

Concept2Creation

Teacher Implementation Guide

February 2011



C2CTeacher Implementation Guide

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1. Introducing C2C

Concept2Creation (C2C) is managed by the Northern Advanced Manufacturing Industry Group (NAMIG).

It is a suite of programs that can be utilised as an ongoing process across the year levels and curriculum to:

- Initiate inquiry/research through contextualised project-based learning;
- Develop self awareness and employability skills, particularly teamwork, communication and critical thinking;
- Promote the relevance of and more fully engage students in curriculum, particularly Maths, Science and Technology;
- Create awareness of the diversity of Advanced Manufacturing and of the course and career pathways that exist within this industry sector.

These outcomes are important regardless of whether students intend pursuing professional, technical or trade level pathways.

The C2C suite of programs should be particularly considered for students with strong interests and abilities in STEM subjects.

Industry partners provide tours, talks, professional development, project briefs and project mentors to create relevance and a real-world context for student projects.

Tertiary partners support undergraduates to act as project mentors and facilitate opportunities for participating schools to access professional development and advice from relevant faculties and research institutes.

The BAE Systems/C2C Scholarship Program is available for C2C students enrolling in university or TAFE courses that align with BAE's recruitment needs. Currently there are three scholarships available each year, these include paid work placement opportunities and provision of mentors and buddies for each under-graduate.

2. A Summary of the C2C Suite of Programs

The **C2C Program (Year 10)** is identified as the heart of the suite of programs. It epitomises the philosophy of the entire program by fostering innovation and creativity within an authentic project management experience. At this stage student teams have free choice to identify their concept. The complementary programs are seen as preparatory and extension elements.



The C Program (Middle Years)

“C” (as in “See”) programs provide an introduction to Advanced Manufacturing. This can be:

- Tours;
- Talks;
- Simple tasks/projects;
- Linkage with a participating secondary school.

Some of the above might be achieved by utilising the Speakers In Schools and similar opportunities offered by other providers. NAMIG also supports participation in the CSIRO CREST program as a means of introducing C2C in schools.

These projects might progress from simple activities, through to some introductory electronics projects, C2C In Space or the Engineers Without Borders program. EWB enables classes to enter via SOSE or STEM subjects to develop engineering solutions with Third World communities.

Short courses in some relevant skills are available through partnering tertiary institutions for Year 9 & 10 students of schools that plan to integrate C2C in higher year levels.

The C2C Program (Year Ten)

- **Student teams initiate and develop a concept using a project management approach and basic research and development skills;**
- **At this stage students are given free choice to foster innovation and creativity;**
- **Assistance through tours, mentors and training in Lean Manufacturing;**
- **Scope for cross-curricular recognition;**
- **Presentation at expos highlighting their formative research and development skills and accomplishments.**

This program supports small teams of students to identify a concept for a product or service that aligns with Advanced Manufacturing and to utilise a project management approach to create it. There is an expectation that tours, relevant training and mentorship by industry and tertiary education partners will be a key component of the program. Just like in industry, a pre, mid and post appraisal process will inform the projects. The major focus is upon creativity and that learning is in the process rather than the product. Again as in industry, projects can be R&D or just research or development.

A Summary of the C2C Suite of Programs (cont/d)

The C2C+ Program (Year Eleven)

- Industry-developed projects, ie UAV, SWAT and Holden, see C2C website for details.
- Student teams undertake more advanced projects compared to the C2C program;
- Assistance through tours, training, mentors and appraisals;
- Scope for cross-curricular and VET recognition;
- Presentation at expos demonstrating more refined research and development skills and accomplishments.

This program provides small teams of students with a range of concept briefs that have been developed by industry partners. Using project management skills, plus training and mentorship that is offered through C2C+, teams work to take the concept to creation.

The C2C² Program (Year Twelve)

Two possibilities:

- Extension of C2C+ or negotiated learning relevant to Advanced Manufacturing (Research Project).
- Assistance in preparation for:
 - a) Transition to tertiary education;
 - b) BAE/NAMIG scholarship application.

The C2C Similar Program (Year Ten–Twelve)

This option enables NAMIG to provide some assistance to schools that are currently conducting programs that complement the C2C suite of programs, ie CSIRO in Schools, Industry Pathways Programs, Pedal Prix.

C2C is an ongoing career development process rather than a series of events

3. Integrating with curriculum

The following summary of relevant frameworks is provided to assist teachers in mapping C2C activities against curriculum requirements. A study of learning outcomes that are stipulated within specific subject descriptions will identify other opportunities for aligning the Project Based Learning of C2C within curriculum planning.

The “Melbourne Declaration” identifies a national curriculum framework that pursues two key goals:

- G1 Australian schooling promotes equity and excellence;
- G2 All young Australian becomes: successful learners; confident and creative individuals; active and informed citizens.

