DLR Design Challenge 2025

Dr. Markus Fischer, Chief Aeronautics Officer at the German Aerospace Center (DLR), invites students to delve into the future of emergency air transport. Through their innovative ideas and concepts, students will contribute to enhance the emergency response capabilities of specialized aircraft worldwide.

The task, set by DLR, is open to students at German universities. Interested students can register for the competition through their university's supervising institutes until March 23, 2025. Each team is limited to a maximum of six students. During the kick-off event on April 8, 2025, all participants will receive this year's task and a detailed explanation of its background. They will then have time until July 21, 2025, to develop their concepts. These will be presented to DLR at a joint closing event, and the most outstanding designs will be selected by a jury of technical experts. The participating teams will be invited to present their concepts at the German Aerospace Congress 2025 (DLRK) in Augsburg. Additionally, the winning team will have the opportunity to showcase their results at the Congress of the European Aerospace Science Network (EASN) 2025 in Madrid, Spain.

The DLR Design Challenge 2025 is organized around the following challenge:

Development of a flexible medical evacuation aircraft that effectively meets diverse operational challenges, ensuring efficient patient transport, medical care, and adaptability to challenging environments.

Introduction

Medical Evacuation (MedEvac) play a crucial role in emergency response, often making the difference between life and death. The increasing demand for rapid, efficient and safe air transport solutions requires the development of innovative aircraft that integrate advanced medical systems with cutting-edge aviation technologies. The DLR Design

Challenge 2025 invites students to design an aircraft tailored to critical operational and medical requirements, enhancing emergency response capabilities worldwide.

Participants will have the freedom to explore new aircraft concepts, selecting the most suitable propulsion technology, integrating it effectively into the airframe, and addressing energy storage and the overall cabin layout. Most importantly, their designs must be capable of performing the complex and demanding missions that define real-world medical emergencies. The challenge aims to identify the most promising technologies and concepts for various operational scenarios, pushing the boundaries of future air rescue operations.

Task definition

While helicopters and specialized fixed-wing aircraft have long played a role in medical evacuation, they often face limitations in range, maneuverability and access to challenging environments. Remote regions, disaster-stricken areas and densely populated urban centers with congested ground transportation require more advanced air solutions to ensure faster response times and larger operational flexibility. Existing aircraft also struggle with the demands of steep approaches, short takeoff and landing distances, and the ability to operate on unpaved, icy, or debris-covered surfaces, making many critical locations inaccessible.

Interior design plays a critical role in patient safety and medical efficiency, requiring a layout that optimally accommodates stretchers, life support systems and medical personnel, while providing easy access to onboard treatment facilities. The ability to quickly install or replace specialized medical equipment should also be incorporated into the design, allowing the aircraft to adapt to different profiles.

To address these challenges, this year's DLR Design Challenge invites participants to design a single, innovative, efficient and reliable MedEvac aircraft capable of performing a wide range of emergency medical operations. Participants are challenged to design a fully operational aircraft that balances technical feasibility, economic viability, and medical effectiveness, with a technology level of 2035. By developing an innovative concept that meets these complex requirements, the teams will contribute to the future of emergency air transport and push the boundaries of aviation technology.

Design specifications

The designed aircraft must be capable of transporting critically ill or injured patients, medical personnel and life support systems under emergency conditions. In addition, the aircraft must be capable of rapid response, stable in-flight medical care, and operation in a variety of environments, such as remote or hostile locations. In particular, the aircraft should be able to perform the pre-defined mission scenarios starting from a fixed location (base). For simplicity, the base is located on sea level, at ISA conditions and there are no runway restrictions.

The following mission scenarios, like many medical emergencies, occur in locations with little infrastructure, such as mountainous regions, deserts, dense forests or polar environments. The aircraft must be able to take off and land in confined spaces and on a variety of ground conditions and overcome challenges such as high altitudes, strong winds and sudden weather changes. The ability to reach victims in locations inaccessible to ground vehicles or traditional fixed-wing aircraft is critical. The design must consider how medical teams will safely load patients so that life-saving treatment can begin immediately upon arrival.

