Concurrent Design Facility for Aerospace Design Education

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Presentation Outline

- Aircraft Design Education at RMIT University
- Overview of current Concurrent Design Facilities (CDF)
- Key Elements of CDF
- A Collaborative Architecture based on Cloud Technology
- A Generic CDF for Design Education
- Conclusions

Aerospace Design in Bachelor of Engineering (Aerospace) - Overview

RMIT University offers:

- Bachelor of Engineering (Aerospace), which is a 4-year programme.
- Double degree Bachelor of Engineering (Aerospace)/Bachelor of Business (Management), which is a 5-year programme.

The design content for both programmes is the same:

Course Name	Year	Credit Points	Theme
Introduction to Aircraft	1	12	Product and Environment
Computer-Aided Design	2	12	Design process/Design tools
Design for Manufacturing and Assembly	2	12	Component Design
Systems Engineering	2	12	Requirements and trade-offs
Management of Aerospace Design and Research	3	12	Multi-disciplinary Design
Aircraft Design Project	4	12	Design Project/Specialist lectures
Advanced Aerospace Design (elective)	4	12	Component design/test/experiment

Aerospace Design Project

Aerospace Design in fourth year, first semester, introduces students to conceptual aircraft design practice:

- Students are given a Request For Proposal (RFP.
- Students can chose from an RFP based on fixed-wing aircraft, spacecraft, UAV or rotary-wing vehicle.
- Students from teams of 10 to 12 students (about 100 to 120 students)
- Normally there are about 12 design groups.
- Each team selects a team leader.
- Each team is assigned an academic advisor and meets with the advisor at least once per week.
- There is a mid-semester design review and a final design review (presentations)
- Each group submits a final design report.
- Each student must submit an individual design portfolio.
- Each group conducts a peer assessment of each student in the team.

Aerospace Design Project – Learning Outcomes

In the aerospace design project, we assess a range of learning outcomes, such as:

- Problem solving, working systematically
- Critical review
- Decision making with arguments and evidence
- Communication and reporting
- Working in a team, interpersonal skills
- Working to a project plan in a timely manner
- Presentation skills

Observations:

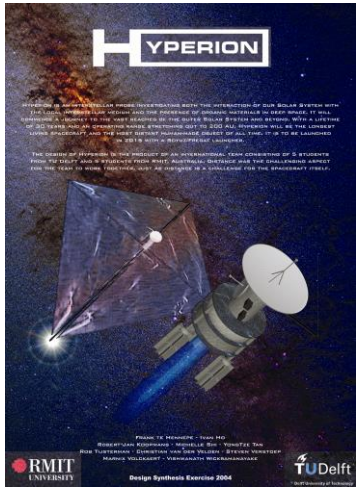
Students do not seem to like open ended problems, they are confused and are not confident enough to make decisions.

Working in teams remains a challenge in terms of project management, planning, progress and peer assessment.

Aerospace Design – International Projects

If an opportunity exists, a design team may choose to work together with students from another overseas university. International collaboration has been conduced with Delft University of Technology and Georgia Tech:

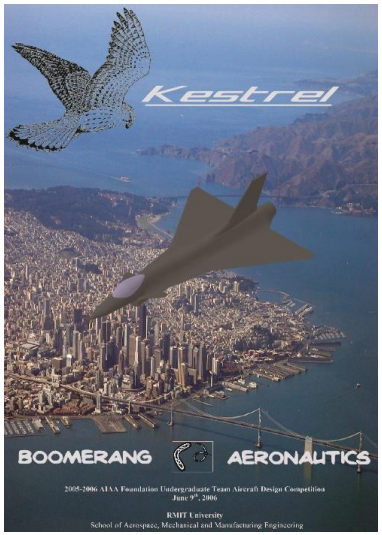
- Students communicate using modern communication techniques, such as video conferencing, chat, email and Skype.
- Students prepare a communication schedule based on availability and time zone considerations.