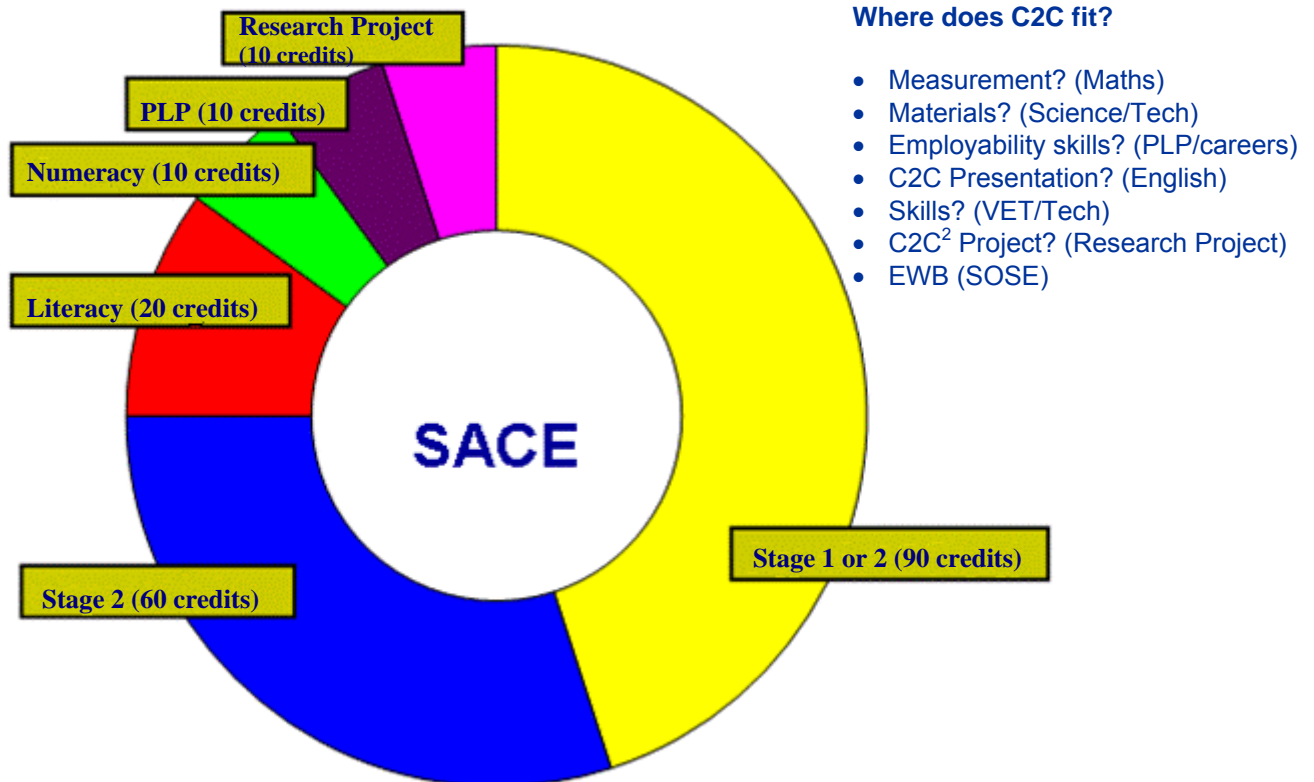
and the following perspectives:

- Sustainable patterns
- Indigenous perspective
- Skills, knowledge and understanding related to Asia.

C2C has the capacity to integrate these goals and perspectives.

SACSA Essential Learnings	SACE Capabilities	Employability Skills	Key Competencies	National Curriculum	
Futures Develop the flexibility to respond to change, recognise connections with the past and conceive solutions for preferred futures.	Learning	Learning that contributes to ongoing improvement and expansion in employee and company operations and outcomes.	Collecting, Analysing & Organising Information	Literacy	
Identity Develop a positive sense of self and group, accept individual and group responsibilities and respect individual and group differences.	Personal Development	Self Management that contributes to employee satisfaction and growth.	Using Mathematical Ideas & Techniques	Numeracy; Self Management; Ethical Behaviour & Social Competence	
Interdependence Work in harmony with others and for common purposes, within and across cultures.	Citizenship	Teamwork that contributes to productive working relationships and outcomes.	Working with Others & in Teams	Teamwork; Intercultural Understanding	
Thinking Be independent and critical thinkers, with the ability to appraise information, make decisions, be innovative and devise creative solutions	Work	Planning & Organising that contributes to long and short-term strategic planning.	Planning & Organising Activities	Thinking Skills; Creative Skills	
		Problem Solving that contributes to productive outcomes.			Solving problems
		Initiative & Enterprise that contribute to innovative outcomes.			
Communication Communicate powerfully, in a range of forms including ICT.	Communication	Communication that contributes to productive and harmonious relations between employees and customers.	Communicating Ideas & Information	ICT	
		Technology that contributes to effective execution of tasks.	Using Technology		

The previous table suggests the scope to integrate C2C across middle school subjects and year levels. Students and teachers could then become more familiar with project based learning and C2C before progressing to more refined projects and processes in the SACE years.



Although there is wisdom in starting in a small number of subject areas, a more mature C2C program has the capacity to be utilised across many areas of SACE. It would be a productive exercise to sit down with a few curriculum statements and scan for the possibilities to satisfy components from several of the above frameworks through one project. C2C develops broad inquiry based learning strategies rather than just a project for a specific subject.

Introducing other teachers through professional development, industry tours or visiting the C2C Expo are great ways of facilitating growth across subjects and years.

Sample SACE assessments are available on www.concept2creation.com.au and could be achieved through networking at C2C teachers' meetings.

