Assessment methodology for a new learning pathway at the National University of Singapore

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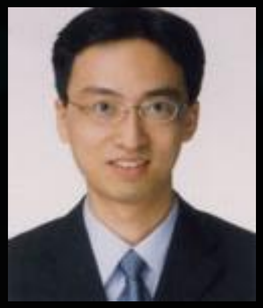

Class Summary

- Design-centric curriculum (DCC) is an alternative learning pathway established two years ago at the National University of Singapore (NUS) in response to the increasing demand from the industry for engineering graduates who is able to think outside the box, define problems and work across disciplines in a multidisciplinary team.

- Design-thinking as a technique to develop innovative solutions to a set of problems defined by the students formed the back-bone of the curriculum. This alternative curriculum consists of students working in a team on a multi-year, multi-disciplinary project which is the main learning vehicle in DCC aimed at developing certain desired traits in our students.

- The types of assessment developed by the team in DCC to assess the achievement of our students will be outlined and we will share with the audience our philosophy, methodology and experience in the development of the assessment method adopted within DCC

Learning Objectives

At the end of this class, you will be able to:

- Appreciate the various aspects in the development of an assessment method for team-based projects
- Develop an assessment methodology to monitor the progress of students' achievement in a team-based project
- Gain insights into the experience encountered in the implementation of the assessment method developed and adopted within DCC
- Appreciate learning culture of Asian students

Engineering Design and Innovation Centre

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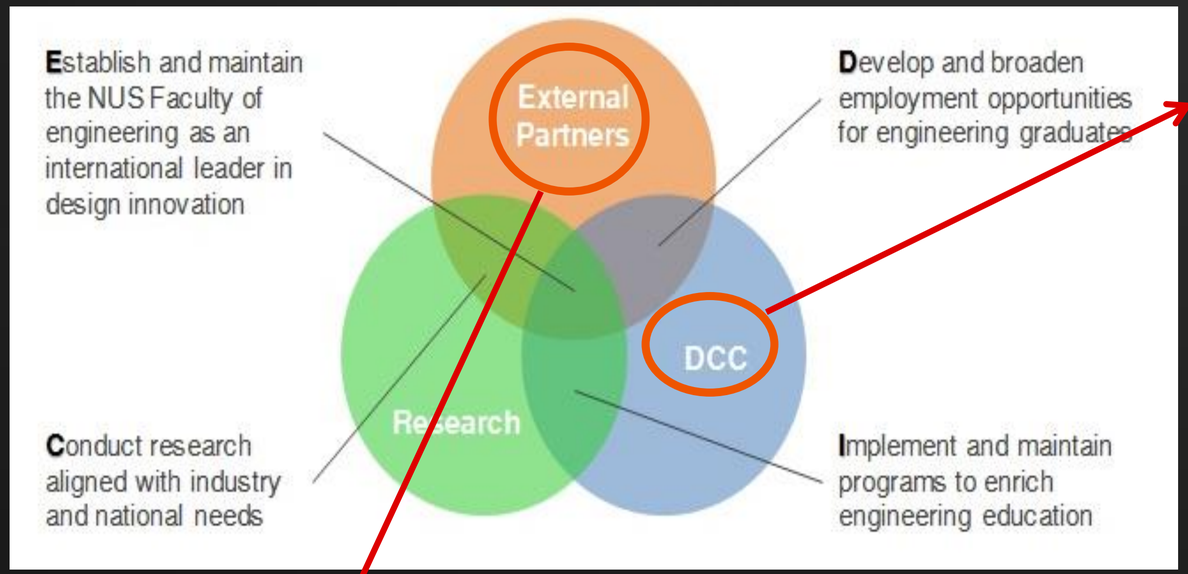
NUS/EDIC and Autodesk

The collaboration (17 Jan 2012) will allow staff and students from the University's (EDIC) and DCC to access the Autodesk Education Master Suites.

Appointed two NUS-Autodesk Term Professors at the NUS Engineering Design and Innovation Centre (EDIC).

EDIC : who we are



EDIC was first established as a launch pad for the Design-Centric Curriculum, providing an environment that promotes interaction and exchange of ideas among staff and students of different disciplines to address design projects that require a wide spectrum of expertise. The first batch of students joined the DCC in January 2010.

MoU between Autodesk and NUS/EDIC

The partnership will also promote use, training and certification of Autodesk software for DCC students. In addition we will explore new applications for Autodesk software, particularly in the areas of facilitating communication, and collaborative innovation across multidisciplinary teams.

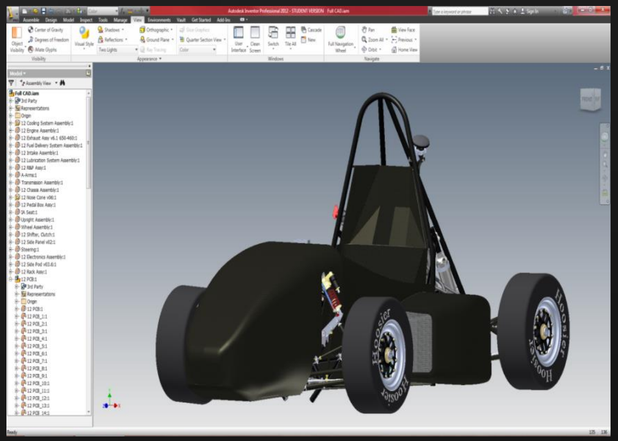
ACE and ACI courses in NUS

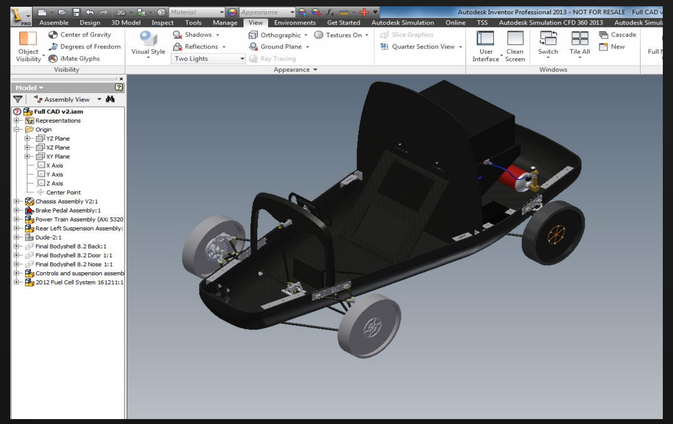
- To date 2 Autodesk Certified Evaluator (ACE) and 2 Autodesk Certified Instructors (ACI) courses have been conducted arising from the partnership between Autodesk and EDIC.

Autodesk in NUS race car project

- Autodesk software is being used in the NUS FSAE (Formula Society of Automotive Engineering) race car project, as well as the NUS Eco-car project.
- These flagship design projects have been hosted by the Faculty of Engineering since 2001 (FSAE racecar project) and 2006 (Eco-car project).

