2009
School-assessed Task Report

Systems Engineering GA 2

BACKGROUND INFORMATION
The School-assessed Task is undertaken over Units 3 and 4. The components of the School-assessed Task are completed to demonstrate achievement of Outcome 2, in both Units 3 and 4.

Unit 3: Systems engineering and energy
Outcome 2
Design, plan, construct and document an integrated system to be completed in Unit 4 Outcome 2, and effectively use diagnostic procedures for the system.

Nature of task
A record of research, design, planning and production
and
Production work

Unit 4: Integrated and controlled systems engineering
Outcome 2
Select components for, construct, diagnose, adjust, modify and repair an integrated technological system and its control devices commenced in Unit 3 Outcome 2, and provide an evaluation report of the system, its performance and the management of the project.

Nature of task
Production work accompanied by a record of progress and modifications (pictorial and text material)
and
A report of diagnostic testing and performance data
and
An evaluation report

Scope of task
The record of design, planning and production should include:
- a design brief (student or teacher generated)
- criteria for evaluating the integrated, controlled system
- research (background information to produce ideas for the design options such as safety, relevant Australian Standards, conventions, components, materials, processes, component assembly methods, suitability of tools, equipment and machines). Students must accurately cite all sources of information they use
- design alternatives and options. Where relevant, alternative options should be provided and the preferred option should be clearly indicated with justification for its selection
- a design plan (drawings, sketches, annotations, diagrams, block diagrams, flow charts) for the configuration, assembly, integration and resourcing of manufactured systems, subsystems and components intended to produce an operational device with a **control device**
- components and materials list, including sources and cost
- a production work plan (including processes, proposed methods of diagnostic testing and a timeline for the manufacture of the integrated system)
- a record of progress that may include photographic evidence of production work (e.g. logbook) including decisions made and notes of modifications with justifications.

Where appropriate, students should use information and communications technology (ICT) in the production of the record of design, planning and production and documenting diagnostic testing and the evaluation report. Where ICT is used, hard copy printouts must be provided.

One product only is to be completed over Units 3 and 4. By the end of Unit 3 the production work should be partially constructed. By the end of Unit 4, the production work will result in an operational device in the form of an integrated system with a control device; that is, a system which is a functional integration of a mechanical subsystem (includes pneumatic, hydraulic) and an electrotechnology (electrical/electronic) subsystem (includes microelectronic). All products must be compliant with safety standards and Australian Standards. Risk assessment and risk management must be addressed throughout the design, construction, testing and operation of the product, which must adhere to safety standards, laws and regulations.

In Unit 4, the evaluation report should be based on the previously developed criteria. The report will include references to the results of at least one diagnostic test carried out on the student's system to assess the functioning and performance of the integrated system with a control device, providing it is not hazardous to do so.

When undertaking diagnostic procedures students need to document (using appropriate technical language):

- the purpose of the test
- procedural steps to perform the test including the equipment used
- expected results
- actual results of the test in quantified (numerical) form
- explanation of the results.

Students are also required to evaluate their management of the project and their work practices.

Teachers must sight and monitor the development and documentation of the student's work on a regular basis. The Authentication Record for School-assessed Tasks should be used for monitoring student's work in progress for authentication purposes. This sheet must be available if requested by the VCAA. If the work is required for review by the VCAA, teachers must produce the Additional Comment Sheet to document skills and competencies; particularly those relating to the safe use of tools, equipment and machines and construction methods that may not be apparent from only viewing the students work.

The information on completing the relevant information for the Teacher Additional Comment Sheet is published in the School assessment Supplement to the February *VCAA Bulletin VCE, VCAL and VET*.