Aerospace Design Prize

Industry offers a prize for the best design project. The best design project is selected based on:

- Originality
- Technical rigour and soundness
- Reporting quality and presentation
- Professionalism and team endeavour



Aerospace Design Outreach – Spiders in Space

- On 16 January 2003, eight Australian spiders embarked on a 16-day mission into space on board the space shuttle Columbia STS-107.
- The project was a 3-year collaborative programme between students from Glen Waverley Secondary College, RMIT University and the Royal Melbourne Zoo.
- The students were involved in the design of the experiment as well as in investigations into issues such flight clearance and mission simulation.
- The research topic for the Australian experiment was 'Spiders in Space: the effect of microgravity on spider behaviour and web composition'

Other Special Projects

- Spacex - Hyperloop
- Airbus Fly Your Ideas Competition
- AIAA Student Design Competition
- Formula SAE racing (mechanical/automotive)
- AIAA Design, Built and Fly (TBC)

fly your ideas with Airbus

Concurrent Design Facility

To further enrich the advanced aerospace design teaching and research, RMIT University is planning to set up a Concurrent Design Facility (CDF):

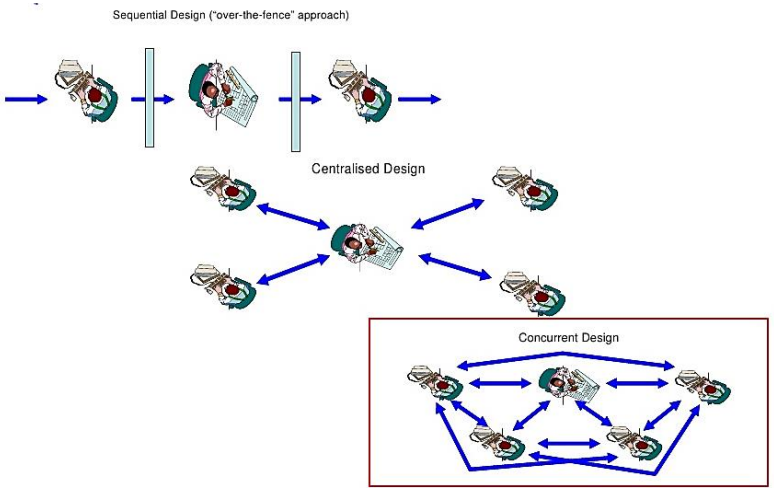
- Emulate industry practice of engineering design of complex systems.
- Reinforce the application of basic engineering science, mathematics and physics in engineering design and computer modeling.
- Avoid of repetitive programming, integration and data management. Use of a CDF library of standard tools.
- Facilitate easy access to standard and tested design tools. Bring the design to the next level of detail.
- Focus on trade-offs, design optimization studies and including operational performance, such as maintenance, support, reliability, etc.
- Facilitate customized and specialized software development and retain in the CDF tools library for re-use.
- Expose students to modern IT technologies.
- Connect to other CDF facilities around the world for collaborative design projects.

Concurrent Engineering

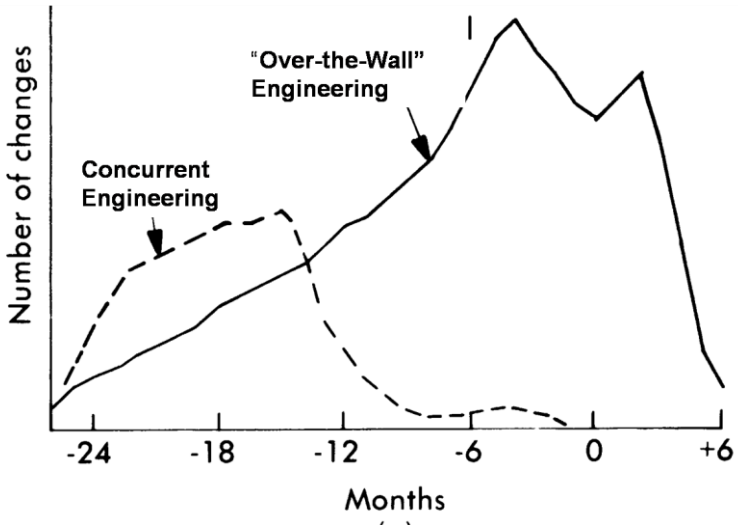
"Concurrent Engineering (CE) is a systematic approach to integrated product development that emphasises the response to customer expectations. It embodies team values of co-operation, trust and sharing in such a manner that decision-making is by consensus, involving all perspectives in parallel, from the beginning of the product life-cycle." (ESA)