NUS FSAE Race Car

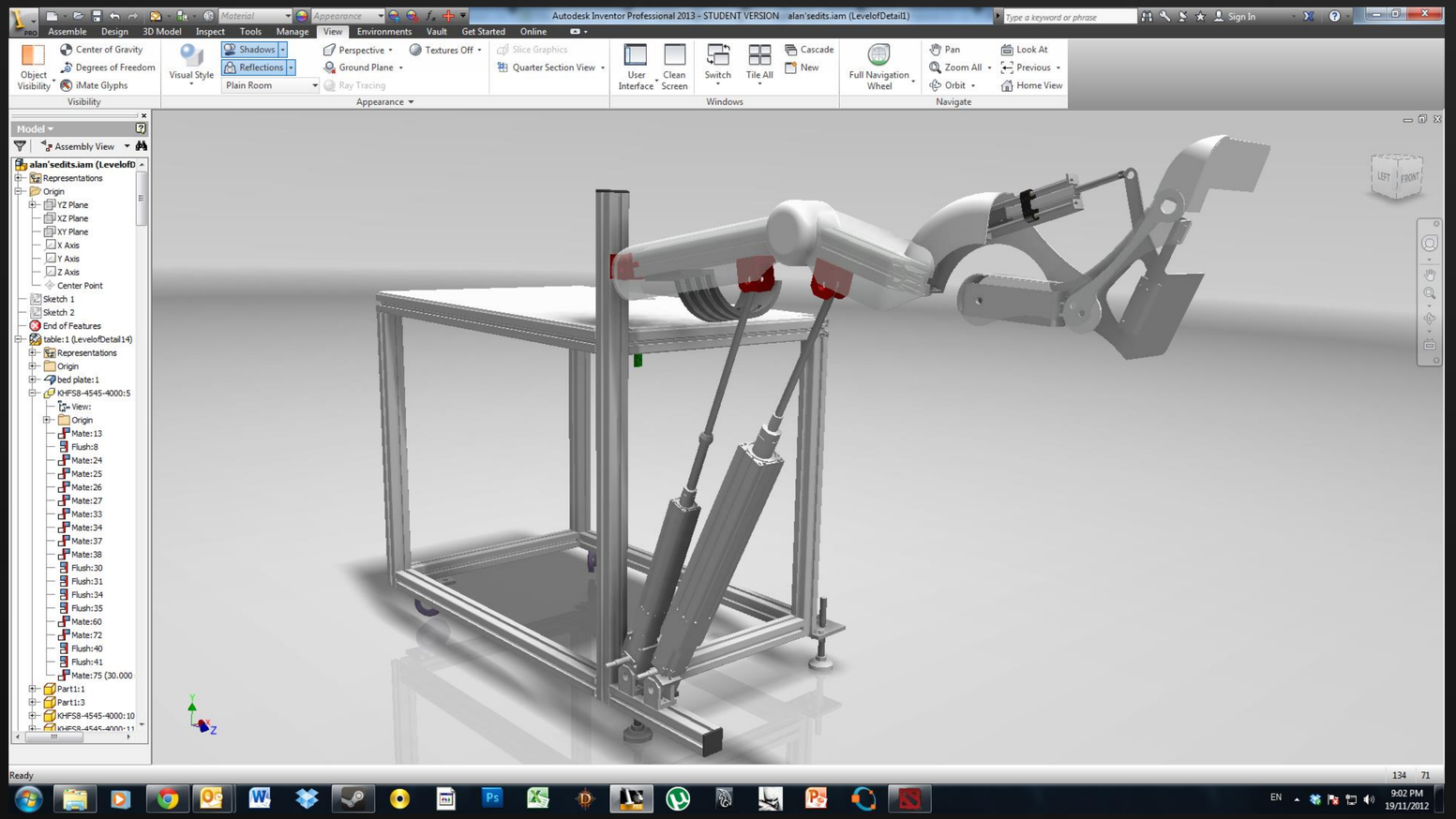


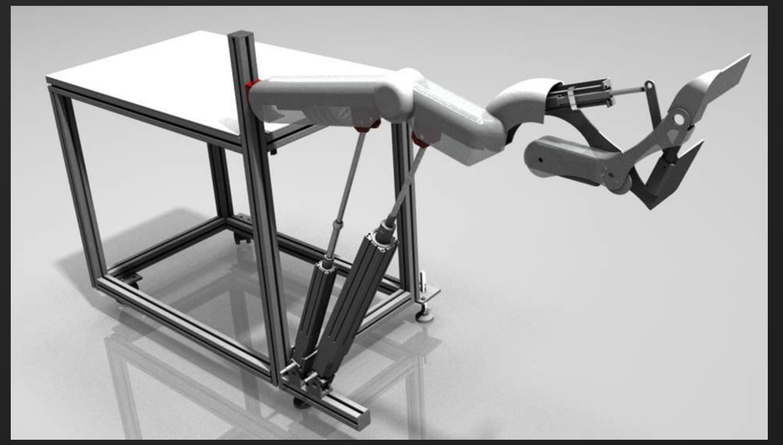


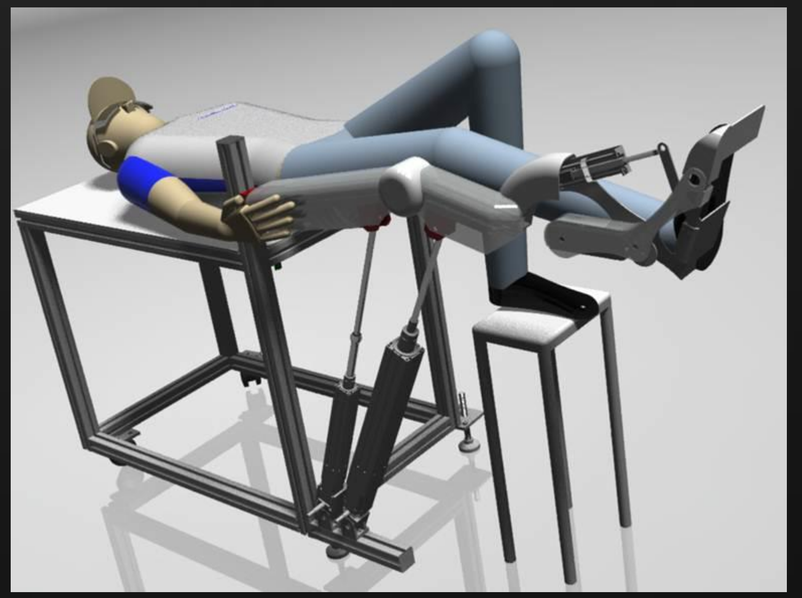
NUS Eco-car

Gait Rehabilitation Project

Example of a DCC project using Autodesk Inventor







Mandate of DCC

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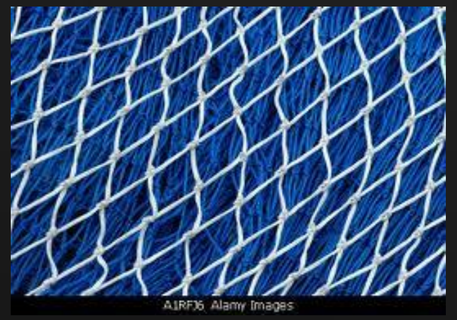
The Mandate for DCC

Selection of 'Right' Students



DCC Route (3.5 years)

Transformational Education

Learning through project activities which need to be assessed effectively (achievement & grading)

Desired Traits

1. Possess depth of expertise in their fields of specialization
2. Take on new challenges and be comfortable with tackling the unfamiliar
3. Identify and define problems and formulate innovative and creative solutions
4. Take ideas from conceptualization through to design, implementation and operation
5. Engage in **systems-level thinking** and deal with complex systems
6. Articulate ideas effectively
7. Lead or work in a multi-disciplinary team
8. Appreciate the cultural and social dimensions of design