GENERAL COMMENTS

Advice on management and organisation

Conditions which are conducive to student achievement in the School-assessed Task include well-managed, organised classrooms/work areas and provision of relevant technical resource materials. Teachers need to provide guidelines on the selection of appropriate tasks, timelines, due dates and the requirements of the task. Regular monitoring of progress is also important in supporting and encouraging students through their tasks. Discussion and ongoing feedback assists students in remaining focused on their work throughout the duration of the task. Structuring the task through the various stages of its development is useful and timelines should be set to assist students.
Teachers should document skills and competencies related to Criteria 3, 4, 5 and 6 that may not be clearly demonstrated in the students' final presentation on the Additional Teacher Comment sheet. This is available at:

www.vcaa.vic.edu.au/vcaa/schooladmin/forms/vce/additionalcomment.pdf
www.vcaa.vic.edu.au/vce/studies/systemseng/systemsengindex.html

Features of successful folio and production work

A wide range of topics was explored in the School-assessed Task. Most students negotiated production topics with their teacher. They organised work plans, work processes and set goals for completion and evaluation.

Successful student work exhibited the following features:

- the production tasks were completed using a diverse range of work processes requiring a high degree of skill and knowledge
- design plans were thorough, detailed in depth and content with a range of design proposals or options; justifications were made for selection of appropriate options and developed solutions
- diagnostic tests were planned with expected and actual outcomes identified; a sound analysis of the test data was made and explained
- evaluation reports were thorough and discussed the production activities as well as the practical outcomes of the task
- production activities involved working on an integrated system, its subsystems, parts and components; appropriate steps were taken to control the system, its inputs, processes and outputs
- completed systems were operational and produced to a very high standard of assembly and finish
- work required a high degree of effort and time to achieve completed and operational status
- folio work was of high standard in content and detail; a range of communication techniques was used to present information and design work.

Types of products

Examples of successful production activities selected for the School-assessed Task were:

micro-controlled toys and games
electromechanical toys and games
controlled robot arms and vehicles
controlled solar systems integrated through to a mechanical subsystem
controlled model houses
model watercraft and aircraft
controlled light and sound systems.

Areas of strength and weakness

Production tasks that were of a high standard reflected the emphasis on quality practical work. With few exceptions the products were integrated systems characterised by ‘input–process–output and control’ of integrated electrical, electronic and mechanical subsystems. An increasing number of micro-controlled systems (predominately ‘Picaxe’ based) was apparent.

Safety

It was evident that some very dangerous productions, equipment use, and practices had been undertaken by students. The state legislation is now quite specific about the very low power ratings of powered vehicles; bikes; scooters; go karts that are designed and built with the intention to transport people. The low power rating essentially makes the powered vehicles move at speed which is less than walking pace, or also need human kinetic input for motion to be sustained for any period. The regulatory requirement combined with the Australian standards that must be adhered for plant, equipment or machinery that has the intention of transporting people is very difficult to implement and would generally be viewed as being well beyond the scope of the School-assessed Task. For example, concerns were raised by the reviewers about a goods lift that was constructed for moving goods into a loft area. While it was not intended that people rode on the lift, fundamental structural engineering issues arose such as: structural design, engineering calculations, issues of overloading and compliance with Australian Standards with this type of project. Also, students should not be working on the actual mains 240-volt wiring connections within any equipment. If students are using mains connected equipment as part of their project, it should be a ‘tested and tagged’ piece of equipment which is used. Examples of such equipment that could be used as part of the constructed system could include laptops, power supplies, audio amplifiers, electric drills and video monitors. When reviewers identify products which are potentially dangerous, the process is to report the product to the school Principal.

Teachers and students should note:
Most projects incorporated control of integrated systems; successful student production activities involved work on integrated systems with processes such as manufacture, repair, modification and assembly of elements and subsystems within controlled operating systems.

High level evaluation responses involved students commenting on and evaluating their production outcomes by comparing the production plan with the actual outcomes of the production work plans, processes, modifications and difficulties encountered.

Technical data (obtained from the diagnostic test and essential relevant texts) was used to prove how well the system was performing, rather than static data presented, such as voltages that were recorded. Design and planning work should be thorough and reflect requirements of the assessment criteria. Students should consider a range of possible ideas or options then select from these for further development. Justifications should be made for selecting what should be the most appropriate option. Students who produced both design and production plans with limited detail were disadvantaged as they had little documentation to refer to when assessing and evaluating their work and related planning activities.