4. Getting Prepared

A. Preparing The School For C2C

C2C is founded in project based learning approaches that generate student engagement through real world context and their involvement in creating the project. Therefore, students and teachers need to gain a transparent overview of C2C that includes relevant processes and context.

The C2C suite of programs provides opportunities for inquiry, problem and project based learning approaches for all abilities and with a strong STEM orientation.

Advanced Manufacturing covers a wide range of industries but by adopting a common understanding that ***the learning is in the process rather than the product***, teachers should feel empowered to act as facilitators rather than experts on a broad range of projects that student teams might undertake. Therefore, there is a focus upon:

- Systems Engineering (Critical Thinking and Problem Solving);
- Project Management;
- Lean Manufacturing and Quality Principles.

This training tends to empower teachers with more facilitative processes for this style of teaching.

Adopting inquiry, project and project-based approaches to learning will probably require several other paradigm shifts in your school. The NAMIG Coordination Team is readily available to assist in creating awareness and commitment from your leadership team and the broader school community to achieve sustainability of the Concept2Creation program through initiating these changes.

These might involve a coordinated implementation of the following:

- Appreciation of advanced manufacturing opportunities in a high tech world;
- Shifts in school culture;
- Changes in structure & organisation;
- Moves to student centred learning;
- Promotion of new methodologies and pedagogies;
- Maintenance of currency with emerging curriculum frameworks.

NB If any of these components are actioned in isolation, they might have limited or no effect.

Program Management Checklist

This checklist is provided to assist schools in delivering the C2C program. Preparation and delivery of a project will ideally occupy a minimum of two terms.

Step	Action	Check
1	Gain & maintain awareness, comfort and commitment from the school community to participate in C2C programs. This could involve presentations, publications and initial use of the C2C website.	
2	Identify a member of the school leadership team (minimum Deputy Principal) to actively advocate the program and to maintain active membership of the NAMIECC leadership group.	
3	Identify and establish support for key teacher/s to develop and deliver the school program and be a representative on the Key Teachers Group.	
4	Establish a school-based C2C Teacher Group.	
5	Identify outcomes sought from the program.	
6	Map opportunities for delivery of C2C programs across curriculum and year levels. In particular, link to the PLP, projects and other components of SACE, plus scope for VET recognition.	
7	Recognise the designated year level for each type of C2C program.	
8	Evaluate operational considerations:- Site, Timetable, Staffing, Tours & Transport, Training & Support and Time Allowance (at least 10 project weeks after preparation)	
9	Provide professional development and support for participating teachers.	
10	Specific introduction of C2C to students.	
11	Lodgement of MOA including an accurate nomination of student numbers and realistic budget.	
12	Inform parents/guardians and obtain clearance for participation, travel and use of student images.	
13	Conduct & Submit Pre-program Surveys of students and staff.	
14	Identification of chosen programs/projects and at least one full semester to stage the program/project.	
15	Ensure projects have transparent links to Advanced Manufacturing.	
16	Establish relationship with designated mentors and other partners through an introductory meeting and initial analysis of student concepts, followed by development of a meeting schedule for the duration of the project	
17	Ensure projects are structured to ensure that all participants experience all aspects of the Project Management Process and that student teams have a work schedule/time line established.	
18	Confirm & complete tours, workshops and other training for students.	
19	Advise of any changes in participation levels.	
20	Complete & Present projects, including reports/evaluations, for school-based and C2C Expo.	
21	Submit final participation details and reimbursement claims to the Coordination Team.	
22	Conduct & submit staff and student post participation surveys.	
23	Conduct an internal review of the program to establish continuous improvement and to establish that C2C is not just an event but that it is part of an ongoing curriculum & career development process.	
24	Use the school review and/or Focus Groups to inform NAMIG.	
25	Formally thank mentors and other partners.	
26	Celebrate & publicise the experience.	

B. Preparing Yourself

It is recommended that teachers allow 10 weeks to prepare themselves and their school for the delivery of C2C. During this time, teachers need to:

- Undertake a mandatory induction to the C2C program and integral processes for delivering it. These include Systems Engineering, Project Management and Lean Manufacturing;
- Become familiar with Advanced Manufacturing and resources that can create the initial context for students. Some of these are available at www.concept2creation.com.au;
- Become familiar with methodologies for initiating teams, brainstorming concepts etc (also see C2C website)
- Follow the program management checklist (see page 7);
- Allow time for other staff to make appropriate shifts suggested in the section above.
- Foster industry immersion through tours, talks, mentorship etc.

Teachers should also recognise that delivery of a C2C program in semester one of a year could generate more resources and less pressure for delivering the program.

Consider the difference between:

- Inquiry based learning
- Project based learning
- Problem based learning

Does C2C focus on one or more of these? Teachers are encouraged to progress from a more structured problem based approach to utilise inquiry and project based learning in the more advanced levels of C2C.

Inquiry based learning: is based around students' questions and requires students to work together to solve problems rather than receiving direct instructions on what to do from the teacher.

Project-based learning: the students set their own learning objectives, decide on their own learning strategies and might propose what they want to be assessed.

Problem-based learning: the overall goals and problems are set by the teacher.

Inquiry and project based learning requires the teacher to become a ‘learning facilitator’, with the possibility of several student teams pursuing quite distinct projects but following the same processes. Therefore, C2C is supported by industry and tertiary partners to provide teachers with training in models of:

- Systems Engineering (Critical Thinking Process);
- Project Management;
- Lean Manufacturing Principles;
- General awareness of industry environments and practices.