The curriculum and the multi-year project

Non-DCC

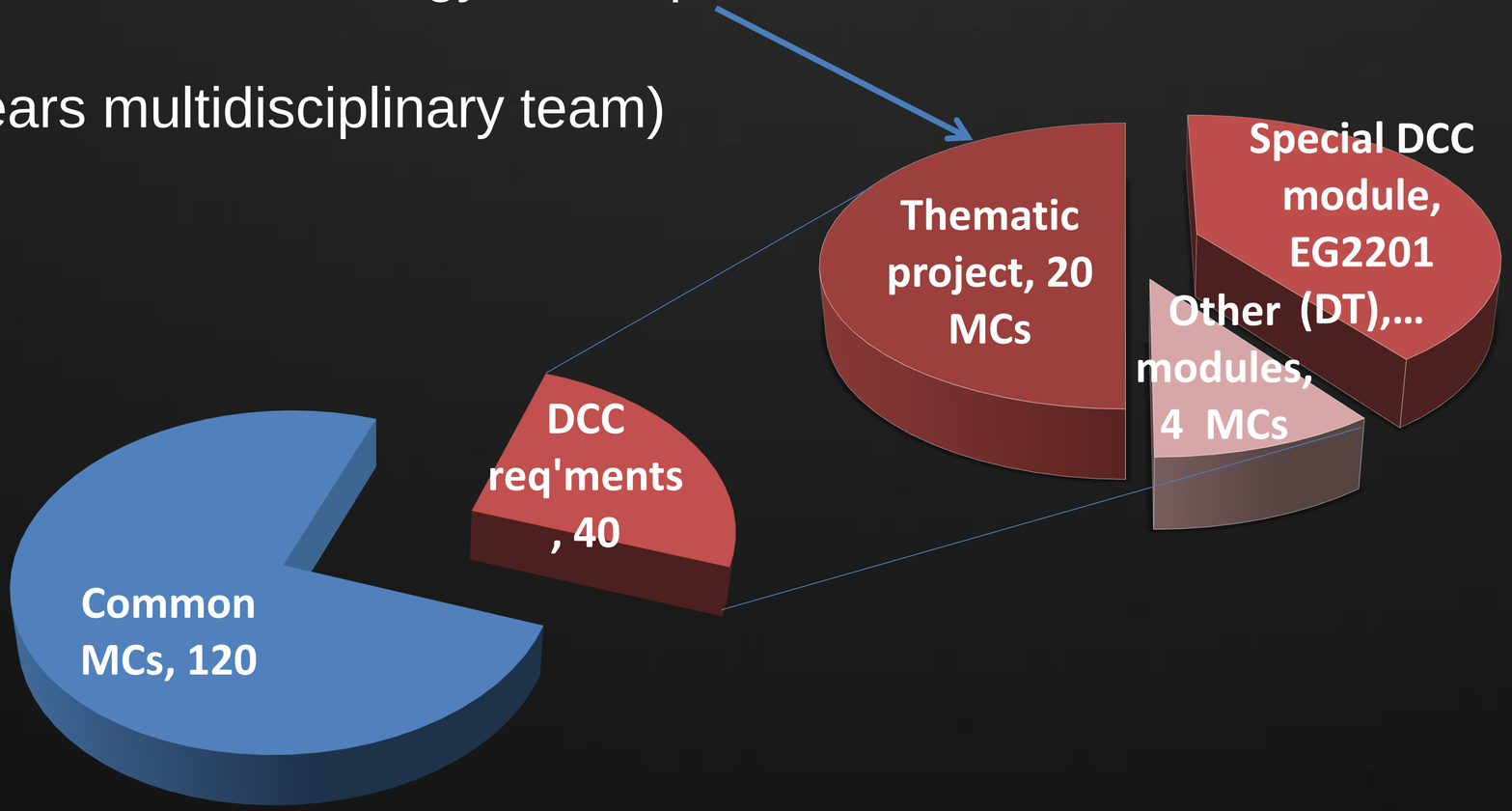
MCs	Requirements
140	Core Modules & Electives taken over 4 years
20	FYP + Y3 & Y4 Design Projects*

MCs	Requirements
120	Core Modules & Electives taken over 4 years
20	Multi-year DCC Project
20	Design Thinking Modules (EG2201,2202, 2203…..)
-	Other DCC-way Electives/ Future DCC Generic Modules
-	Equipping clinics/tuitions

Breakdown of MCs for DCC students

Assessment methodology developed for this

(3.5 years multidisciplinary team)



Samples of student projects

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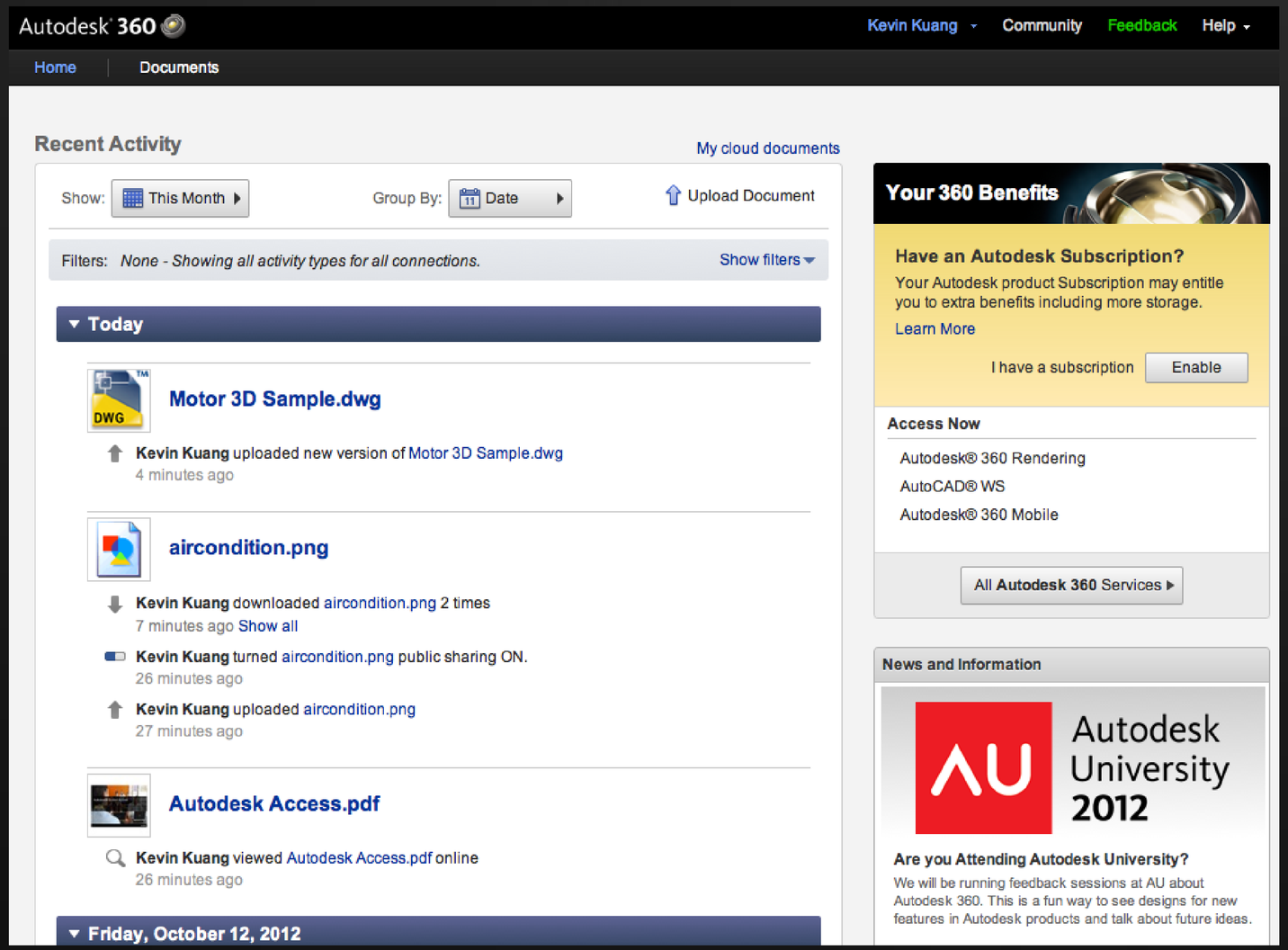
Examples of projects