Essentially, CE provides a collaborative, co-operative, collective and simultaneous engineering working environment. The concurrent engineering approach is based on five key elements:

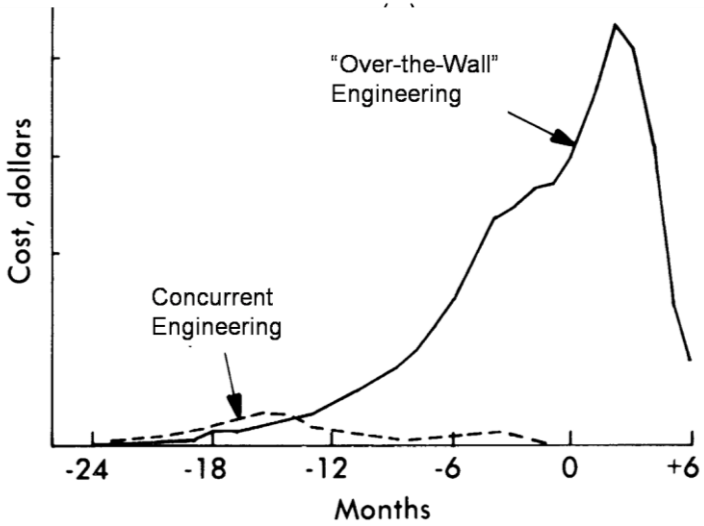
- Process
- Multidisciplinary team
- Integrated design model
- Facility
- Software infrastructure



Overall Design/Short Lead Time



Shorter Time to Market: Concurrent engineering teams make far fewer design changes before the launch of the product while the over-the-wall teams filed a huge number of changes.



Less Costly Product Development Projects. In the beginning the concurrent engineering strategy costs more because of the cost paying representatives of all of the stakeholders to participate on the design team. The over-the-wall strategy is expensive near launch because many people are added to the design team correct design issues that were not detected and dealt with earlier in the process.

