engine durability" edizioni ETS. International Journal of Heat and Technology, ISSN 0392-8764. 30(1): 89-92.

[13] L. Piancastelli, L. Frizziero and I. Rocchi. 2012. Feasible optimum design of a turbo compound Diesel Brayton cycle for diesel-turbo-fan aircraft propulsion. International Journal of Heat and Technology, ISSN 0392-8764. 30(2): 121-126.

[14] L. Piancastelli, L. Frizziero, S. Marcoppido, A. Donnarumma and E. Pezzuti. 2011. Fuzzy control system for recovering direction after spinning. International Journal of Heat and Technology, ISSN 0392-8764. 29(2): 87-93.

[15] L. Piancastelli, L. Frizziero, E. Morganti and E. Pezzuti. 2012. Method for evaluating the durability of aircraft piston engines. Published by Walailak Journal of Science and Technology The Walailak Journal of Science and Technology, Institute of Research and Development, Walailak University, ISSN: 1686-3933, Thasala, Nakhon Si Thammarat 80161. 9(4): 425-431, Thailand.

[16] L. Frizziero and I. Rocchi. 2013. New finite element analysis approach. Pushpa Publishing House, Far East Journal of Electronics and Communications, ISSN: 0973-7006, Allahabad, India. 11(2): 85-100.

[17] L. Frizziero, I. Rocchi: "New finite element analysis approach", Published by Pushpa Publishing House, "Far East Journal of Electronics and Communications", ISSN: 0973-7006, Volume 11, Issue 2, pages 85-100, Allahabad, India, 2013.

[18] L. Piancastelli, L. Frizziero, E. Pezzuti, "Kers applications to aerospace diesel propulsion", Asian Research Publishing Network (ARPN), "Journal of Engineering and Applied Sciences", ISSN 1819-6608, Volume 9, Issue 5, pp. 807-818, 2014, EBSCO Publishing, 10 Estes Street, P.O. Box 682, Ipswich, MA 01938, USA.

[19] L. Piancastelli, L. Frizziero, "How to adopt innovative design in a sportscar factory", Asian Research Publishing Network (ARPN), "Journal of Engineering and Applied Sciences", ISSN 1819-6608, Volume 9, Issue 6, pp. 859-870, 2014, EBSCO Publishing, 10 Estes Street, P.O. Box 682, Ipswich, MA 01938, USA.

[20] L. Frizziero, F. R. Curbastro, "Innovative methodologies in mechanical design: QFD vs TRIZ to develop an innovative pressure control system", Asian Research Publishing Network (ARPN), "Journal of Engineering and Applied Sciences", ISSN 1819-6608, Volume 9, Issue 6, pp. 966-970, 2014, EBSCO Publishing, 10 Estes Street, P.O. Box 682, Ipswich, MA 01938, USA.

[21] L. Piancastelli, L. Frizziero, G. Donnici, "A highly constrained geometric problem: The inside-outhuman-based approach for the automotive vehicles design", Asian Research Publishing Network (ARPN), "Journal of Engineering and Applied Sciences", ISSN 1819-6608, Volume 9, Issue 6, pp. 901-906, 2014, EBSCO Publishing, 10 Estes Street, P.O. Box 682, Ipswich, MA 01938, USA.

[22] L. Piancastelli, L. Frizziero, E. Pezzuti, "Aircraft diesel engines controlled by fuzzy logic", Asian Research Publishing Network (ARPN), "Journal of Engineering and Applied Sciences", ISSN 1819-6608, Volume 9, Issue 1, pp. 30-34, 2014, EBSCO Publishing, 10 Estes Street, P.O. Box 682, Ipswich, MA 01938, USA.