- Urban Remote Site commuter
- Morpheus: The Dream Travel Guide
- Develop and design an Interactive Social Robot for elderly-development of a platform based on Android
- Energy Efficient Humidity Control System in an Equatorial Country
- Development of an Electric Hovering Vehicle

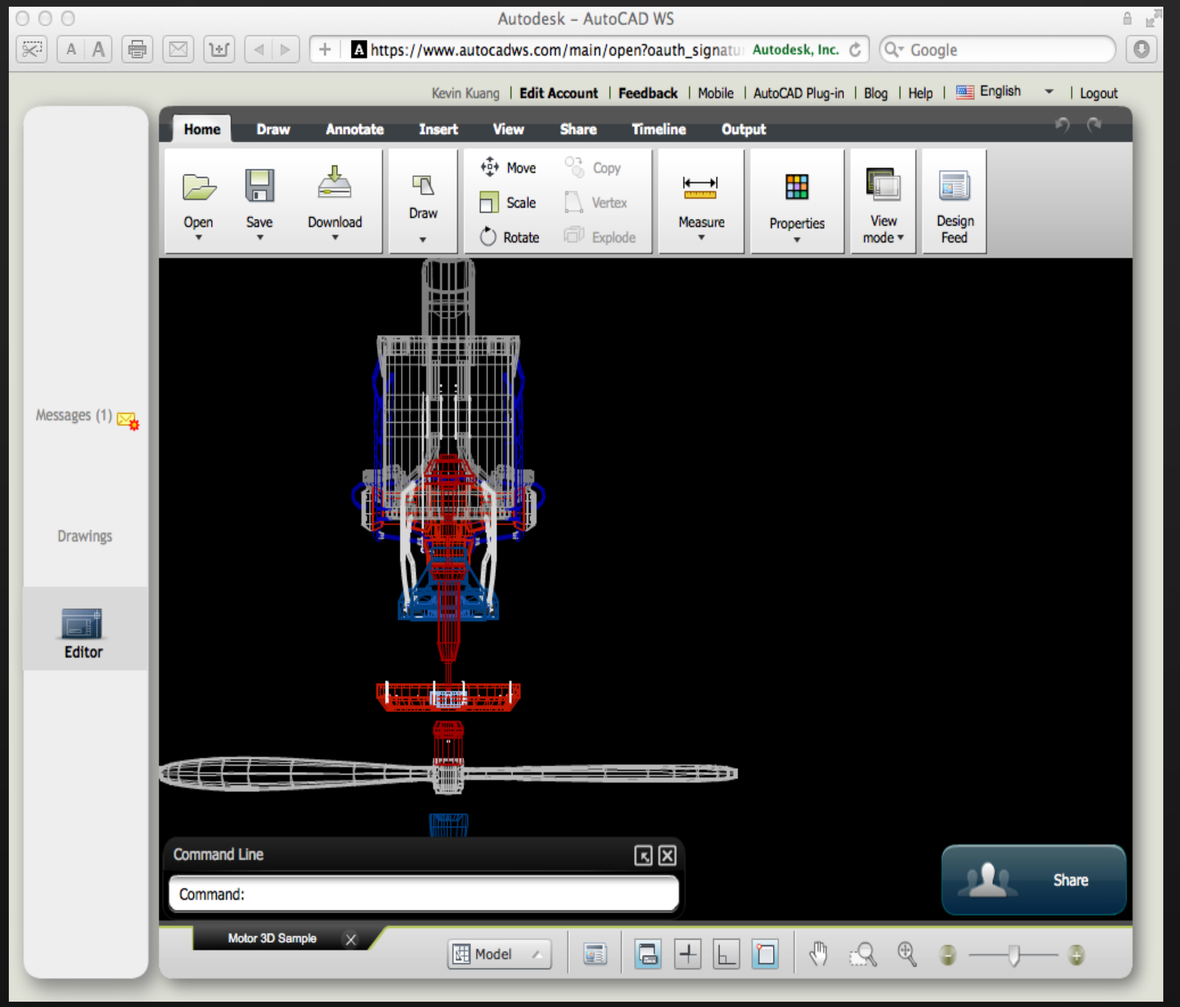
Students are encouraged to use software provided free of charge from Autodesk in their designing process. We have also set-up the IT infrastructure to maximize their utilization of what Autodesk has to offer. E,g, the use of Autodesk360, where students can collaborate through cloud computing in addition to cloud-based rendering of models

Autodesk360 used in student collaboration



Typical DCC student collaboration page in Autodesk 360

Autodesk360 used in DCC student work



Design Summer Programme

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Design Summer Programme 2012

Designing Solutions for 2030: An Asian Perspective

Key learning experience in Design-Centric Curriculum for 2nd/3rd year students*

10 days event
20 universities
11 nationalities
66 students
20 staff
07 field trips
03 Keynote lecture
02 DT Workshops
04 days of group work

Design Summer Programme 2012

Designing Solutions for 2030: An Asian Perspective

***Number* of students: 66 (37 overseas, 29 DCC) –over-subscribed**

In-campus accommodation (4 in 1 apartment in U-town)

Registration Fee: S$300 (overseas) S$200 (local)

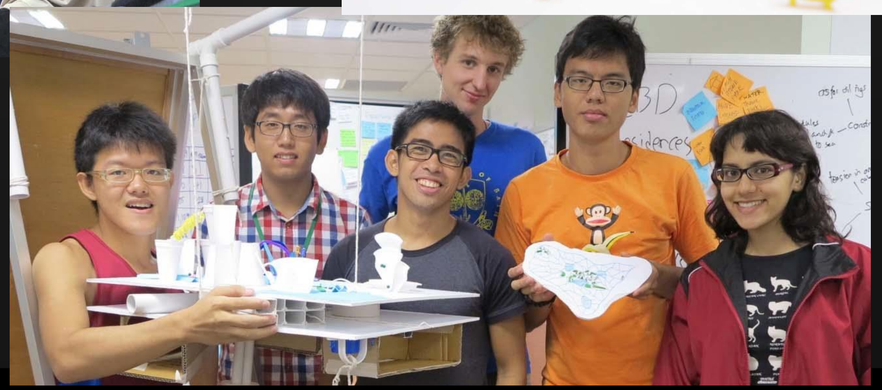
2-week day programme + student-led evening programme

80% of EDIC staff heavily involved in execution

Over 20 DCC student helpers (airport pick-up, evening events)

Design Summer Programme 2012

Designing Solutions for 2030: An Asian Perspective



Design Summer Programme 2012

Designing Solutions for 2030: An Asian Perspective

Participants in DSP2012 given a stimulating introduction by representative from Autodesk on the capabilities of Autodesk software to help students in the designing of solutions in their project work.