Promote the need for C2C to be developed as an ongoing process that supports several subjects, PLP and Research components of SACE rather than just being isolated events.

Plan to start with small steps, for example one level of C2C with a manageable group, but with a longer term strategy to build a more comprehensive program that is embedded within curriculum. Note that if C2C remains offline and outside of curriculum, it will struggle to be sustained.

10 Tips For Project-Based Learning

1. Begin with the end in mind
2. Make a tough topic fun
3. Focus on standards - but not too many
4. Start small when you are new
5. Test-drive the final product before starting the project
6. Start your project with an “entry event”
7. Keep students in the loop
8. Set clear deadlines - but allow for some flexibility
9. Create a balanced assessment plan
10. Conclude projects with a bang.

Source: <http://www.edutopia.org/maine-project-learning-ten-key-lessons>

Six Steps for Planning A Successful Project

Step 1 - Develop a compelling topic that covers state standards, has an authentic connection to the local community, and provides opportunities for every student to do meaningful, independent research.

Step 2: Develop or design a comprehensive final product that each student will have a role in creating, and could be used by local residents or professionals in the field.

Step 3: Involve professional organisations and professionals from the community to connect the academic study with the real world, and have students assume these professional roles during the project so they get a sense of what it would mean to be professionally engaged in meaningful work.

Step 4: Identify and organise the major learning resources for the project, and make sure they're available (this one is critical and is often left out by schools).

Step 5: Coordinate calendars (this may be the hardest piece of all). Projects are interdisciplinary and require a lot of planning to ensure that each piece flows smoothly from one to the next. They require enough time for each component to be done well, for students to get time in the field, for experts to come in at the appropriate place, and for the final product to be high quality.

Step 6: Plan a final experience or culminating event. Showcase student work to the public or outside of school.

Source: <http://www.edutopia.org/maine-project-learning-six-steps-planning>

C. Preparing The Students

To ensure maximum benefit for the students, C2C should be experienced as a complete project comprising three distinct elements:

- Setting the context (talk, tour, activity, tapping personal experiences);
- Laying the foundation (appreciating common underlying process, gaining training);
- Undertaking the project.

In defining a complete program, teachers should consider time and content. A combination of C2C and other outreach activities could be used to achieve this.

Why do students need a complete project?

Before commencing their C2C project, it is essential to create a context for students and to provide them with the opportunity to gain an awareness of industry. Although context and relevance can originate from many sources, C2C provides the following:

- Industry tours or other engagement;
- Participation in a Lean Manufacturing Workshop, facilitated by the Coordination Team;
- Participation in a OHS&W workshop either school-based or facilitated by the Coordination Team.

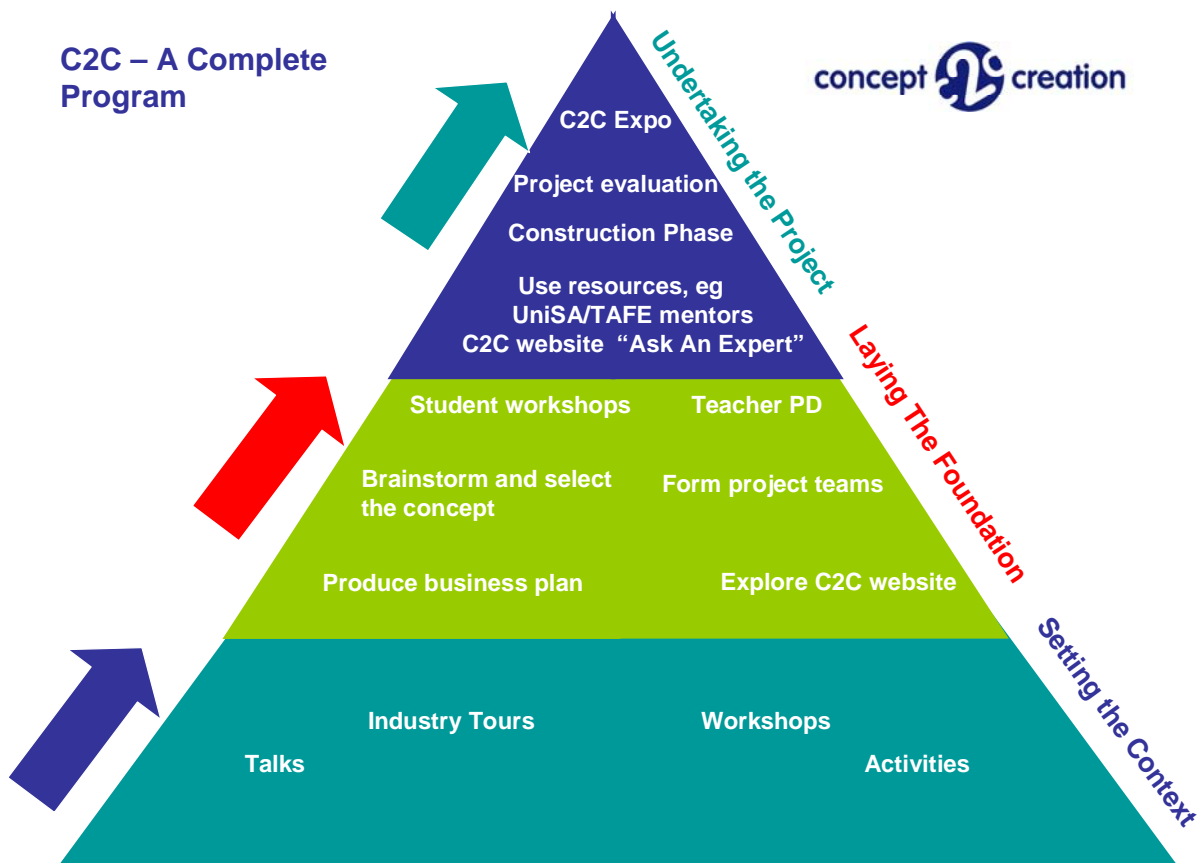
However, the essential step is to give students a transparent view of the relevance of C2C to their learning and life and to involve them in the C2C process from the start. Without this they will struggle to own or engage in a project, to apply learning from STEM and other sources and to appreciate underlying project and people management skills.