1. **Emergency Medical Response in Remote Areas**

   The first mission the aircraft will be required to complete, involves taking off from the base to rescue a group of injured hikers in a remote mountainous area. The location for pick-up of the group is a small airfield located at 153 km distance from the base. The group should then safely be transported back to the base, while making sure first aid, and in-flight medical aid is provided. More details on the pick-up location and mission requirements are given in the following table:

Parameter	Value
Ground alt.	2.850 m
Surface condition	Hard turf (friction coef. = 0.05)
Runway length	756 m
Atmosphere	ISA +20
Total mission time	< 1.5 hour
Response time	< 0.5 hour
Turnaround time	< 10 minutes
Mission radius	153 km
Number of medical personnel	2 x
Number of injured people	5 x
Condition of injured people	1 x high 1 x medium 3 x low

**some parameters are defined below*

2. **Humanitarian Disaster Response**

   In the aftermath of natural disasters such as earthquakes, floods, wildfires and hurricanes, rapid medical evacuation is critical to saving lives. The aircraft must be able to deploy quickly to disaster areas with minimal operational support, landing on temporary or damaged runways while maintaining high payload capacity for multiple casualties. The aircraft should also be able to reconfigure quickly to carry additional medical supplies, doctors or even multiple patients in critical condition. Given the unpredictability of disaster zones, the aircraft must also be prepared to operate in extreme temperatures, low visibility or debris-filled environments while maintaining continuous medical support.

This mission entails rescuing a large group of people from an area affected by a natural disaster located 400 km away from the base. The objective is to get there, deliver cargo including first aid kits and aliments (500 kg), bring back a group of survivors to base, and repeating the mission a second time in the least amount of time possible. More details on the pick-up location and mission requirements are given in the following table:

Parameter	Value
Ground alt.	0 m
Surface condition	Icy concrete (friction coef. = 0.02)
Runway length	1250 m
Atmosphere	ISA -35
Total mission time	< 3.5 hours
Response time	< 45 minutes
Turnaround time	< 10 minutes
Mission radius	400 km
Number of medical personnel	4 x
Number of injured people	15 x
Condition of injured people	0 x high 4 x medium 11 x low

**some parameters are defined below*

***Mission parameters in this case refers to only one (out of two) return trip (from base to emergency location and back)*

3. **Long-Range Critical Care Transfer**

Critically ill patients often need to be transported from rural doctor’s practice to a hospital to receive specialized medical care. Unlike short-distance emergency evacuations, these long-distance MedEvac missions require an aircraft that is fast and optimized for extended in-flight patient care. The cabin layout should be designed to support continuous life support systems and ensure that medical personnel have space to monitor and stabilize the patient for the entire duration of the transport. The aircraft should also include pressurization and climate control systems that can accommodate sensitive medical conditions.

The last operation to fulfill entails transporting a critically ill patient from a peripherical facility to the main hospital at base. Patient is located at 1250 km from the base. More details on the pick-up location and mission requirements are given in the following table:

Parameter	Value
Ground alt.	150 m
Surface condition	Concrete (friction coef. = 0.04)
Runway length	1000 m

Parameter	Value
Atmosphere	ISA +5
Total mission time	< 9 hours
Response time	< 2 hours
Turnaround time	< 25 minutes
Mission radius	1250 km
Number of medical personnel	2 x
Number of injured people	1 x
Condition of injured people	1 x high 0 x medium 0 x low

**some parameters are defined below*

Students must design the MedEvac aircraft to transition between these different operational scenarios while maintaining high efficiency, safety, and reliability. The aircraft should be designed with modularity and adaptability in mind, allowing it to operate effectively in all environments while providing optimal conditions for in-flight medical care. The challenge is to balance competing design requirements such as short takeoff and landing time versus long endurance, rapid response versus stable patient conditions, and low noise versus high performance.