Design Summer Programme 2012

Designing Solutions for 2030: An Asian Perspective

Field Visits

- Land Transport Authority (LTA)
- Urban Redevelopment Authority (URA)
- Housing Development Board (HDB)
- Ubin Island (R&R)
- Zero Energy Building (ZEB)
- Semakau Island Landfill

DSP2012 Assessment Criteria

DSP2012 Final Presentation 3rd August 2012- Scoring Sheet

PANEL MEMBER NAME: _____

Marks: 1----------2----------3----------4----------5
Achievement Level: Elementary---------Intermediate---------Advanced

Judging Criteria	Team 1	Team 2	Team 3	Team 4	Team 5	Team 6	Team 7	Team 8	Team 9	Team 10	Team 11
1. The problem identified is given solid justification to show it is deserving of attention. **(max: 5 marks)**											
2. The proposed solution is feasible, realistic and implementable by 2030 (i.e. not far-fetched and have to rely on assumed non-existent technologies/capabilities) **(max:5 marks)**											
3. The proposed solution is innovative and it optimizes local resources and considers local constraints, customs, social norms (i.e. local solution for local context) **(max: 5 marks)**											
4. The presentation is inspiring, clear, convincing and well executed by team **(max: 5 marks)**											
5. Ability to answer questions during Q&A time. **(max: 5 marks)**											
TOTAL (max: 25 marks)											

1. Problem Definition
2. Feasibility of solution
3. Level of innovation
4. Presentation skills
5. Ability to answer questions

Features of DCC student groups

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Features of DCC student groups

- Multi-disciplines (student members in a group from various departments)
- Size of group: from 2-6 students
- Multi-national (ASEAN region + China and India)*
- Self-formed
- Self-defined problem
- Multi-year: 3-3.5 year long project
- Supervised by a Principal Supervisor plus co-supervisor
- Access to expert staff in the whole faculty of engineering & beyond (NUS and industry partners)

DCC Learning Outcomes

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Desired Traits in DCC Graduates

1. Possess depth of expertise in their fields of specialization
2. Take on new challenges and be comfortable with tackling the unfamiliar
3. Identify and define problems and formulate innovative and creative solutions
4. Take ideas from conceptualization through to design, implementation and operation
5. Engage in systems-level thinking and deal with complex systems
6. Articulate ideas effectively
7. Lead or work in a multi-disciplinary team
8. Appreciate the cultural and social dimensions of design

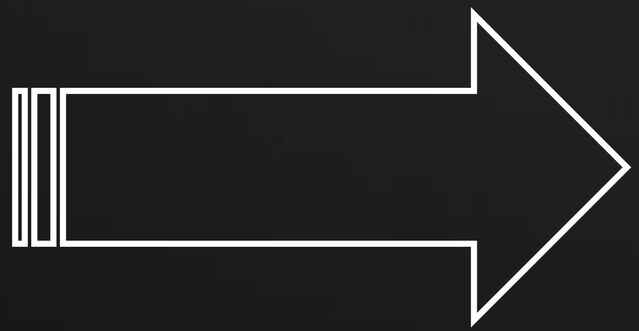
Translate into a list of specific learning outcomes

Expected Learning Outcomes (derived)

1. Ability to look at the broader context
2. Ability to accepts contradiction and ambiguity
3. Ability to leverage on diversity,
4. Ability to grasp complex concepts
5. Ability to apply mathematical, scientific and engineering principles to solve problem
6. Use of system thinking tools
7. System dynamics skills
8. Ability to see the commercial potential of problem and solution
9. Ability to see constraints as opportunities
10. Awareness of current affairs and socio-cultural trends.
11. Ability to evaluate socio-cultural impact on project
12. Ability to synthesise, filter and process information
13. Ability to apply analytical skills to break down complex problems
14. Ability to design engineering processes and products to meet desired needs.
15. Ability to use information to arrive at informed decision
16. Ability to plan work processes and identify bottlenecks
17. Ability to lead in a team and work as a team member
18. Ability to use IT for team collaboration
19. Develop ability to motivate others, persuading and influencing others, negotiation,
20. Develop ability to co-operating giving/accepting constructive criticism
21. Ability to adapt (recovery from setback), initiative
22. Ability to communicate effectively in multidisciplinary teams
23. Ability to present ideas in writing and speaking in a variety of professional context

How to assess level of student learning?

- Before we can list out the assessment criteria to assess level of attainment of the expected learning outcome, here are 3 operational questions to address…



Assessment Criteria in the assessment rubrics

What activities are we going to assess?

What rubrics do we need to have?

Who is/are going to do the assessment?

3 Operational Questions

1. What activities in the DCC program nurture these traits?

a.Working in a team
b.Project deliverables
c.Special DT modules
d.DCC seminar modules
e.Design summer school
f. Coaching/feedback

2.How are the growth of these traits monitored & assessed?

7 Rubrics to grade learning outcomes & to guide assessment process.

- includes interview by mentor (to enhance assessment)

The assessment process provides
- Formative assessment (feedback)
- Summative assessment (grading)

3.Who will do the assessment?

a.Mentor (C. Supervisor & Specialist Expert)
b.User (of the product/solution)
c.Peer
d.Self

Types of student deliverables

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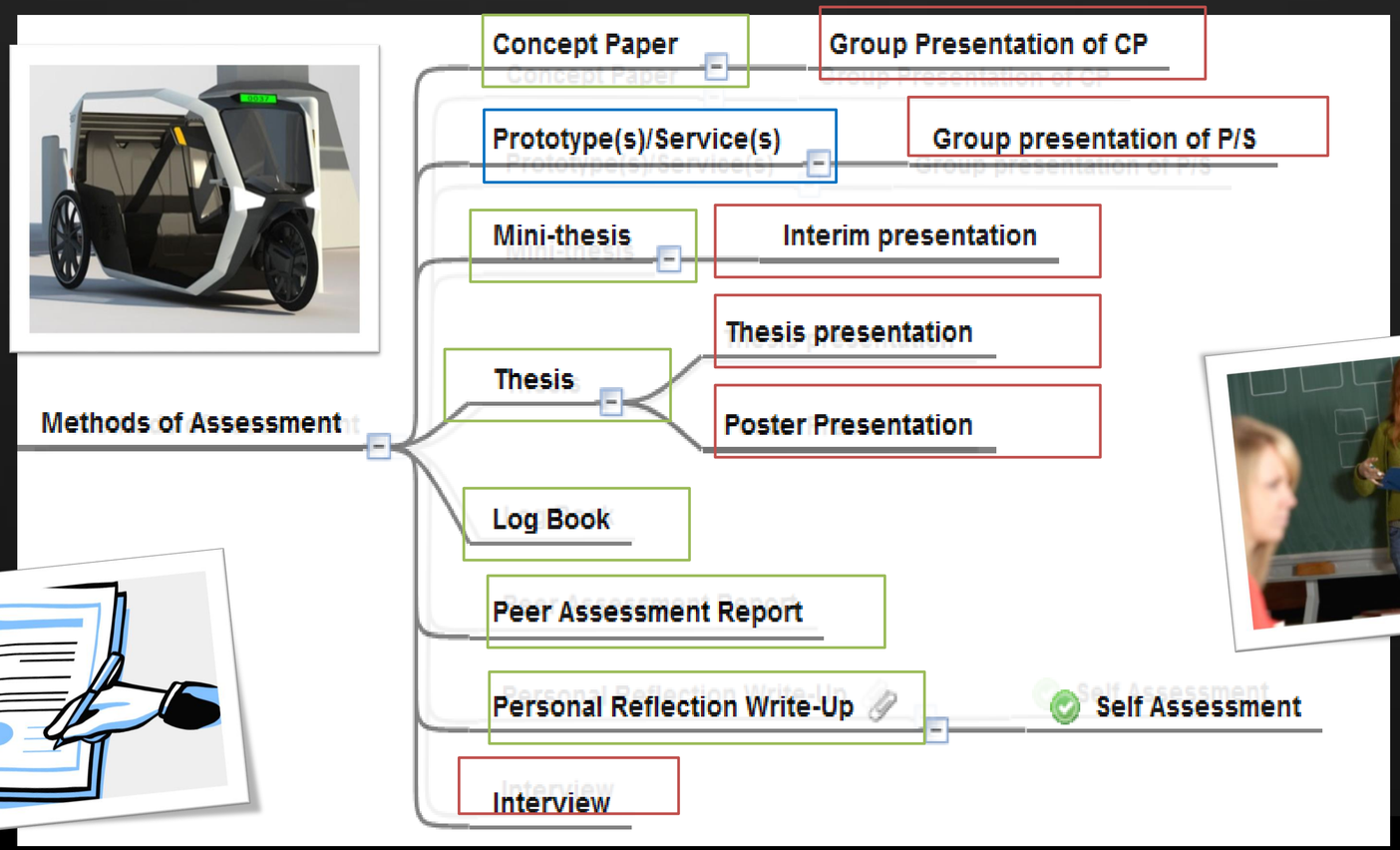
Types of student deliverables