The above are key elements in the success of the C2C programme and should be undertaken as early as possible.

What constitutes a complete project?

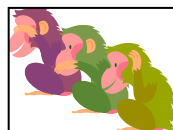
As the diagram on the following page illustrates, the key elements to achieving a complete C2C project are:

- Talks, tours and other activities to set context (media, personal experiences);
- Relevance to students' learning and life;
- Links to curriculum;
- Research and project planning;
- Understanding of underlying processes through lean manufacturing, systems engineering and project management;
- Project support, through UniSA and industry mentors, C2C website, teacher PD;
- Project evaluation and showcasing at C2C and in-school expos;
- Accessing other providers (see page 12).



Let students hear it, see it and do it! Not as disjointed short-term events but across years and curriculum. Then students see relevance in subjects, transparent links across curriculum and appreciate the impact on their personal and career development.

*See no!
Speak no!
Hear no!.....
Is for monkeys!!*



*Seeing & Hearing & Doing!
.....is far from evil!!!*

What can other partners offer?

Create a more complete process by utilising the providers of complementary activities to further enhance your C2C program.

The list on the following page gives examples of organisations whose services could be utilised to create a more complete C2C program.



CREST Awards - preparatory projects.
Kylie Turton/Theo Kermandis Ph 8463 5920 crest-sa@csiro.au

Scientists In School - setting the scene through visits, talks and mentorship.
www.scientistsinschools.edu.au



Presentations and class activities.

Dina Zebian Ph 8207 8707
dina.zebian@sa.gov.au



In school talks by young professionals.

Jessica Bosnakis Ph 8211 8111
jessica.bosnakis@advantagesa.com.au
www.advantagesa.com.au