Some tasks did not involve the ‘control of a system’ as required for this task. Production work should involve developing an ‘operational integrated and controlled system’.

Using commercially produced kits and working with simple or basic projects can disadvantage students as this limits the scope of designing, planning and production activities; less complex kits can be suitable as a subsystem of a larger integrated system.

Some systems were not fully integrated; these systems were generally very simple to make and did not use a sufficient range of processes and skill level to achieve high grades. These tasks did not fully satisfy the task criteria for the product to be an ‘integrated system’ as they did not comprise mechanical and electrical or electronic subsystems.

The use of projects that require mains 240-volt AC power appear to be diminishing; teachers should refer to advice on electrical power supply and related safety issues published in the *VCE Systems Engineering Study Design* (page 9).

Workbooks and prepared worksheets

A number of schools used commercially produced workbooks and/or pro formas. Concerns were raised by the reviewers if the workbook alone, was the only documentation used to support the completed project. It was felt that some publications seriously limited students in developing a relevant and thorough folio, consisting of detailed plans, tests and evaluations. If teachers prepare work sheets or use the commercially available workbooks they should be employed as a drafting tool, rather than be the basis of the completed task. Some commonly occurring issues were a few lines for students to justify options or to complete an evaluation. Another significant issue of the reviewed work was actually finding the relevant information related to assessment criterion, as they were disjointed or not related to the 2009 assessment criteria. Teachers are encouraged to develop their own project task guidelines each year. These could be based on a combination of the relevant outcomes/ key knowledge and key skills in the study design and the task criteria and use of headings linked to each criterion and related sub-criterion points.

It is recognised that some students may enter Units 3 and 4 without any previous experience in Systems Engineering. In such cases teachers or class groups have produced the same or similar projects. It is important that each student does their own work, and that the students' work contains the important elements of research, design, planning, manufacture, diagnostic testing and product evaluation. A smaller scale project that combines these elements is better far better than a larger project that has not been completed. The School-assessed Task requires assessment of individual student work. Students are required to propose and develop individual products of their own choice, with guidance from their teacher.

Diagnostic practice

Diagnostic testing can and should be performed at relevant stages of the production, with final testing on completion of the system. Diagnostic testing needs to relate to the production activity and not be just an unrelated activity developed by the teacher to satisfy the outcome. It involves using test or measuring equipment to assess the performance of a system and its parts in terms of input–process–output and effective control. The data obtained as a result of the diagnostic testing is used to gain a greater understanding of the system, rectify problems or to measure its performance against prescribed, recognised or expected standards.
Tests were usually performed:

- at the beginning of the task, in order to determine faults
- during the production task, as a means of testing a sub-system
- in most cases, at the end of the production activity to determine the outcome and operational effectiveness of the system.

For 2010 the VCAA has published a formula sheet and worked examples for Systems Engineering. Teachers and students may wish to refer to it particularly when addressing the diagnostic testing criteria. These documents are available from the Systems Engineering page on the VCAA website.

Further information

Teachers should refer to:

VCAA website
<www.vcaa.vic.edu.au/vce/studies/systemseng/systemsengindex.html>

VCE Systems Engineering Study Design 2007–2010
<www.vcaa.vic.edu.au/vce/studies/systemseng/Systems-Eng-SD-2007.pdf>

Study design amendment, November2006
<www.vcaa.vic.edu.au/vce/studies/systemseng/syseng-sdchanges.html>

2010 Advice for School assessment
<http://www.vcaa.vic.edu.au/correspondence/bulletins/2010/bulletin2010.html>

VCE Assessment Handbook Systems Engineering
<www.vcaa.vic.edu.au/vce/studies/systemseng/SystemsEngHB.doc>

Seasons of Excellence – Top Designs
<www.vcaa.vic.edu.au/excellenceawards/seasonofexcellence/index.html>

Professional development and other support are available through the *Design and Technology Teachers Association Victoria*
<www.datta.vic.edu.au>.