Tan, C.F., Chen, W. and Rauterberg, M. "Creative thinking of design and redesign on SEAT aircraft cabin testbed: a case study". 14th International Conference on Thinking, Kuala Lumpur, Malaysia, pp. 122-131, 22-26 June 2009. (ISBN 978-983-41184-5-7)

Intuitive thinking of design and redesign on innovative aircraft cabin simulator

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Abstract

In this paper, the intuition approach in the design and redesign of the environmental friendly innovative aircraft cabin simulator is presented. The simulator is a testbed that was designed and built for research on aircraft passenger comfort improvement of long haul air travel. The simulation consists of an aircraft cabin, an inventory section, a control section and a simulation section. During the design and redesign of the simulator, intuition of the designers was played the important role for the success of the project.

1.0 Introduction

Testbed is a platform on which an assortment of experimental tools and products may be deployed and allowed to interact in real-time. Successful tools and products can be identified and developed in an interactive testbed. A testbed also can be defined as an environment that is created for testing and validating purpose. The aircraft cabin simulator is a testbed that used for European Project SEAT (Smart tEchnologies for Stress free Air Travel). The SEAT project aims to develop a new radical approach through integration of cabin systems with multimedia features. The aircraft cabin simulator is fully designed and built by us. The simulator consists of a small scale cabin-like testing platform, an inventory section, a simulation section and a control section. The built up size for the simulator is 227 m^3. The interior of the aircraft cabin consists of an economy class section, a business class section, a galley and a lavatory. Each passenger seat and the lavatory are provided with a personal entertainment touch screen monitor. An inventory section is used to store the testing related equipments. A sky-like projection environment is created at the external location. In addition, the simulator is built with an innovative low-cost motion platform. The motion platform is used to simulate the flight environment such as taxi, taking off, turbulence, descending and landing. The control section is fully equipped with a state of art computer system that is used to control and monitor the simulator remotely. The aim of the paper is to describe the intuition approach in the design and redesign of the aircraft cabin simulator.

2.0 Intuitive Thinking

The fact that many people regularly make decisions based on 'gut feel' or intuition is well known. These intuitive thinkers experience more breakthroughs, have greater knowledge, experience more clarity and certainty when making decisions, have more empathy and understanding of other people and lowered stress levels. People often balance analysis with their intuition or 'gut feeling'. This practice increases when there is too much information available and too little time to make a considered decision.

Intuition regarded by many as knowledge accompanied by superior pattern recognition is an invaluable aid for all. Science informs us that intuition is much more than cognitive processes in the brain (Mara, 2009).

Mara (2009) defines Intuition as a process by which information normally outside the range of cognitive awareness is sensed and perceived in the body and in the mind. The entire psycho-physiological system is involved. This feeling of absolute certainty or knowledge of an event or situation distant or about to occur can be relied upon to provide knowledge, clarity and wisdom beyond what is available to you from the conscious mind.

3.0 Smart Technologies for Stress-free Air Travel

The SEAT project is funded by the Sixth Framework Programme of the European Commission; Priority “Aeronautics and Space” that focuses on upstream questions of an integrated system in the aircraft cabin that i) creates a healthier and more comfortable cabin environment and ii) provides a high level of customer focused services that simulate home and office environment. The SEAT project aims to develop such new radical approach through integration of cabin systems with multimedia features. The project is focused on [SEAT, 2006]:

- creation of a “smart seat” that adapts climatic characteristic to the passenger physiological status;
- integrated physiological monitoring system with health alert options;
- development of a system for active/passive vibration dampening incorporating smart textiles;
- development of interactive entertainment; and
- development of fully integrated cabin passenger services.

Technical University Eindhoven, contribute as the Work Package 4 (WP4) leader. The aims is to develop a new intelligent in-flight entertainment system where both entertainment contents and entertaining interactive patterns are sensitive to passengers’ personal information and different fly phases to address the passenger's personalized entertainment requirements.

4.0 Design Process of Aircraft Cabin Simulator

A design process shown in Figure 1 is used in the development of the aircraft cabin simulator. At the product planning stage, a market survey about the current aircraft cabin simulator and market were conducted. The design knowledge and experience of the designer are also important as an input to the planning stage. Various type of aircraft cabin was found as the input of design idea. The location for the simulator was inspected and measured. After that, concept of the simulator was generated based on the project requirements and constraints. During the concept generation, brainstorming and minds mapping method were used. Figure 2 shows the first draft of the concept generation process.