Talks (ei)² program
Andrea McCarthy Ph 8272 5222
andrea.mccarthy@tia.asn.au



Talks & Events Ph 8221 6563
science@riaus.org.au



Science & Engineering Challenge
Engineers Australia Ph 8267 1783

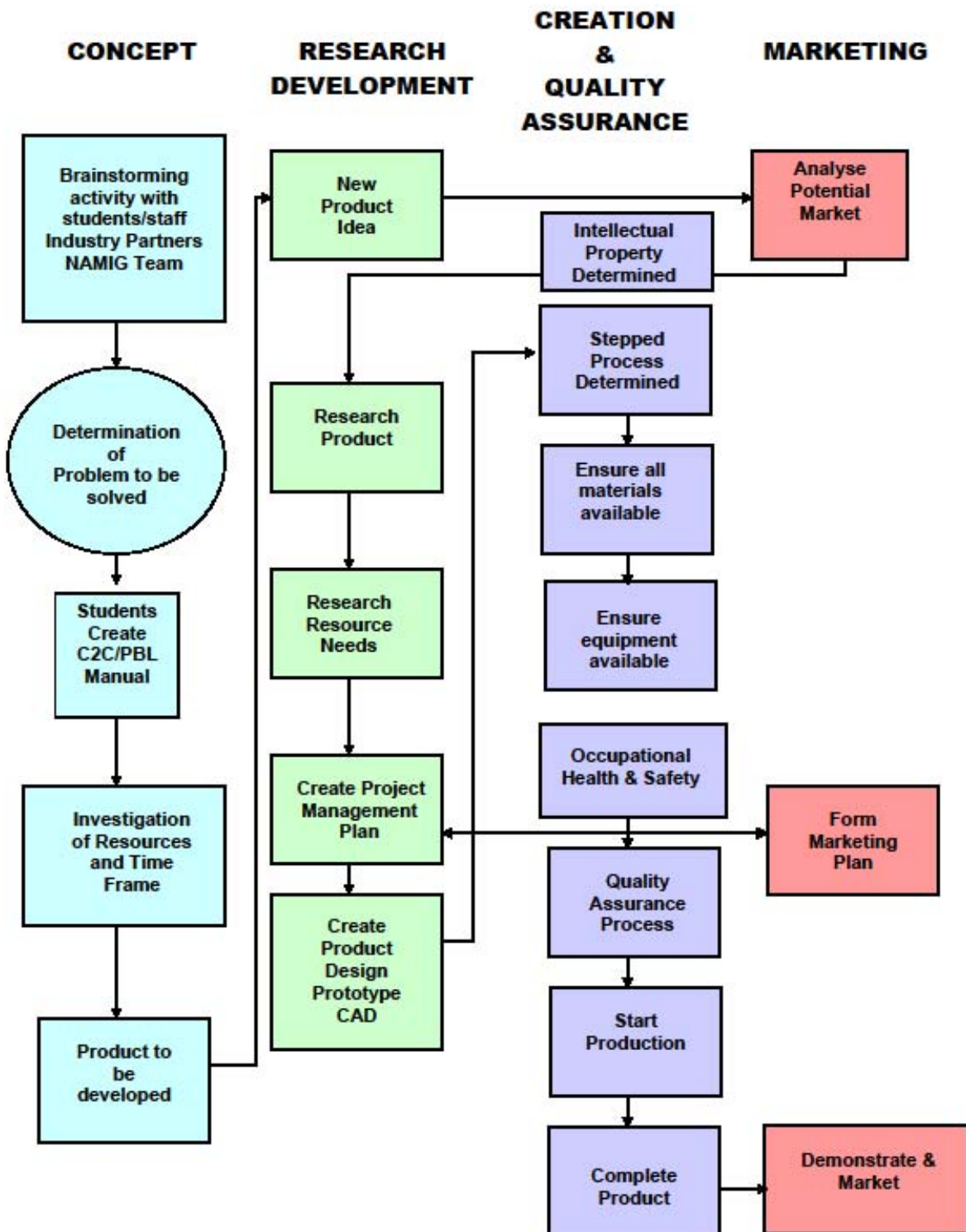


Others sources, for example:

- students work, community and sporting experiences
- career experience of parents
- former teachers
- other providers

Flowchart for a Complete C2C Project

The complexity of the project and the ability or year level of the team will determine to what depth the flowchart is followed. But all projects should have the four key project components, ie concept, research and development, creation and quality assurance, and marketing.



Industry visits will be incorporated into this process at the most appropriate junctures.

5. Starting Students

Creating a Context

Once your preparatory 10 weeks is over, it is time to get students started. The big challenge is helping students to:

- Create a context for Advanced Manufacturing;
- Conceptualising a project without stifling creativity;
- Take ownership of their project.

In order to achieve this six key ingredients should be sought from each student team. These are:

- A clear concept;
- Team structure and expectations;
- Realistic vision and planning;
- Inter-relationship of STEM and research material;
- Use of maths and science for proofing and reality checking;
- Production and presentation.

Project Based Learning approaches generate student engagement and ownership through real world context and their involvement in creating the project. Therefore, students and teachers need to gain a transparent overview of C2C that includes relevant processes and context.

General context can be created by tours, talks and use of some of the materials on the C2C website. Screening of shows such as Junkyard Challenge or New Inventors are ideal to introduce the concept and stimulate the creative process. YouTube clips on inventions etc are great but should not stifle the creativity of students. Creativity can then be cultivated with some introductory activities (eg Mystery Bag: each team removes a mystery object and has to brainstorm as many uses for it as they can in a set time) or the introduction of a Junkyard Challenge theme perhaps.

Similarly deciding on a project can be commenced by a communal brainstorm with prizes for the first five ideas.

Teams can also be workshopped on purposes, roles and mechanisms to gain productivity. Student involvement in team formation and conceptualisation of their project breeds ownership.

Do not be discouraged by a lull before students become empowered to decide upon a concept. Here is where the introduction of some initial System Engineering ideas might be handy: ***give students some process and a lot of encouragement to define their own learning.***

Project development and viability could be enhanced through the expectation that teams will present their initial concept and business plan for approval by a school panel prior to commencement of the project.

Industry Engagement

Industry engagement involves a range of experiences that can enhance student projects in a number of ways.

Projects can be staged in isolation or in conjunction with a speaker. However, students and teachers can only truly **establish context for a project by experiencing a work environment** and seeing the production process in action. In addition, to enhancing projects, schools should also consider other benefits that can be derived from such learning experiences.

If tours are to generate such learning, preparation and debriefing are essential. This results in students, teachers and the host company **having a clear and consistent vision of the purpose/s of the tour**, this vision being achieved and it then being successfully utilised in ongoing learning activities at school.

An early tour might simply be intended to provide an introduction to a work environment. Yet a more senior class might request a focus upon a particular aspect of the operation. These might include OHS&W, use of automation, just-in-time scheduling, design or applications of a particular area of study.

It is also worth being conscious of the considerable administration and support functions that are common to the manufacturing and service industry sectors. This provides potential for career and other curriculum areas that form a part of student learning.

If used strategically tours can make a great contribution to the Personal Learning Plan, research project and subjects undertaken at school. Hopefully, this will also engender an appreciation for acquisition of competency in a number of subjects and the employability skills. These include critical thinking, problem solving, communication, teamwork, initiative and organisation.

The production activity does not always have to reflect the concept or product being developed by students: provided that the **students have a transparent understanding of how the visit relates to their work.**

Just as the “warm up” (preparation) is important, so is the “warm down” (debrief). This is where learnings and observations are identified, clarified and applied to the ongoing student process. It might also be a good time to link with a relevant speaker or to undertake some research to qualify the initial learning.

