

Title: Cockpit Systems Design and Pleasure of Flying: From Conception to Realization

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Abstract

The subject of our study consisted of designing, using a method oriented towards the user's pleasure, a demonstration model (non airborne) for a French aeronautical group. In this article we will explain how we have designed an aircraft cockpit based on the pleasurable aspects of the pilot's activity. Then we tried to compare the notions of pleasure identified in the activity of flying a plane, aspects symbolizing the stronger sensations and the aspects of tranquillity and avoidance. We have attempted to formally translate this analogy, whilst respecting the design rules of ergonomics and current official aeronautical rules.

Key words: Design Product, Ergonomic design, Cockpit systems, Pilot experience and pleasure, Human Factors, Creativity.

Introduction

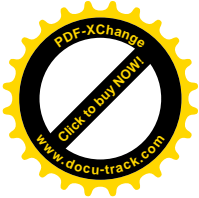
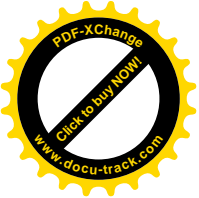
The wealth of products available on the market generates an increasingly strong consumer demand. In our industrial societies we are no longer satisfied that a product fulfils the function that it was designed for, we also want it to be a source of pleasure.

In our opinion creativity contributes fully to the innovation process and it is one of the most important factors in the economic growth [10]. The creativity and the process of innovation are complex and uncertain [5]. The market dynamics are getting fluctuating, requiring the companies to give competitive, clear and technological answers at a speed that has never been reached before [16]. Companies are faced with a complex and competitive market [7]. The mutation, deliquescence or expansion of this one are happening in a worrying way [13] because they are partly unpredictable. Thus a company has to define a strategy of resolution enabling it to keep, and if possible, increase its shares of the market. For that matter the only strong feature a company can rely on is the constant growing need to change [8].

Numerous industrial methods to aid creativity are based on processes of definition of objectives structured on the functionality of the products proposed by the enterprise on a mastered market.

However, these methods rapidly meet their limits. Firstly because they remain "stuck" on existing knowledge or on the existing product. Secondly, because very often, these methods only take into account a functional and utilitarian aspect of the product. Lastly they don't help very much in the shaping and physical translation of ideas into the creation of a product. In general they stop at a verbal formulation expressed in writing (e.g. the specifications).

In this article we will see how by taking into account consumer pleasure, the designer can by using a method integrating this aspect, encourage creativity. Our analysis was based on a project involving the production, using an approach guided by consumer pleasure, a "demonstration model" of the creativity of a French aeronautical group. This project had to be displayed at an internationally renowned aeronautical show, at Oshkosh in the USA.



Throughout this article we will present a creativity process articulated around the comprehension of design in relation to pilot pleasure.

Creativity is therefore the founder base to innovation [6], [17].

We consider that creativity can be defined as follow [1] :

- *“creativity is the ability of the brain to reorganise and express understandably the elements of the perception domain in a manner that is original and likely to give way to processes in any phenomenal domain”.*

We will demonstrate how this method can be generalised and can suit to general breakthrough innovations.

User pleasure, methodological approach

The products and the markets: for Laurent BACH and Gilles LAMBERT [4], the study of results a posteriori, of innovations enables to identify the factors leading to success, the factors without influence and the failure factors of innovations. The singularity of the product and the benefit that it contributes to the customer is an important factor contributing to success. This evaluation does not take into account the complex path of innovation. It offers us a "photograph" of the results after a few years. The criteria "Newness of the project or superiority/competition", "Adaptation to demand", "Benefits for the customer" are those that we try to satisfy by our approach based on user pleasure. Here below we take the step of linking customer benefit and customer pleasure.