Teams must carefully consider how their design will maximize performance in all scenarios to ensure the aircraft is truly versatile and ready for real-world emergency operations. They should demonstrate their aircraft capabilities in operating in the 3 different missions depicted above.

Definitions to keep in mind:

- **Response time:** defines the time from the emergency call to the departure. It is the time the crew needs to prepare all personnel, choose appropriate equipment, board and be ready to fly the mission.
- **Total mission time:** It is the time to complete all mission segments, not including the response time. The mission always starts at the base and finishes when the patients are safe at the final location.
- **Turnaround time:** from landing in emergency location to take-off from emergency location. Considered for emergency location only.
- **Condition of the patients:**
    - High: requires bed, intense in-flight medical care, Ad hoc/special equipment
    - Medium: Bed or Seat required, basic in-flight medical care, first aid capabilities
    - Low: does not require bed, No in-flight medical care, Firs aid / bandages

Cabin Design

As an additional task, teams should consider a specialized cabin design optimized for patient care, medical efficiency, and crew operations under emergency conditions. The configuration should be designed to accommodate multiple stretchers, thereby enabling the concurrent transportation of patients with critical illnesses or injuries. The incorporation of adjustable mounting systems is paramount to ensure the accommodation of diverse medical scenarios. Dedicated workspaces for medical personnel should be included, equipped with essential medical devices such as defibrillators, ventilators, and infusion pumps. The interior layout should allow for rapid reconfiguration to suit different mission types, whether it be for high-volume patient transport, neonatal care, or specialized trauma treatment.

Teams are asked to discuss ideas that address these cabin design elements. The objective is to guarantee that the aircraft meets the highest medical care standards while maximizing operational flexibility and efficiency.

Considerations for Design

The MedEvac aircraft must seamlessly transition between different operational scenarios while maintaining efficiency, safety, and reliability. The design should prioritize modularity and adaptability, enabling operation in both urban and remote environments while optimizing in-flight medical care. Teams must balance competing requirements such as short takeoff and landing versus long endurance, rapid response versus stable patient conditions, and low noise versus high performance.

Key considerations include:

- Efficient and safe patient loading and unloading.
- Carrying and installing appropriate medical equipment.
- Adherence to CS-23 regulations.
- High climb and descent capabilities for challenging environments.
- Modular and adaptable interior configurations.
- Balancing short takeoff and landing capabilities with long-range performance.
- Optimizing cruise speed, stability, and medical support systems.

By addressing these elements, teams will develop an aircraft capable of significantly improving emergency response times, enhancing patient care, and redefining aeromedical evacuation standards for the future.

In summary, the competing designs will be evaluated based on their ability to meet the operational requirements. The key aspects for a successful product will be: reasonable assumptions supported by scientific literature and pertinent argumentations, and thorough consideration of operational boundaries and procedures.

Technical report, presentation and video

Technical report

The report is limited to 25 pages and English language. It should include a discussion of the derived design requirements, including all derived requirements for subsystems. A thorough literature search should be carried out. Dimensions, masses and key performance parameters of the aircraft should be presented. All tools and methods used to design and analyze the concept should be briefly described. This includes tool validation and verification of results using plausibility checks, handbook methods, historical data or other appropriate means (if not already done, in that case reference must be included). A systematic approach should be taken to substantiate the final concept as reasonable. The following data should be provided as a minimum:

- Three-sided view of the designed aircraft including dimensions.
- List of key technologies and reasons why they will be available for the EIS. (TRL estimation)
- Table summarizing the fulfilment of the operational scenarios. It should be accompanied by pertinent arguments, and detailed reasoning supporting the concept of operation of your design in the 3 operational scenarios
- Tables showing the weight composition of the concept, including weight of the structure (wings, fuselage, empennage, etc.), weight of the propulsion system, payload, energy storage, etc. The table should include empty weight, MZFW (empty weight + payload) and MTOW.
- Tables and/or figures containing the most important mission parameters of the concepts. These include climb and descent rates, cruising speed and altitude, aerodynamic and propulsion characteristics (e.g. glide ratio, energy consumption), energy consumption of the mission segments and the total energy consumption of the design missions.
- Payload/range diagram