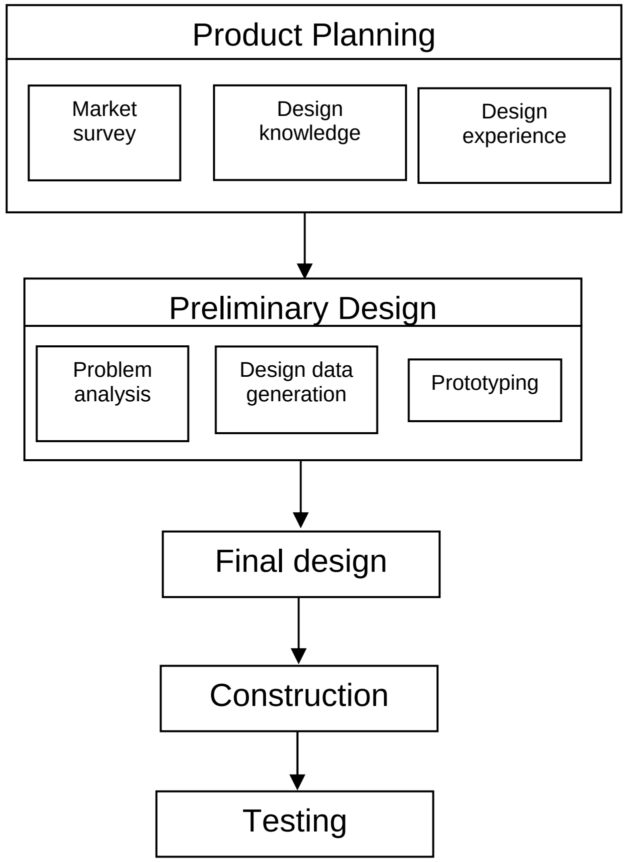

Figure 1: Simplify design process of SEAT simulator

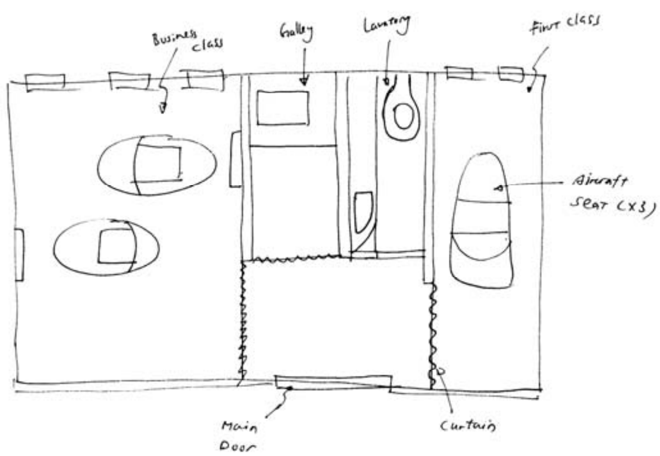

Figure 2: First draft of conceptual design

For the prototyping stage, computer-aided design (CAD) was used to generate a three dimensional (3D) view of the simulator. Intuition and creativity approach was used in this stage. From the CAD drawing, it was found that the arrangement of the business class section and first class section is not according to the real aircraft cabin arrangement. The simulator setup was redesigned and the CAD drawing was redraw subsequently. A new location for the simulator and its requirement was given. Under the new requirement, a business class section and economy class section were setup. The lavatory was rearranged and placed beside the business class area (Figure 4). Due to the new setup, the measurement of the aircraft cabin simulator was changed. The intuition of the designer is important at the redesign stage. First, the new location for each area was designed according to the new requirement and future needs. Second, the designer must know the area like business class and economy class able to place the aircraft seat into it. Third, the designer must know how to transport the equipment and seat into the simulator.

During the construction stage, the aircraft cabin simulator was built. Before the construction, the designers need to estimate the quantity and quality of the building materials for the simulator. The good intuition and estimation skill of designers would be able to save the production cost and time. After the construction was completed, the simulator was tested for durability and safety.

4.1. Preliminary Design of Aircraft Cabin Simulator

The SEAT simulator was constructed from a mixture of high quality and durable materials such as aluminum, steel, composite and wood. Due to the short timeline of the project and to minimize costs, the final material for the structure is aluminum, wood and medium density fiberboard (MDF) materials. All material was finished with primer and appropriate paint finish to the common aircraft interior color scheme. The structure and the floor are constructed in wood to provide the required fuselage strength & profile. The size of simulator is 36 m^3. The size was constraint by the project funding and space that is available. The challenge for the simulator construction is to build in low cost and able to simulate a real flight condition. Figure 3 shows the conceptual design of the simulator. Figure 4 shows the plan view of different sections inside the simulator.