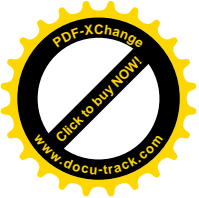
User pleasure

The "Petit Larousse" [15] dictionary defines pleasures as a, "sensation, an enjoyable feeling, contentedness, satisfaction (e.g. read with pleasure)." Pat JORDAN [9] defines it as, "emotional, hedonistic and enveloping all the practical benefits associated with products." Pleasure according to PLATON is a state of conscience that consists of two essential characteristics:

- **Fatality:** we cannot stop pleasure appearing. It is often the consequence of events of circumstances which we have no control over and these circumstances reveal or amplify our pleasure.
- **Relativity:** our pleasure depends on our past, on our education and our intimate character. For example: for a student who finds mathematics extremely difficult, encountering an equation generates a lot of anxiety whereas for scientists, formulas have an intrinsic beauty.

Pleasure and pain have been considered as opposing and complimentary notions. According to PLATON, pleasure cannot exist without pain, one is not possible without the other. Transposed to products and their consumption, one example could be the following: to use of a difficult electronic system is a challenge which gives a lot of pleasure once the difficulties have been overcome. But as Aristotle has indicated: a simple pleasure can also be found in free activities and in a great variety of activity. The Apple company, by the creation of Macintosh, and instinctive interfaces, made computers pleasant for users.

We will use two categories of pleasure: intellectual satisfaction to have overcome a difficulty and the pleasure of simple and varied usage. At the beginning of this study, we put forward the hypothesis that the pleasures expected by air pilots could vary according to the profiles of the latter. As a consequence, it was necessary to check that a typology of pilots existed and an adequate relationship between pilots and the different pleasures.



The qualitative questionnaire

The study of latent pleasures of French and American pilots seem to us to have been built in two phases. First of all, we carried out a qualitative questionnaire having as objective to define the items (cited here below) enabling to develop a quantitative survey protocol that we could apply (afterwards) to a representative sample.

Objectives of the qualitative questionnaire:

- Enable to establish a typology of pilots the target of our design
- Analyse current aeroplanes on the market in their functional environment (competition study)
- Evaluate the constraints and the needs imposed by flying an aircraft (notions of flying task and ergonomic of the cockpit)
- Discover the topics concerning the desires and potential pleasures (typology of pleasure)
- Determine the questions for the quantitative survey and determine a list of potential "answer" (refine the targets and their needs).

The topics covered are divided into three items presented here-below:

- Private environment of the pilot
- Pilot and flying
- Subjective appreciation of the aeronautical environment in situation (sat inside the aircraft taken as a reference for the set of pilots questioned)

This qualitative questionnaire concerns generic topics enabling to understand the socio-cultural environment of the pilot. It was used as a guide for semi-structured interviews recorded with the pilot in the aim of making emerge the themes to pose question on via a quantitative survey.

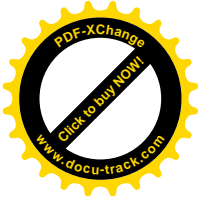
Quantitative survey

The analysis of the answers shows that pilot pleasure is first of all stimulated through the sensual perception in the cockpit. We organised our quantitative survey protocol according to a logical schema taking into account the five human senses.

The demonstration model resulting from the project should demonstrate the efficiency in terms of creativity of an approach centred on the appropriateness of the relationship between the typology of the pilot and pleasure. We articulated our Quantitative survey protocol according to three areas.

- **Identity:** This part enables to establish the personality of the pilots. It questions the pilot on his personality and his attraction to aeronautics.
- **Senses:** The aim of this part is to establish a sensual "cartography" of the pilots feelings in relation to existing cockpits.
- **Flying pleasure:** We would like this part to produce the pleasures felt by different modes of flying to enrich the topics involving de creativity. For this, we have raised with the pilot, specific flying situations. Our questions were orientated on the specific pleasure linked to these flying situations.

The quantitative survey protocol was carried out in English and in French on the basis of a spreadsheet directly linked to a database which automatically analysed the answers. The questionnaire could therefore be put online on aeronautical sites. The response time to the protocol varies between 15 and 20 minutes.



Analysis of quantitative survey protocol

The determination of the profiles of pilots whilst/faced with flying

The segmentation of the pilot population consists of discriminating their cognitive processes. New, we establish a precise and shared definition of the basic concepts. Nevertheless, it seemed to us to be necessary to cross this method using another approach based on cognitive criteria enabling the segmentation of populations studies according to their psychological parameters. The results of the segmentation by typology enabled us to obtain six items which were representative of the pilot population the three categories of expectations.