There are 3 forms of deliverables:
(1) Pen and Paper (2) Presentation (3) Physical representation



7 assessment rubrics
Criteria based on elements of the 8 desired traits

Types of student deliverables

Emphasis on both team work and individual work

Group deliverables:
All students in the group have common marks

Individual deliverables:
Peer assessment as reference for tweat for individual merits

	Type of Deliverables	
DCC Deliverables	Individual Deliverables	Group Deliverables
Presentation	✓	✓
Logbook	✓	
Personal Reflection	✓	
Peer Assessment	✓	
Thesis Proposal Report		✓
Model of Concept and Report		✓
Thesis	✓	

Deliverable Packs	Documents and/or Presentations required				
Thesis Proposal	Presentation	Report	-	-	-
Technical Design 1	Presentation	Logbook	Personal Reflection	Peer Assessment	Model of concept + Report
Technical Design 2	Presentation	Logbook	Personal Reflection	Peer Assessment	Model of concept + Report
Thesis Update	Presentation	-	-	-	-
Final Thesis	Presentation	Logbook	Personal Reflection	Peer Assessment	Thesis

Student project deliverables for project

Marks for	Documents and/or Presentations required					Total
Semester 5	TP + MC Presentations (5%+ 10%)	Logbook (15%)	Personal Reflection (10%)	Thesis Proposal Report (20%)	Model of Concept (MC) & Report (40%) + Peer Assessment	100%
Semester 6	Presentation (15%)	Logbook (15%)	Personal Reflection (10%)	Model of Concept & Report (60%) + Peer Assessment		100%
Semesters 7 & 8	Presentations* (*Sem. 7*: 10%, *Sem. 8*: 15%)	Logbook (*Sem. 7*: 7.5%, *Sem. 8*: 7.5%)	Personal Reflection (*Sem. 7* : 5%, *Sem. 8* : 5%)	Prototype/ Demonstration (25%) + Final Thesis (25%) (*Sem. 8* only)		100%

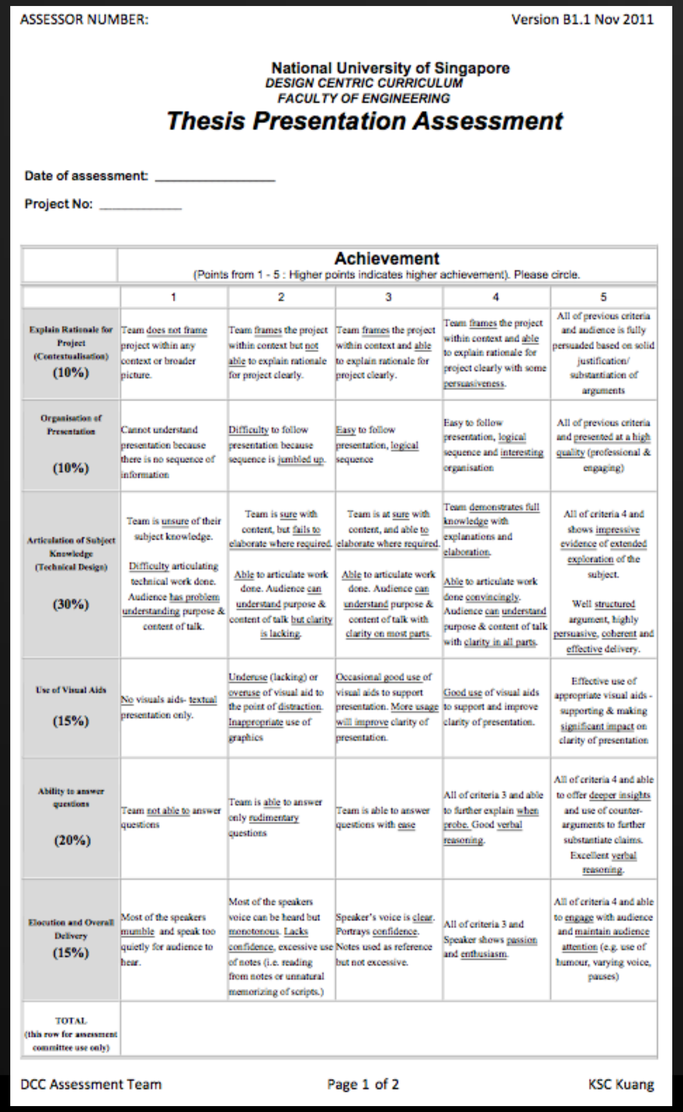
Designing Rubrics Considerations

Rubrics for DCC projects

- Rubric directs student effort in their learning, the scoring criteria must be clearly specified before the student begin work.
- The following are considerations taken in developing the rubrics used for assessment of DCC projects.

1. Clear Expectations
2. Mastery Level
3. Multi-dimensional
4. Grade distinction
5. High but attainable standards: cumulative criteria
6. Allowance for part marks & flexibility

Examples of rubrics based on learning outcomes



ASSESSOR NUMBER: Version B1.1 Nov 2011

National University of Singapore
DESIGN CENTRIC CURRICULUM
FACULTY OF ENGINEERING