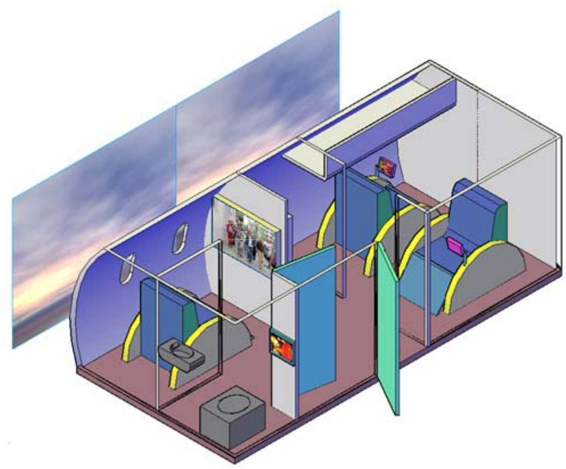

Figure 3: Second conceptual designs

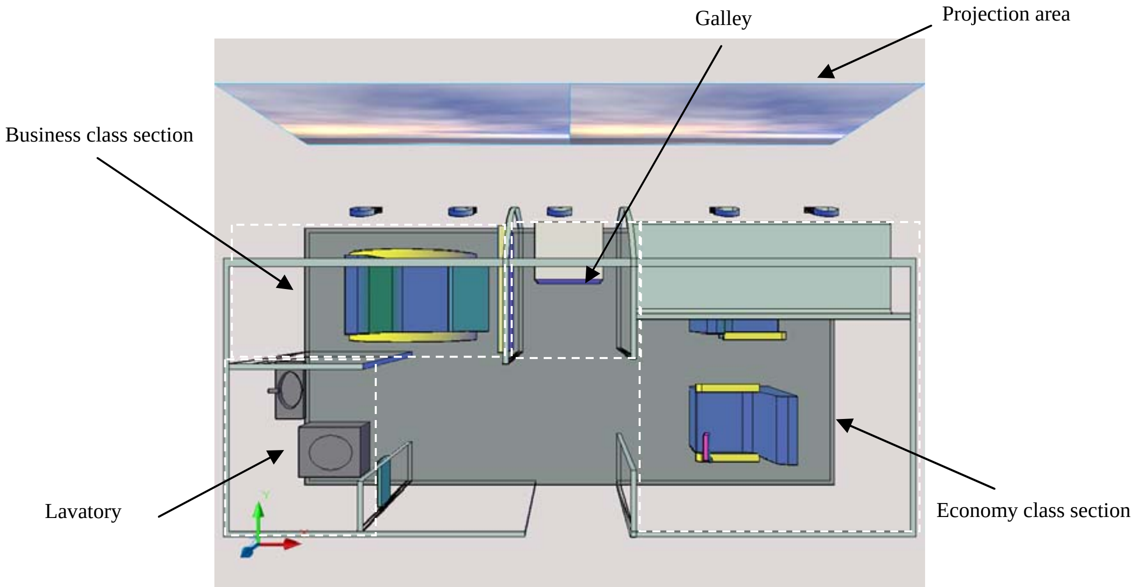

Figure 4: Second conceptual simulator design in plan view

During the design process, the arrangement of the simulator interior was changed due to some constraints that occurred along the process. For example, when the space, which used to install the cabin simulator, was changed, the entire simulator size will be changed as well. The entire simulator was redesigned so that the original plan was not affected to ensure it was capable to fulfill the strength requirement. Figure 5 shows the final interior arrangement of the simulator.