Teams should also discuss the following:

- Aerodynamic properties of the concept. This includes an L/D- C_L trade and a breakdown of the total drag into the individual components.
- Load and structure concept
- Engine requirements and energy supply.
- Cabin layout

Structure of the technical report

- Introductory material: The introductory material is required, but does not fall under the 25-page limit.
  - Title page: Name of the project, name of the sponsoring organization or institution, name of the supervisor, head of the student team, date of submission;
  - Abstract (1 page, written in English);
  - List of members of the student team and number of semesters (Bachelor's or Master's degree programme);
  - Letter from the supervisor confirming that the student has completed the thesis independently;
  - Table of contents and nomenclature
- Main body: The main body (maximum 25 pages) must include the following:
  - Introduction and brief overview of the underlying literature;
  - Illustration of the developed aircraft design;

- Detailed specification of the aircraft, based on the minimum requirements set out in the "Technical Report" section. The required tables and figures must be included
- Conclusion and recommendations for further investigations;

Please note: Appendices are not assessed. Make sure that all essential information is included in the main body of your paper.

- Supplementary material: Supplementary material is required, but does not fall under the 25-page limit.
  - Bibliography
- Optional additional material: This section does not fall under the 25-page limit:
  - Picture of the submitting student group and/or pictures of the participants.
  - List of students' postal addresses.

Lecture

The results must be presented at the final event of the challenge. The presentation of each team should not be longer than 20 minutes. The language of the slides and the presentation is English. Details of the presentation and the event will be communicated after the submission of the report. The slides used must be submitted to DLR no later than two days before the final event.

Video

In addition, the teams must create a pitch video in English lasting a maximum of 3 minutes. The content of the video can be freely customized by the participants. The video may only be created by team members. The required file format is .mp4 (video codec H.264). The resolution should be at least 1080p (**video format 16:9**). The video must be submitted to DLR with the slides no later than two days before the final event.

Evaluation of the concepts

The submitted reports are assessed by an independent jury on the basis of various criteria, which are derived from the "Technical report" section and the capabilities of the designs in meeting the given requirements. In general, the form of the technical report and the use of specialized literature are included in the evaluation. The feasibility and innovation of the concept are also assessed. This includes that the use and availability of new technologies, as well as concept of operation of your aircraft, is assessed and well justified.

The results are included in the evaluation as follows:

- Written report 70 %
- Presentation 20 %
- Video 10 %

In the written report, the focus is on the aircraft concept presented. Care must be taken to ensure that the technical report contains the minimum data required in the relevant chapter. The specific assessment criteria for the assignment and their weighting are as follows:

- Aircraft design 60 %
- Mission execution 20 %
- Cabin design 10 %
- Form of the reports 10 %

Further information

Within the scope of this DLR Design Challenge, DLR does not provide any technical supervision of the work that goes beyond the questions within the scope of the Q&A rules.

Conditions of participation

All participants must be enrolled at a German university or university of applied sciences. Registration for participation in the competition and for the kick-off event takes place via the supervising chair. In the case of inter-chair teams, registration is made by the chair of the team spokesperson. The application and documents must also be submitted via the supervising chair or the team spokesperson. Participants must agree that all submitted documents, illustrations and diagrams may be used for publication on the DLR website or for other types of public relations work, stating the author's name. This consent must be received by DLR before the kick-off event.

Dates

14.02.2025	**Announcement** of the DLR Design Challenge
23.03.2025	**Application for participation** by e-mail to DLR at DesignChallenge@dlr.de via the university supervisors
08.04.2025	**Kick-off event** for potentially interested professors and all participating teams • Location: Hamburg-Finkenwerder (ZAL) • Costs: Travel costs (2nd class train journey, overnight stay the evening before) will be covered by the DLR for all participating teams and the supervising university employee. A maximum reimbursement amount per team applies.
22.04.2025	**Q&A session**, virtual
21.07.2025	**Electronic submission** of the technical report (also add an anonymous version for unbiased grading) by e-mail to DLR at DesignChallenge@dlr.de by 23.59.
26.08.2025	**Final event** at DLR for all participating teams and the supervising professors to present the work and announce the winning team

- Location: Braunschweig
- Costs: Travel costs (2nd class train journey, overnight stay the evening before) will be covered by DLR for all participating teams and the supervising university employee. A maximum reimbursement amount per team applies.

