EGPR 2013 PROJECT PROPOSAL

Design and optimisation of the fuselage for
an airplane to be flown by disabled people

CONTENT

1. INTRODUCTION

1.1 THE EGPR COURSE

The European Global Product Realization (EGPR) course 2013 is an academic virtual enterprise, consisting of five universities from Budapest, Lausanne, Ljubljana, London, Zagreb and one UK industrial partner: Condor Projects Ltd. The general foundation basis of the enterprise, the rights and obligations of the partners and other terms and conditions are summarized in the document "The EGPR Constitution". The human resources of the academic enterprise are the academic instructors, university students and company specialists. The enterprise is formed for one study semester. The primary goals of the enterprise are to gain the professional and communication knowledge and the solution of the practical problem, assigned by the partner company. The EGPR 2012 student's project task is **Design and optimisation of the fuselage for an airplane to be flown by disabled people**

The people involved in the EGPR course will be brought together by advanced communication means, where videoconferencing is considered as the key communication tool. The students will gradually gain knowledge by attending lectures, given by renowned professors and other experts and professionals. Student international teams will be formed to bring together their knowledge from different fields to try to solve the problems arising from the assignment. The teams will then elaborate and present their research work during common sessions. At the end of the semester, students will develop physical prototypes of their proposed concepts. All people involved in the EGPR 2013 will finally meet in person during the closing workshop in London at the end of the semester in early June 2013, where all components will be assembled together and the research work publicly presented and evaluated.

1.2 THE EGPR PARTNERS

a) The industrial partner

With extensive workshop facilities, a skilled engineering workforce and a passion for flying throughout the company, it was only logical that Condor Projects Ltd would expend into the building, maintenance and flying of small private aircraft.

With the acquisition of its own 6 acre base near York, Condor Aviation will be offering a full workshop facility for maintenance, repair, re-spray and refurbishment.

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b) Academic partners

In 2012 five European Universities are taking part in EGPR.

- **University of Ljubljana, Faculty of Mechanical Engineering** (FME): FME is one of the constituting EGPR partners and has been actively involved in developing the course throughout the years. The EGPR course is managed by LECAD, Laboratory for computer aided design.
  The course is led by:
  Professor Joze Duhovnik - joze.duhovnik@fs.uni-lj.si
  The coaches for EGPR are:
  Nikola vukasinovic - Nikola.vukasinovic@lecad.fs.uni-lj.si
  Vanja Cok - Vanja.cok@lecad.fs.uni-lj.si

- **École Polytechnique Fédérale de Lausanne:** EPFL is Europe's most cosmopolitan technical university. It receives students, professors and staff from over 120 nationalities. The EGPR course is done by the Laboratory for Computer aided design which was also the co-founder of the course in the year 2002.
  The course is led by:
  Professor Paul Xirouchakis - paul.xirouchakis@epfl.ch
  The coach for EGPR is:
  Ian Stroud - ian.stroud@epfl.ch

- **University of Zagreb, Faculty of Mechanical Engineering and Naval Architecture:** Chair for design and product development at Faculty of Mechanical Engineering and Naval architecture Zagreb has been involved in EGPR since 2003. CADLab is nowadays the operational centre of the Chair of Design and Product Development.

The EGPR course is led by:
Professor Dorian Marjanovic - dorian@fsb.hr
The coaches for EGPR are:
Ass. prof. Neven Pavkovic - neven.pavkovic@fsb.hr
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- **Budapest University of Technology and Economics:** More than 110 departments and institutes operate within the structure of eight faculties within the University. The Budapest University of Technology and Economics issues about 70% of Hungary's engineering degrees.

The course is led by:
Professor Karoly Varadi - varadik@eik.bme.hu

The coach for EGPR is:
Balazs Vidovics - vidovics.balazs@gt3.bme.hu

- **City University London:** City University is the academic host of EGPR 2013. The University is proud to be a principal provider of undergraduate, postgraduate, professional and vocational education in the United Kingdom and is renowned for its international focus and the employability of its graduates. The University attracts over 23,000 students from 156 countries, while teaching staff are drawn from nearly 50 international locations, ensuring that the University has a truly international outlook. The University maintains strong links with internationally renowned professional organizations, facilitating excellent work placement opportunities on many courses. It is also research intensive. Students are taught and supervised by experts who are up to date with the latest industry developments in their subject areas. The University joined the EGPR course in 2005.

Additional information about the EGPR course can be found at: http://www.egpr.org
The course is led by Professor Ahmed Kovacevic - a.kovacevic@city.ac.uk
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2. THE PROJECT

Condor Projects Ltd is the company mainly working in civil engineering and is setting up a charity to help fund the development of aircraft and motor vehicles, specifically for the use of disabled / wheelchair people and pilots.