Concurrent Engineering Facilities

European Space Agency

Goddard Space Flight Center

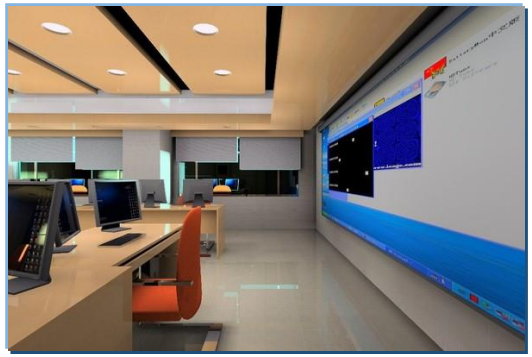
Glenn Research Center

Georgia Institute of Technology

Jet Propulsion Laboratory

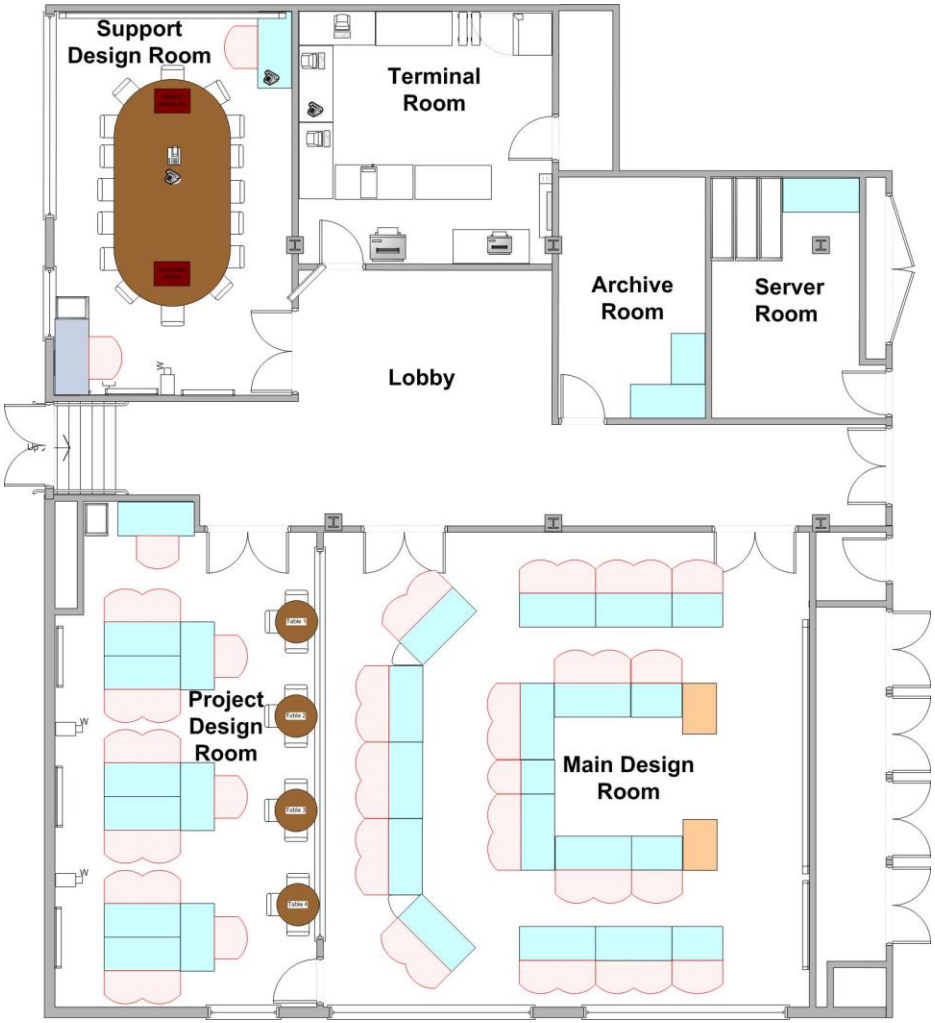
Shengzhou Institute of China Academy of Space Technology