23.-25.09.2025 **Presentation** of the teams at the **German Aerospace Congress 2025 (DLRK 2025)**

- Location: Augsburg
- Costs: Travel costs (2nd class rail travel, conference fees) will be covered by DLR for the teams and the supervising university employee. A maximum reimbursement amount per team applies.

14.-17.10.2025 **Presentation** of the winning team at the **15th European Aerospace Science Network (EASN) International Conference**

- Location: Madrid, Spain
- Costs: (economy flight, accommodation) will be covered by DLR for the winning team. There is a maximum reimbursement amount for the team.

Submission guidelines

The following applies as a condition of participation and format requirement for all submitted work: contributions must be submitted in English. There are no restrictions on the part of the participants regarding the use, reproduction and publication of the content by DLR.

All entries must be received by 21/07/2025 at 23:59; entries received after this time will not be considered. Please do not wait until the last minute to check the file size and reduce the resolution of any integrated graphics, tables or images. All documents must be in **English. Save** the **file as .pdf**; other file formats will not be accepted.

Entries must be submitted electronically by e-mail to the following address:

- **E-mail address**: DesignChallenge@dlr.de
- **Subject**: DLR Design Challenge 2025 [team name]

All contributions must have the attachments to the email listed below. If your email server has an email size limit, the various attachments can be distributed across several emails. These emails should all be sent on the same day. Alternatively, it is preferable to submit the files via GigaMove at https://gigamove.rwth-aachen.de as a link in the email for large attachments.

1. A **digital document** that includes the following in one (!) file: Introduction, title page, main body, references, graphics, figures, scanned letter from the faculty, supplementary material, etc. The letter from the faculty must certify that the student's contribution has been reviewed and approved by a member of the faculty's academic staff and that the submission to the DLR Design Challenge is endorsed. Please also note the following:
    - Compress the file size of graphics and images in your work so that the file remains under **80 MB.**
    - Follow the instructions in point 5 for naming files.
2. A **digital document** that includes the following in one (!) file: Introduction, title page, main body, references, graphics, illustrations, additional material, etc. This document is identical in content to the document in point 1, but must **not** allow **any conclusions to be drawn about the name of the university or the participants.** Care must be taken to remove logos, university names, etc. from the pictures of the aircraft. This document ensures an unbiased assessment of the design.

    All other boundary conditions are identical to point 1.
3. A **digital document** that describes the design with the most important properties on **one page.** Please also note the following: The file must contain the following elements:
    - a **three-sided view** of the aircraft.
    - A table with the following data:
        - Geometric dimensions (wingspan, wing area, etc.)
        - Surface load
        - Shear load
        - L/D
        - C_L in cruising flight
        - MTOM, OEM
        - Maximum range
        - Maximum payload
        - Cruising speed (in km/h and Ma)
        - Cruising altitude
        - Table summarizing the operational capabilities with respect to given operational requirements
    - Explanatory text on the aircraft concept and its special features. The concept of operation and propulsion technology should also be explained.
    - A freely selectable illustration that justifies the choice of concept.

4. A high-resolution **digital photo of yourself at the university** or, if it is a team, a digital photo of the entire team at the university. Name the photo files with your surname or that of the team leader and submit them as **.png files.** Send us a caption in the body of the email with the name of the student in the photo from left to right. Images will not be judged; they will only be used to announce winners and other public recognition. For use in print media, images should be saved in the highest possible resolution, preferably at least **300 ppi** (image format: 4:3). Obtain the consent of the persons depicted for the publication of the images by DLR to announce the winners or for its other public relations purposes in advance. Please keep the declarations of consent and be able to produce them on request; please submit an electronic copy of the **declarations of consent** with your entry; all participating teams will receive a sample of such a declaration of consent by e-mail.