Pilot typology

- Robinson - calm and serenity of flight,
- Tarzan - adventure and discoveries,
- Schumacher - high-sensation seeking pilots,
- Adam - cross-country and leisure flight course,
- Mac Gyver - mechanical knowledge of aircraft,
- Saint Exupéry - historic and commercial flight aspects

Three expectations categories:

- expectations linked to the attitudes towards nature,
- expectations linked to attitude towards flying,
- expectations linked to a passion,

Going from conceptual aspects to the physical demonstration model

The creativity phase for the cockpit design started in February for a show planned for July at the Oshkosh Show. In addition the coherence of our approach could not avoid carrying out a semiological analysis of the plane which was going to integrate our cockpit.

We segmented the cockpit in sub parts and adapted these to the specific expectations of the pilot whilst ensuring the coherence of the product. We also introduced into this process, a consideration of the culture of the country where the show was taking place (USA – Oshkosh). All of the cockpit was re-thought, nevertheless for this article we will base our discourse on the example of the seat. After analysis we designed a seat enabling the sporty pilots (Schumacher typology) to better feel the movements of his aircraft. This seat also had to stimulated sensations of calm and escape for the pilot looking for escape (Robinson typology).

In order to do this we have first of looking for the activities well-known such as those which involved the same strong sensations of calm and escape. Next, we refined our approach by listing the expectations using transposable means of transport:

- car,
- Sailing/boating (sail or motorised),
- Surfing on snow or water,
- Bicycle,
- Motorcycle riding
- Roller-skating,
- Horse-riding.

We consider that taking competition as a reference as S. SHIBA [18] does in "design listening to the market", enables to make a product « me-to » but true innovation must find other driving forces.

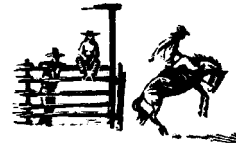


Illustration n°1 : high sensation.

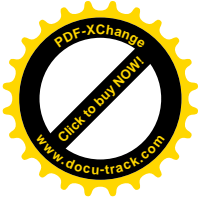
We are principally interested in horse-riding and motorcycle riding which presented requests nearest to air manoeuvres according to the six degrees of liberty with the search for the same pleasures (research of sensations and escape). Let us remember that we are subject to an aircraft structure. We don't envisage for this project to put forward for example, a flying position involving "standing up" as for the case of surfing.



Illustration n°2 : notions of calm and escape.

We have described our research by image-icons. LEE & HARADA [11], [12] have shown that the choice of such an approach enabled to convey objective information which stimulates creative reasoning, to the designs and customers. Image-icons are in the present case intermediate objects of conception [14]. This formalizations enables at the same time to stimulate the creativity of groups [3] and to express in an objective and subjective way the latent expectations of the user-to-be [2].

The position allowed by the equestrian saddle or by a motorcycle seat offers the human being an excellent maintenance by a mastered pressure from the legs, on the flanks of the

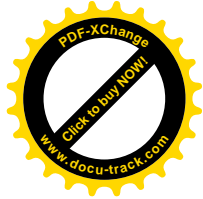


horse or the motorcycle. By this fact, it enables a perfect feeling of the movements of its "mount".

We ensured that these same activities could symbolise the notions of calm and escape.

The horse-rider holding reins, nonchalantly pressing on the pommel of his saddle, steers his mount. This relaxed position enables an adapted management of reactions. In the phases of calm evolution, the muscles are relaxed, whilst remaining available to a potential emergency situation. The conjunction of the posture of the chest and the specific seated position of the horse-rider equates with the specific expectations of the typology of the sporting person wanting to link the movement of his aircraft and the typology of pilots near to nature wanting to evolve in harmony with his aircraft in a pleasant environment.

We have tried to translate physically (cf.: following page) this study, whilst respecting the regulations of ergonomics, the regulations in vigour in the field of aeronautics, the particularity supposed of the USA culture and without falling into the trap of an unsound and superficial analogical approach.