Beihang Univerisity

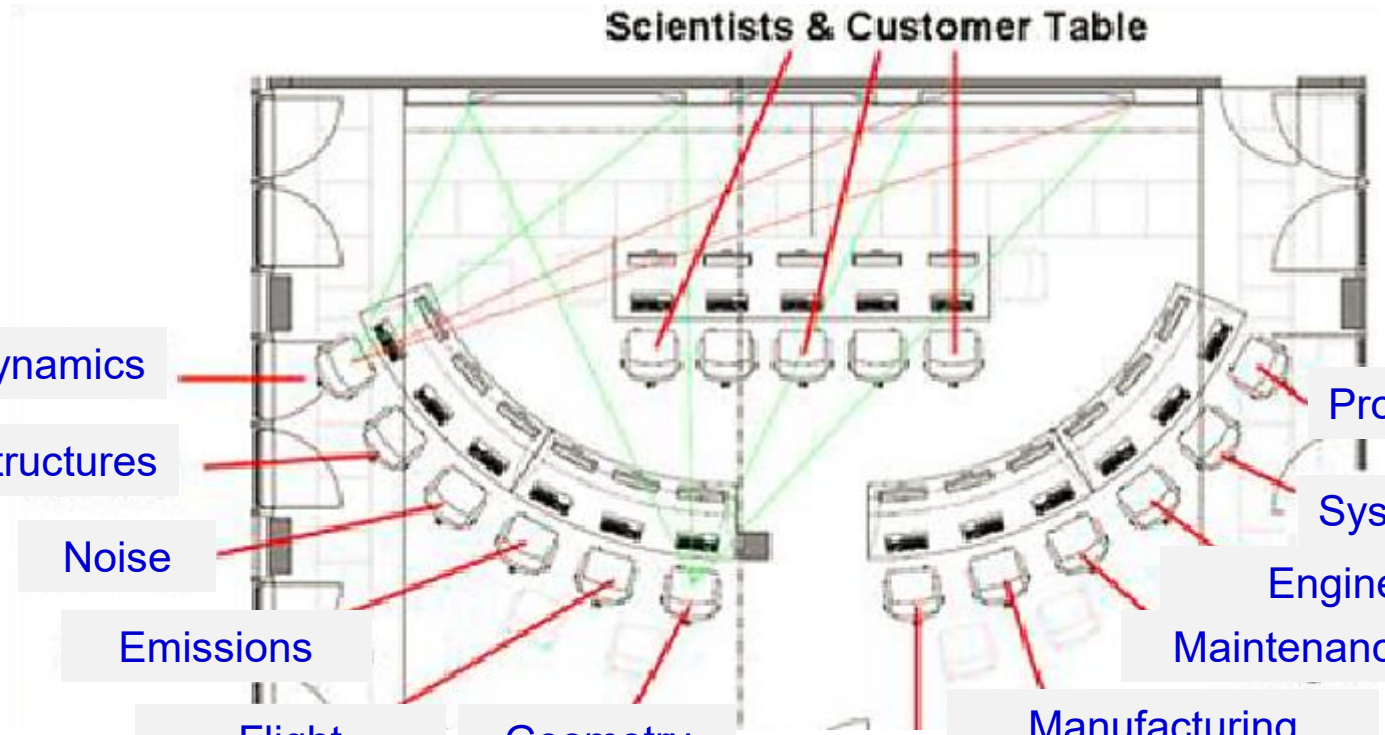


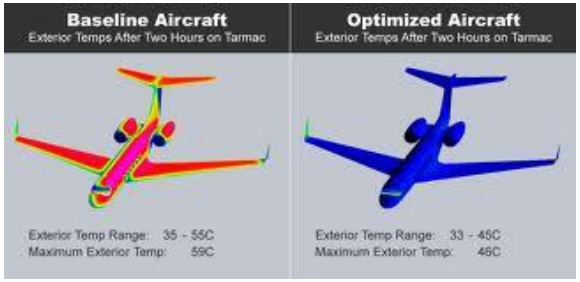
CDF Facility Components

- One main conferencing room with large projection screens.
- Some smaller rooms for breakout meetings.
- Extra rooms available nearby for servers and technical devices.



Generic CDF Layout





Conclusions

- The development of CDF has a history of nearly 20 years. Up to now, more than 20 CDFs have been established around the world.
- Universities and other higher education providers must adapt their curriculum to reflect industry developments and practice.
- Other universities, including RMIT University, is in the process of establishing a new CDF for design teaching and research. The facility will be generic to allow other disciplines to use it.
- The CFD is an excellent catalyst to connect global aerospace design universities and to conduct joint design projects, participate in international design competitions and to exchange software tools.
- EWADE members are invited to comment on this initiave, in particular the architecture of the hardware/software, what is cost effective?, what is best practice?
- Would an EWADE working group be appropriate?
- Are other universities interested in participating in international design projects, either as part of a competition or just for the great experience?