5. A high-resolution **digital image of the aircraft configuration**. The image should contain an appropriate caption stating the name of the student or team leader, the name of the university and, if applicable, the name of the aircraft. File format should also be **.png**. For use in print media, images should be saved in the highest possible resolution, preferably with at least **300 ppi** (image format 4:3). If you have built a model, please also send a photo of the model with the design team. The images must **not** contain the DLR-logo. Please keep the consent forms and be able to produce them on request; please submit an electronic copy of the **consent forms** with your entry; all participating teams will receive a sample consent form by e-mail.

6. Student release forms for small teams for each team member and for larger teams a release form with a signature page for all team members. Save everything in a **.pdf** file and send it by e-mail like the files mentioned above.

7. Please follow the instructions below when naming and saving your files:
    - Article: University_NameOfDesign_Report.pdf
    - Neutral contribution: NameOfDesign_Report_anonymous.pdf
    - Photo: University_NameOfDesign_Teamphoto.jpg
    - Aircraft image: University_NameOfDesign_Aircraft.png
    - Student release forms: University_NameOfDesign_Approvals.pdf
    - Declaration of consent: University_NameOfDesign_Consent.pdf

    The terms DLR and competition should **NOT** be used in file names. Abbreviations of university names are acceptable. Example: Ludwig-Maximilians-Universität to LMU.

Formal requirements

Under no circumstances may formulations or ideas from other authors be used without correct acknowledgement of the source. If you use the statements or ideas, they must be clearly labelled as quotations and the source must be named in the footnotes. Submitted work that contains plagiarism will be **disqualified**. The paper, presentation and video must be prepared independently and **exclusively by team members.**

The structure of the technical report is already explained in the section "Structure of the technical report". As a reminder: the entire report (excluding the title page, foreword, abstract and directories) **must** not exceed **25 single-sided pages.** Furthermore, the **minimum font size is 10 points** and the **minimum line spacing is 1.0.** The page number is in the bottom right-hand corner. All tables, photos and illustrations must be signed. Sources must be cited in a citation format commonly used in scientific publications.

The paper should follow the standards of a technical report and should be well organized using headings and subheadings, with a clear transition from one section to another. The text should be clear and concise. The addition of appendices to the technical report is **prohibited**; ensure that all relevant information is included in the paper itself.

Recognitions

- Interested supervisors and the associated teams who have expressed an interest will be invited to the kick-off event in Hamburg by DLR Executive Board Member for Aeronautics Dr Markus Fischer.
- Participating teams that have submitted work will receive feedback from the jury and will be invited to DLR by DLR Executive Board Member for Aeronautics Dr Markus Fischer for a presentation of their work and the announcement of the winning team (travel costs will be reimbursed, there is a maximum cost per team).
- All participants will receive a "DLR Design Challenge 2025" certificate and a high-quality photo print of their designed aircraft.
- The participating teams will be invited to present their designs at the German Aerospace Congress 2025 in Augsburg (travel costs will be reimbursed, a maximum cost per team applies).
- The winning team will be invited to a presentation of the design at EASN 2025 in Madrid (travel costs will be reimbursed, a maximum cost per team applies). Supervisors of the winning team are welcome to participate (self-financed).

Background information

DLR Design Challenge:	https://www.dlr.de/de/karriere-und-nachwuchs/angebote-fuer-studierende/dlr-design-challenge
Other:	https://www.dlr.de/de/forschung-und-transfer/luftfahrt/leitkonzepte

Jury

The jury selects the winners based on independent expert opinions.

- Jury chair: Dr Markus Fischer
- Jury members: Institute directors from the DLR Aeronautics research field

Contact us

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All information is subject to change. The Federal Travel Expenses Act applies. Legal recourse is excluded

Release notes

Version	date	Notes
1.0	26.03.2024	Publication of the document