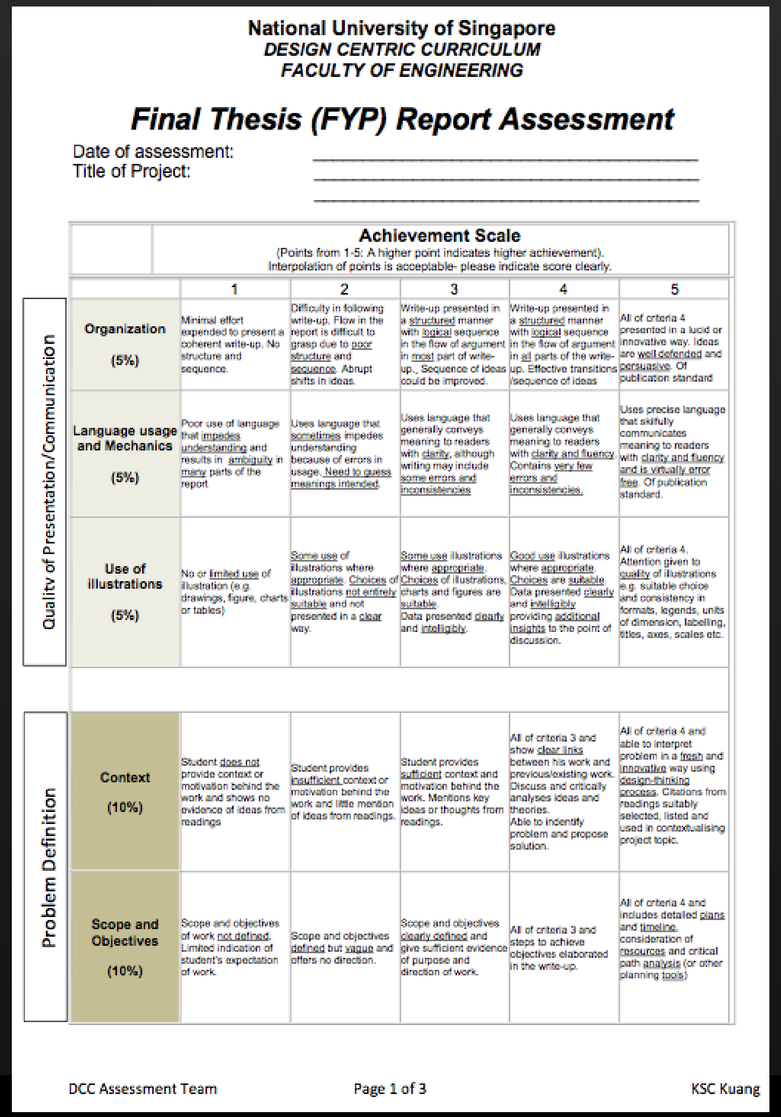
Thesis Presentation Assessment

Date of assessment: _____

Project No: _____

	Achievement (Points from 1 - 5 : Higher points indicates higher achievement). Please circle.				
	1	2	3	4	5
Explain Rationale for Project (Contextualisation) (10%)	Team does not frame project within any context or broader picture.	Team frames the project within context but not able to explain rationale for project clearly.	Team frames the project within context and able to explain rationale for project clearly.	Team frames the project within context and able to explain rationale for project clearly with some persuasiveness.	All of previous criteria and audience is fully persuaded based on solid justification/ substantiation of arguments
Organisation of Presentation (10%)	Cannot understand presentation because there is no sequence of information	Difficulty to follow presentation because sequence is jumbled up.	Easy to follow presentation, logical sequence	Easy to follow presentation, logical sequence and interesting organisation	All of previous criteria and presented at a high quality (professional & engaging)
Articulation of Subject Knowledge (Technical Design) (30%)	Team is unsure of their subject knowledge. Difficulty articulating technical work done. Audience has problem understanding purpose & content of talk.	Team is sure with content, but fails to elaborate where required. Able to articulate work done. Audience can understand purpose & content of talk but clarity is lacking.	Team is at sure with content, and able to elaborate where required. Able to articulate work done. Audience can understand purpose & content of talk with clarity on most parts.	Team demonstrates full knowledge with explanations and elaboration. Able to articulate work done convincingly. Audience can understand purpose & content of talk with clarity in all parts.	All of criteria 4 and shows impressive evidence of extended exploration of the subject. Well structured argument, highly persuasive, coherent and effective delivery.
Use of Visual Aids (15%)	No visuals aids- textual presentation only.	Underuse (lacking) or overuse of visual aid to the point of distraction. Inappropriate use of graphics	Occasional good use of visual aids to support presentation. More usage will improve clarity of presentation.	Good use of visual aids to support and improve clarity of presentation.	Effective use of appropriate visual aids - supporting & making significant impact on clarity of presentation
Ability to answer questions (20%)	Team not able to answer questions	Team is able to answer only rudimentary questions	Team is able to answer questions with ease	All of criteria 3 and able to further explain when probe. Good verbal reasoning.	All of criteria 4 and able to offer deeper insights and use of counter-arguments to further substantiate claims. Excellent verbal reasoning.
Elocution and Overall Delivery (15%)	Most of the speakers mumble and speak too quietly for audience to hear.	Most of the speakers voice can be heard but monotonous. Lacks confidence, excessive use of notes (i.e. reading from notes or unnatural memorizing of scripts.)	Speaker's voice is clear. Portrays confidence. Notes used as reference but not excessive.	All of criteria 3 and Speaker shows passion and enthusiasm.	All of criteria 4 and able to engage with audience and maintain audience attention (e.g. use of humour, varying voice, pauses)
TOTAL (this row for assessment committee use only)					

DCC Assessment Team Page 1 of 2 KSC Kuang



National University of Singapore
DESIGN CENTRIC CURRICULUM
FACULTY OF ENGINEERING

Final Thesis (FYP) Report Assessment

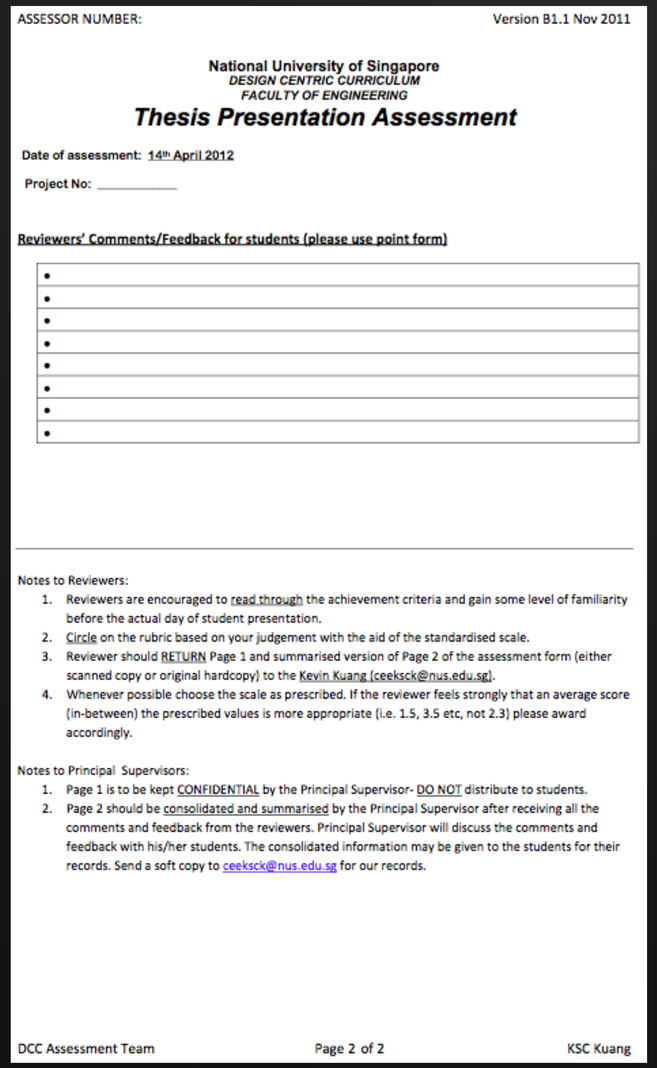
Date of assessment: _____
Title of Project: _____
_____
_____

		Achievement Scale (Points from 1-5: A higher point indicates higher achievement). Interpolation of points is acceptable- please indicate score clearly.				
		1	2	3	4	5
Qualitv of Presentation/Communication	**Organization (5%)**	Minimal effort expended to present a coherent write-up. No structure and sequence.	Difficulty in following write-up. Flow in the report is difficult to grasp due to poor structure and sequence. Abrupt shifts in ideas.	Write-up presented in a structured manner with logical sequence in the flow of argument in most part of write-up., Sequence of ideas could be improved.	Write-up presented in a structured manner with logical sequence in the flow of argument in all parts of the write-up. Effective transitions /sequence of ideas	All of criteria 4 presented in a lucid or innovative way. Ideas are well defended and persuasive. Of publication standard
	Language usage and Mechanics (5%)	Poor use of language that impedes understanding and results in ambiguity in many parts of the report	Uses language that sometimes impedes understanding because of errors in usage. Need to guess meanings intended.	Uses language that generally conveys meaning to readers with clarity, although writing may include some errors and inconsistencies	Uses language that generally conveys meaning to readers with clarity and fluency Contains very few errors and inconsistencies.	Uses precise language that skilfully communicates meaning to readers with clarity and fluency and is virtually error free. Of publication standard.
	Use of illustrations (5%)	No or limited use of illustration (e.g. drawings, figure, charts or tables)	Some use of illustrations where appropriate. Choices of illustrations not entirely suitable and not presented in a clear way.	Some use illustrations where appropriate. Choices of illustrations, charts and figures are suitable. Data presented clearly and intelligibly.	Good use illustrations where appropriate. Choices are suitable. Data presented clearly and intelligibly providing additional insights to the point of discussion.	All of criteria 4. Attention given to quality of illustrations e.g. suitable choice and consistency in formats, legends, units of dimension, labelling, titles, axes, scales etc.
Problem Definition	**Context (10%)**	Student does not provide context or motivation behind the work and shows no evidence of ideas from readings	Student provides insufficient context or motivation behind the work and little mention of ideas from readings.	Student provides sufficient context and motivation behind the work. Mentions key ideas or thoughts from readings.	All of criteria 3 and show clear links between his work and previous/existing work. Discuss and critically analyses ideas and theories. Able to indentify problem and propose solution.	All of criteria 4 and able to interpret problem in a fresh and innovative way using design-thinking process. Citations from readings suitably selected, listed and used in contextualising project topic.
	Scope and Objectives (10%)	Scope and objectives of work not defined. Limited indication of student's expectation of work.	Scope and objectives defined but vague and offers no direction.	Scope and objectives clearly defined and give sufficient evidence of purpose and direction of work.	All of criteria 3 and steps to achieve objectives elaborated in the write-up.	All of criteria 4 and includes detailed plans and timeline, consideration of resources and critical path analysis (or other planning tools)