The company has the support of Cranfield and Bristol Universities, both of which have aeronautical design departments. Both have agreed to undertake some of the design work on the aerodynamics over the next 12 months mostly working on the aerodynamics and the control of the plane. The company is proposing to work with EGPR, in order to work on the design of the fuselage and the practical issues in allowing wheel chair access into the aircraft and to build a full scale prototype of the fuselage.

The objects and goals of the charity are many but summarised as follows:

- To design and build an aircraft that can be accessed directly by a disabled person, either in or out of a wheelchair. It will also need to be flown without the use of foot controls. It may also be possible to modify the aircraft to be operated only using one hand, but this will depend on the extent of the disabilities.
- To design modifications to existing aircraft and have them certified by the CAA / EASA to allow the disabled to fly Cessna 172 and / or 152. This is a separate project to be considered at a later date.
- The Design Rights, Intellectual Property and Patents will be held by the Charity.
- The construction of the aircraft and modifications will be carried out at our bespoke build facility at Birchwood, Selby. This facility is currently under construction, with special emphasis being given to make it disable friendly.
- The charity will assist in any disabled person wishing to build their own aircraft and may hold a number of aircraft to be leased out to flying schools around the UK / Europe to encourage the disabled to take up flying.

It is proposed that a completely new design of aircraft for the disabled / wheelchair user is made, rather than have to compromise existing aircraft.

The design brief discussed with Cranfield, who will be concentrating on the aerodynamics etc is given below.

Because of limited facilities, flying by disabled pilots is quite restricted. It is generally extremely difficult for people with lower limb disability, or who use a wheelchair, to get into or out of an aircraft. Because of this, many disabled people feel that they cannot easily undergo pilot training. Hence a solution needs to be found that will enable disabled people to easily get into

and out of an aircraft either with or without a wheelchair. This will provide a much needed opportunity for many more disabled people to take up either sport flying or a career in flying.

The aim of this project is to carry out a conceptual design development of a new light aircraft that will allow easy access for disabled people in a wheelchair. The cockpit will be specifically designed to be flown by a pilot with lower limb disability. The aircraft will enable a disabled person to obtain their NPPL or PPL license.

2.1 PRODUCT SPECIFICATION

A brief specification for the aircraft as follows:

a) Easy access with or without the use of a wheelchair.
b) Possible opening nose.
c) Two seat tandem configuration that can be flown by a disabled pilot in the front seat, and an able bodied pilot in the rear seat.
d) Nose wheel with Pusher propeller configuration. Diesel engine.
e) Designed to Light Aircraft Association (LAA) regulations.

In the design of the airplane cockpit following issues should be considered:

- The plane should utilise 'pusher' configuration utilising aerodynamic shape of the plane to enhance efficiency of the propeller.
- Potentially building up a plane with a 'spine' wireframe to structurally support engine, wings, seats etc.
- The design should be novel and exciting to enhance business opportunity of the charity
- The cost of the plane should be one of the main considerations in design
- The plane should be driven by three or four cylinder diesel engine specified by the company.
- The plane should potentially be lowered to allow disabled access
- The cost of the fuselage prototype (for all groups collectively) should not exceed £20000

Some examples of the competitor planes are given in the appendix. The Barber Shark airplane presented in Appendix 1 is the shape which the company would like to explore for further developments

2.2 COMPANY EXPECTATIONS

Condor Projects Ltd is happy to be fully involved in this project with regular design reviews. At the end of the project, it is envisaged that we will construct a full sized mock-up of the design so that entry and exit from the aircraft can be fully evaluated by a disabled person.

The company expects the Virtual Enterprise of EGPR to commit fully to the project and requests active communication which will allow novel and cost effective design to lead the company and the charity to successful launch of the new airplane.

2.3 RUNOFF OF THE PROJECT

1. PHASE: IDENTIFICATION OF THE PROBLEM
    - To clarify the objectives of the project, main interests and capabilities of the company problem situation;
    - To understand and predict the needs for the products which company is manufacturing or should be manufacturing, consider future tendencies, trends and technologies
    - To carry out studies in all countries on primary and secondary sources;
    - To set a specific problem per team, based on their findings;
    - To come up with fresh ideas on equipment in the portfolio of the company, infrastructure, or even on overall product ranges or services;

2. PHASE: CONCEPTUALIZATION
    - To conceptualize alternatives to the selected product / system;
    - To provide rational concept evaluation and decision on selection with technical and economical factors considered
    - To present concept ideas in good quality graphics

3. PHASE: DETAILED DESIGN
    - To perform embodiment and detail design of the product and confirm manufacturability;
    - To keep costs of prototype at the level set by the company
    - To manufacture parts in collaboration with company as and when required

4. PHASE: FINAL WORKSHOP
    - To assemble prototypes on the basis of the specification. These may be life-size prototypes and/or scaled models, depending on the requirements and company specification
    - To deliver to the company complete documentation including prototypes, drawings, reports …
    - To present the project to the broad range of audience on the final day of the project

Appendix 1: Barber Shark

Appendix2: Concept Aircrafts and Cars