Motorcycle USA



Calm and Escape



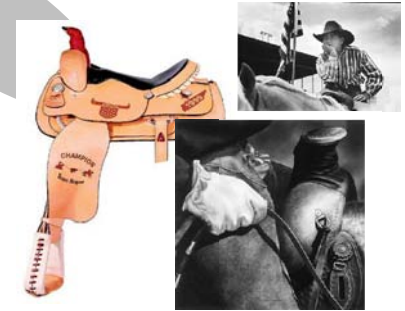
High sensation



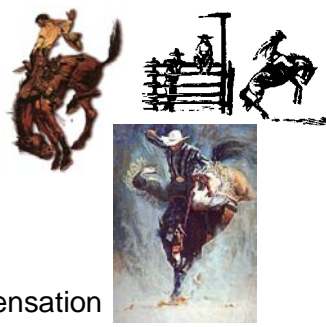
Saddle



Saddle Concept Schumacher/Robinson



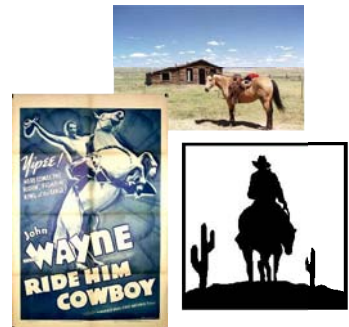
Saddle



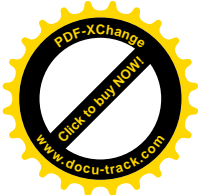
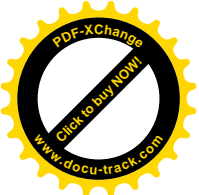
High sensation

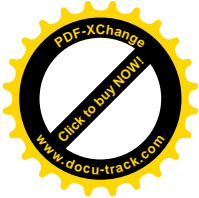


Calm and Escape



Equitation USA





Discussion

First of all, we think that our approach is by its nature applicable to other areas necessitating a creative approach. Our approach "Typology of customer pleasure", is decomposed in sub-phases equipped with generic tools such as the qualitative and quantitative surveys both based on extremely rigorous protocols. It is in this way that we affirm that our approach can be extrapolated to product design in general.

Next, our approach offers a specific characteristic distinguishing it from current approaches. The fact that we tackle design by user pleasure enables us to put forward concepts playing down the usual design criteria. Lets us take an example to explain our argument. The study of an automobile adapted to the pleasure expectations of the "Schumacher" typology could lead us to designing a vehicle whose road holding would be reduced, this to encourage the skids on corners. This goes against current security constraints.

Finally, the results of our study are exclusively from the area of object connotations. They were collected via open interviews with 35 visitors to the Oshkosh show.

- 78% of visitors noticed, quickly the specific design features of the seat,
- 87% made a comparison with the motorcycle or equestrian saddle,
- 95% consider the seat to be comfortable and the posture to be efficient,

Nevertheless, from the point of view of scientific research, these results don't appear to us to be robust. First of all, because the size of the sample is not sufficiently representative. Next, because the survey protocol was not able to be mastered/carried out throughout the Oshkosh show, the visitors came for their pleasure not to reply to a survey. And finally, because we are not capable of isolating the element observed (the seat) from the rest of the other new cockpit features.

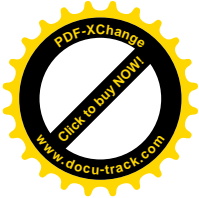
We make the suggestion that you read this article as the beginnings of an area of research where there is a lot of groundwork to do but which can be generalised to all types of product because this method uses quantitative and qualitative protocols mastered as well as an analogy reasoning.

We now work on several axes of development:

- The search for pleasure to try to classify the users into categories of the pleasure sought after,
- The crossing of the pleasures with all the other sources of innovations (e.g. technological, sociological, cultural innovation)

And in the domain of aeronautics:

- The development of a partnership, via an American University, with NASA, for the study and production of a cockpit destined for a specific and growing population of pilots.
- Design on an existing aircraft of a new cockpit in partnership with an American ex fighter pilot having been involved in aeronautics in South Africa. The prototype will be copied in South Africa which will enable us to carry tests during flight.



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