DCC Assessment Team Page 1 of 3 KSC Kuang

Part 1: Scoring rubric by assessor

Examples of rubrics based on learning outcomes



ASSESSOR NUMBER: Version B1.1 Nov 2011

National University of Singapore
DESIGN CENTRIC CURRICULUM
FACULTY OF ENGINEERING

Thesis Presentation Assessment

Date of assessment: 14th April 2012

Project No: _____

Reviewers' Comments/Feedback for students (please use point form)

-
-
-
-
-
-
-
-

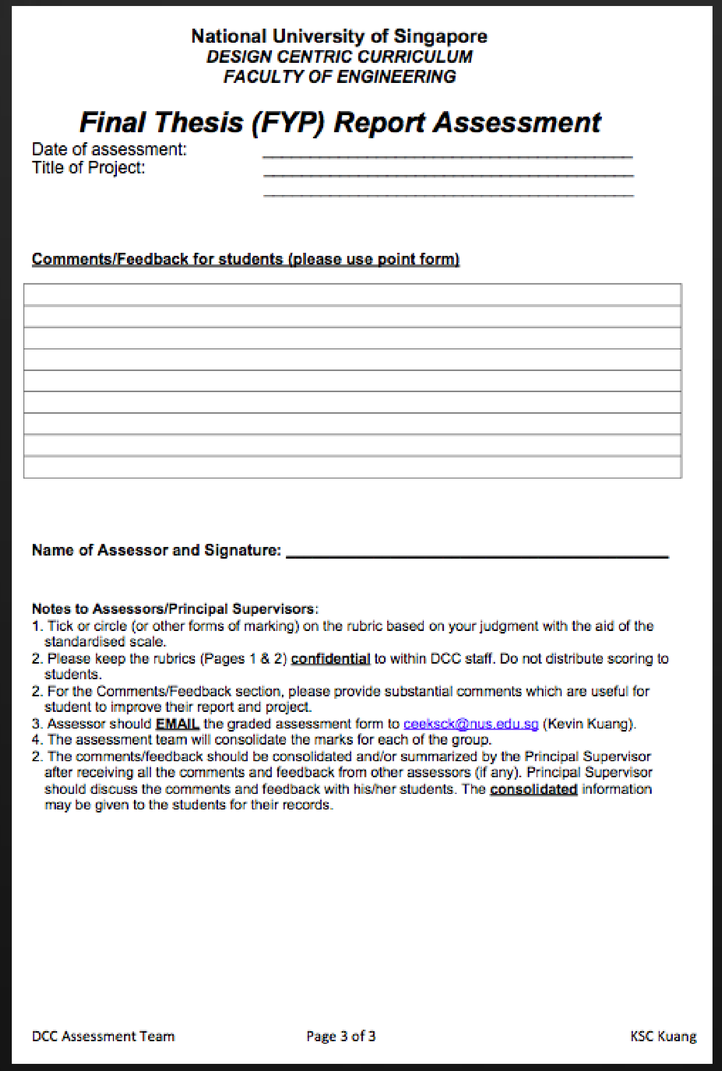
Notes to Reviewers:

1. Reviewers are encouraged to read through the achievement criteria and gain some level of familiarity before the actual day of student presentation.
2. Circle on the rubric based on your judgement with the aid of the standardised scale.
3. Reviewer should RETURN Page 1 and summarised version of Page 2 of the assessment form (either scanned copy or original hardcopy) to the Kevin Kuang (ceeksck@nus.edu.sg).
4. Whenever possible choose the scale as prescribed. If the reviewer feels strongly that an average score (in-between) the prescribed values is more appropriate (i.e. 1.5, 3.5 etc, not 2.3) please award accordingly.

Notes to Principal Supervisors:

1. Page 1 is to be kept CONFIDENTIAL by the Principal Supervisor- DO NOT distribute to students.
2. Page 2 should be consolidated and summarised by the Principal Supervisor after receiving all the comments and feedback from the reviewers. Principal Supervisor will discuss the comments and feedback with his/her students. The consolidated information may be given to the students for their records. Send a soft copy to ceeksck@nus.edu.sg for our records.

DCC Assessment Team Page 2 of 2 KSC Kuang



National University of Singapore
DESIGN CENTRIC CURRICULUM
FACULTY OF ENGINEERING

Final Thesis (FYP) Report Assessment

Date of assessment: _____
Title of Project: _____
_____

Comments/Feedback for students (please use point form)

Name of Assessor and Signature: _____

Notes to Assessors/Principal Supervisors:

1. Tick or circle (or other forms of marking) on the rubric based on your judgment with the aid of the standardised scale.
2. Please keep the rubrics (Pages 1 & 2) **confidential** to within DCC staff. Do not distribute scoring to students.
2. For the Comments/Feedback section, please provide substantial comments which are useful for student to improve their report and project.
3. Assessor should **EMAIL** the graded assessment form to ceeksck@nus.edu.sg (Kevin Kuang).
4. The assessment team will consolidate the marks for each of the group.
2. The comments/feedback should be consolidated and/or summarized by the Principal Supervisor after receiving all the comments and feedback from other assessors (if any). Principal Supervisor should discuss the comments and feedback with his/her students. The **consolidated** information may be given to the students for their records.

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Part 2: Textual feedback by assessor

Some comments on the rubrics

1. Assessors' panel made up of multiple staff from DCC and host department representative. Variation due to assessor subjectivity minimised
2. Quality of feedback received by students depend to a large degree on the effort of assessor to provide details, actionable feedback
3. Criticism from all staff involved in the assessment are vital to improve the rubrics. Rubrics always WIP (many rounds of iterations)
4. All assessors must be familiar with the assessment criteria to be able to provide accurate assessment and useful feedback to students

Final moderation at host department end

- Mapping of credit from DCC to host deparment
- Before students received their final grade for their DCC modules, host department will moderate the marks based on department's bell curve.
- Mapping of DCC modules to host department bell curve is currently the most tedious process.
- Future plans to assigned separate module codes for DCC work done instead of mapping back to host department (current restriction).

Concluding remarks

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1. The DCC experience is an alternative way of learning.
2. We believe the vehicle to achieve to achieve the learning outcome/desired traits is the multi-year project which allow students to start working right at the start- over to make learning more intentional and impactful. You do and you learn.
3. We believe a team-based approach in project work provides a real-world setting where collaboration and creativity is allows the room to grow and blossom.
4. Tools such as assessment rubrics based on to specific learning outcomes needs to be continuously improve with feedback from all assessors involved in the assessment process and understand mandate of DCC well.

Thank you

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