The Coordination Team provides organisation, hosting and transport subsidies for tours but due notice and preparation are critical for gaining maximum impact from tours.

Another key element of tours involves meeting the organisational protocols and respecting the opportunity that is provided by the host company. Details of these protocols, together with details of the tours that are currently available, are included in the Resources section of this Guide and also on the C2C website <http://www.concept2creation.com.au/tours>

C2C Mentors

The term mentoring is being used as part of many different programs and there are distinctive differences in the definition and interpretations of the term. In the Concept2Creation program, mentoring refers to the assistance that is provided to teachers and student teams by industry, tertiary staff and most often undergraduates from faculties that relate to C2C.

Mentorship by industry and tertiary staff, usually occurs through an “Ask an Expert” function that might be sought occasionally, or is directed at teachers or more advanced level of projects. Undergraduates provide a more regular presence for project teams. However, there might only be sufficient mentors to support teams at C2C and C2C+ levels and teachers in C level programs.

Mentoring is often delivered by undergraduates with limited time, knowledge and a need to derive some benefit from the experience for them. Schools need to understand and respect this situation and not place undue expectations upon these undergraduates. Some might be near graduation as teachers or engineers but they are not expected to replace teachers or to work for the teams: they are provided to advise and support the C2C process to produce a product.

Mentors are allocated to a school following an induction. They are available for a maximum of 30 hours and any further participation requires considered negotiation.

An orientation meeting with the undergraduate mentor should be staged well in advance of commencing with the student projects. At this meeting, teachers should discuss:

- Key contacts;
- Schedules & timelines:
 - The project;
 - The school;
 - The mentor’s situation and perceived benefits (course, part-time work, life);
- Recognition & remuneration.

Teachers should ensure that mentors are aware of the following duty of care and OHS&W considerations:

- Mentors are required to receive induction to Mandatory Reporting Training which can be accessed through tertiary institutions or the host school;
- School students are generally classified as minors regardless of age;
- All dimensions of OHS&W but especially safety in project process and design;
- Care for yourself as well as others;
- Relevant acts: Sexual Discrimination Act (1984), Equal Opportunity Act (1984), Children’s Protection Act (1993), Racial Discrimination Act (1975), Disability Discrimination Act (1992), SA OHS&W Act (1986), Privacy Act (1988);
- Police checks;
- Is it largely about being a responsible citizen and employee?

The Timeline for Completing the Project

Timeline: 2 (conceptualising) x 2 (proposing) x 6 (project) x 2 (presentation & review)
= 12 weeks

NB This is a guide that emphasises the need for 12 weeks minimum.

Teachers should also recognise that delivery of a C2C program in semester one of a year could generate more resources and less pressure for delivering the program.

Week	Tasks
One	Introduction to C2C, Project Based Learning, Advanced Manufacturing, Teams and creating transparent links with other curriculum. Introduction of mentor. Launch the challenge to brainstorm and decide upon a concept by week three.
Two	Create context with talks, tours that have some previously decided focus and follow-up debrief. Introductory training on Project Management, Systems Engineering and/or Lean Manufacturing
Three	Decision on concept. Preparation of business plan (including budget) to be presented to teacher panel for approval.
Four	Presentations of plans for appraisal and approval. Assignment of team roles, recognition of documentation requirements and research for the project.
Five	Continuation of the research and commencement of the development phase for the project.
Six	Proj & development
Seven	Proje & development
Eight	Project development, including mid-appraisal by mentor and teacher.
Nine	Proj^ & development
Ten	Proje & development
Eleven	Preparation for Expo presentation, including pamphlets, display board capturing the complete R&D process (technical report and evaluation) and Frequently Asked Questions. The complexity of this work is dependant upon the level of the program and ability of the group.
Twelve	Final preparations for the expo, including final challenge presentations for C2C+ projects

Please note that concepts for projects do not always have to be of a traditional engineering focus : learning might be in the underlying processes. It is worth stressing that **LEARNING IS AS MUCH IN PROCESS AS PRODUCT.**

6. Resources

This section consists of three sections:

- Processes that are useful in facilitating Project Based Learning;
- Sources of materials and information that can enhance projects;
- Useful templates and industry tour protocols and booking form.

The contents of this Resources Section are as follows:

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6.1 Processes

Brainstorming

Group dynamics and self consciousness might inhibit the brainstorming process, unless the group is empowered. This might be achieved by:

- Making the purpose transparent for the students (to identify possible concepts that they could create);
- Stimulating ideas without denying creativity, through talks, tours and resources from the C2C and other websites (eg How Biomimicry influences Concepts presentation www.concept2creation.com.au/teachers_sowhat_is_advanced_manufacturing or try www.instructables.com/index);
- Starting with a fun icebreaker (eg how can we achieve a four-day school week?);
- Establish a clear and concise task;
- Have teams nominate a leader and scribe to stay on task and to allow for equal air time.
- Encourage quantity rather than quality at this stage;
- Set a target for number of ideas within a set time (rewarding the winners);
- Incorporate visuals to reflect productivity and engage both sides of the brain (maybe use post-it notes);
- State that 'wild is good' and no ideas are stupid;
- Record every idea;
- Encourage refinement rather than criticism of ideas;
- Allow for individual brainstorming to reflect on and add to the group effort;
- Group the suggestions into categories. (Be visual: use colored textas or similar);
- Celebrate the achievement;
- Introduce the next decision-making stage so that students understand the process and have confidence that their efforts have a purpose;
- Then plant some seeds by considering their interests and hobbies or things they do or use regularly as sources for concepts that could be created, adapted or improved.