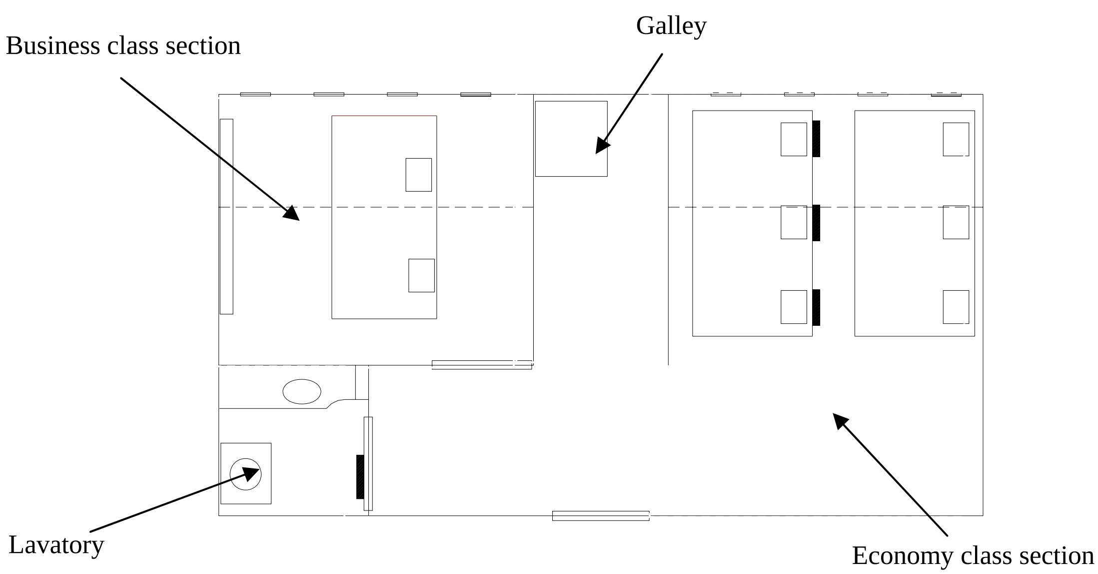

Figure 5: Final arrangement of the simulator cabin

5.0. Intuition Approach in Design and Redesign of Aircraft Cabin Simulator

As shown in Figure 6, intuition approach was used to solve different design problems of the simulator. Intuition is one of the methods used by the designers to solve different design problems occurred at the construction stage. The outcome of the intuitive action generated the idea. In the following section, the intuitive approach used to solve the design problem is described.

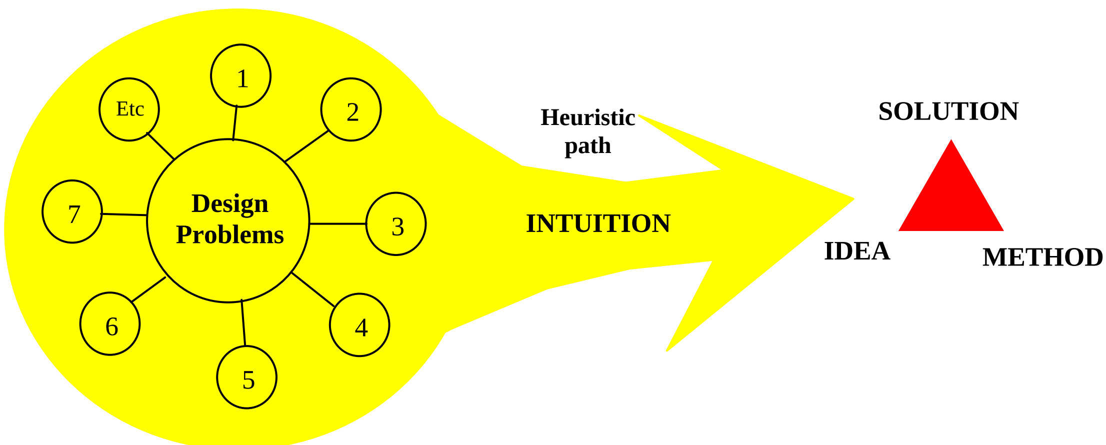

Figure 6: Intuitive problem solving

5.1. Foundation

The foundation of the cabin simulator was constructed from the wood and connected with metal plate. The foundation was used to support the entire cabin simulator. In the first design concept, the simulator was a static setup and attached to the floor directly. The first foundation was built as shown in Figure 7(a). When the simulator was redesign with the motion platform and to avoid the waste of material, the first foundation was reused and place on top of the new foundation as shown in Figure 7(b). The new foundation became stronger and was able to withstand the vibration shock due to the motion.

(a)

(b)

Figure 7: (a) the first foundation (b) the final foundation

5.2. Gang Way and Access Door

A short gang way was built to simulate the gang way in the airport. To ensure the aircraft cabin like environment, the backstage of the simulator was hiding from the test subject. The gang way design is one of the innovative ways to hide the simulator back stage. The simulator was incorporated with one access door. For the access door, we used the caravan door to replace the aircraft door.

5.3. Interior

For the interior, the cabin is fitted with window panels, ceiling panels, business class section, economy class section, galley, lavatory, partitions between seating areas and galley. The port side window panels of the simulator were fitted with simulated windows with clear see through glass. The window is all with blinds. The dark blue colour carpet was selected throughout the cabin. Due to the redesign of simulator, the simulator size became smaller and some modifications needed to be made. As shown in Figure 8, the leg room for the front low of the economy class was improved by making a rectangular hole. Figure 9 shows the internal side window with luggage compartment.

Figure 8: Additional leg room

Figure 9: Internal side window panels

5.4 Business Class Section

The business class section equipped with a massage chair, a touch screen monitor, a high quality surround sound system and a 47 inches ambient LCD television. In the first setup, a row of 2 person's business class seat was used. Due to the space constraint, it was replaced by a massage chair. The setup is to test the user reaction in the comfort environment during the flight. Figure 10 shows the business class section.

Figure 10: Business class section

5.5 Economy Class Section

Two rows of economy class seat were setup; each of the seats was equipped with a touch screen monitor and a noise reduction ear phone. The seat was embedded by a series of sensors to detect the physiological and posture change of the passenger. Figure 11 shows the economy class section.

Figure 11 Economy class sections

5.6. Galley

The simulator was designed with a galley function with the setup of shelves to store items. The galley was equipped with a refrigerator, a microwave and a peripheral compartment. The galley was used to provide the food and beverage to the test passenger during a 10 hours flight experiment. Figure 12 shows the galley of aircraft cabin.

Figure 12 Galley

5.7. Lavatory

The lavatory was designed and built for the passenger usage during a 10 hours flight experiment. The lavatory was equipped with a portable camping car toilet, a wash basin and a touch screen monitor. Figure 13 shows the external view of the lavatory.

Figure 13 Lavatory

5.8. Simulation Section

The simulation section was located external of the aircraft cabin. The simulation section consists of a wall and a floor that were painted in white color. One wide screen LCD beamer used to project the real flight condition such as airport view and sky view. The wide screen LCD projector is one of the innovative solutions, which can project the required view for the business class section and economy class section. Figure 14 shows the simulation view from business class section.

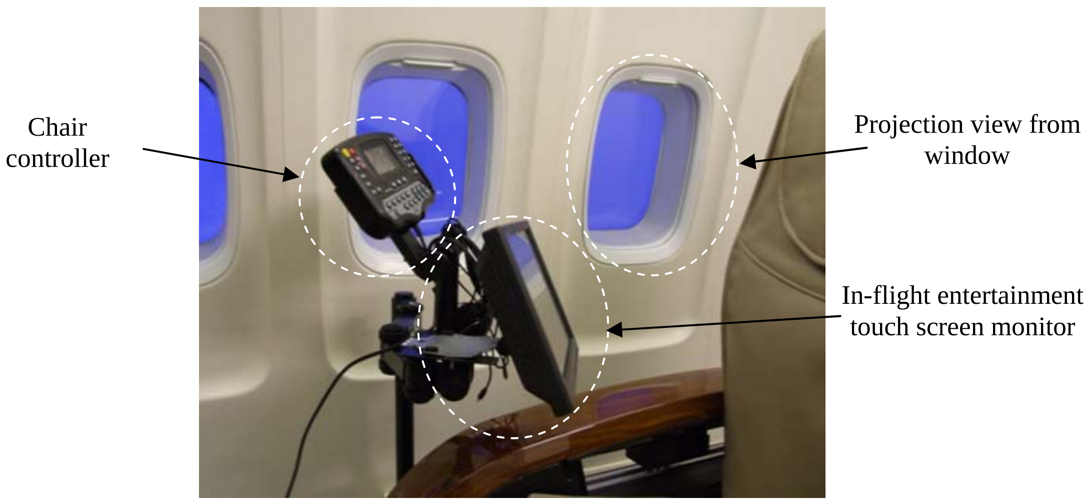

Figure 14 The simulation view from business class section

4.0. Conclusion

This paper has explained the intuition approach in the design and redesign of the low cost aircraft cabin simulator. For the aircraft cabin simulator, the designer's intuition plays an important role in the design and redesign process. The heuristic of the designer in the problem solving was based on the intuition solution approach. The designer intuition was influenced by his knowledge and experience. It can be concluded that intuition is one of the important factor in the success of a project.

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14th ICOT International Conference on Thinking
22-26 June 2009 Kuala Lumpur Convention Centre, Malaysia
'Thinking Minds: Nurturing the Design of a Better Future'

Hosted by

UPM
UNIVERSITI PUTRA MALAYSIA

Proceedings of 14th ICOT

Theme:

Thinking Minds: Nurturing the Design of a Better Future

Edited by

Tan Bee Hoon and **Shameem Rafik Galea**

Published by

Universiti Putra Malaysia

2009

ISBN 978-983-41184-5-7

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