Decision Making

- Commence by having teams review the brainstorming process and their results.
- Identify that their next task is to decide upon a concept and they have a limited time to decide and develop their concept (issue a copy of the schedule provided in this guide).
- Encourage the team to consider the following as they enter the Decision-Making Phase:
 - ◇ their goal;
 - ◇ obvious factors that might affect their decision (resources, time and other constraints).
- Introduce a decision-making model. This would involve:
 - ◇ identifying the purpose;
 - ◇ gathering information;
 - ◇ identifying options;
 - ◇ judging options;
 - ◇ deciding and explaining the decision.

Some models that could be utilised include:

- ◇ SAME (Specific, Attainable, Measurable, Enjoyable);
- ◇ SMART (Specific, Measurable, Achievable, Relevant, Time framed);
- ◇ SWOT (Strengths, Weaknesses, Opportunities, Threats).

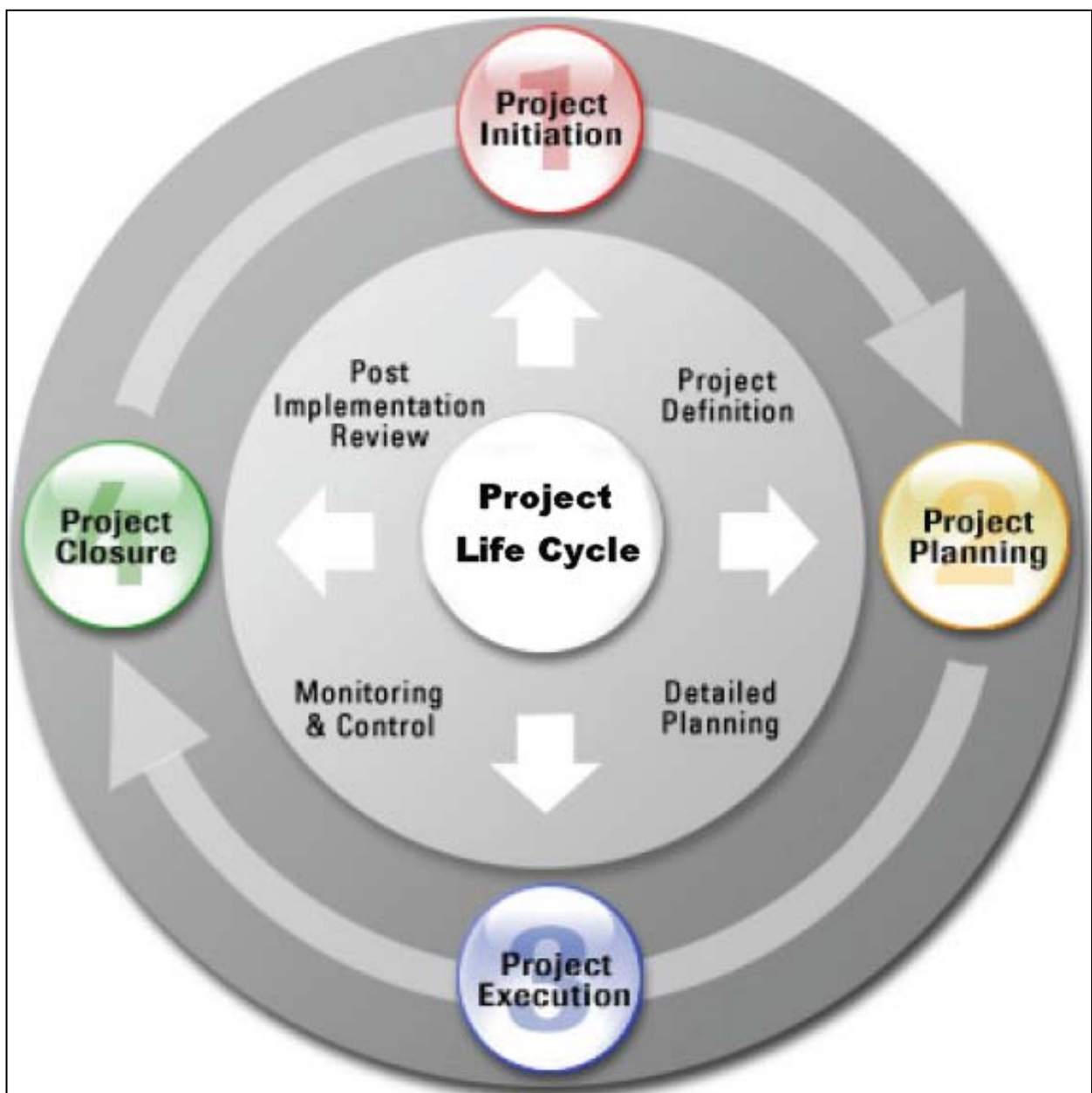
* These models and other templates as provided in 6.1.2 might not only be used in deciding on the concept, but also in other stages of project management.

6.1.1 Key Processes

The following are the three key processes involved in C2C:

- Project Management
- Systems Engineering
- Lean Manufacturing

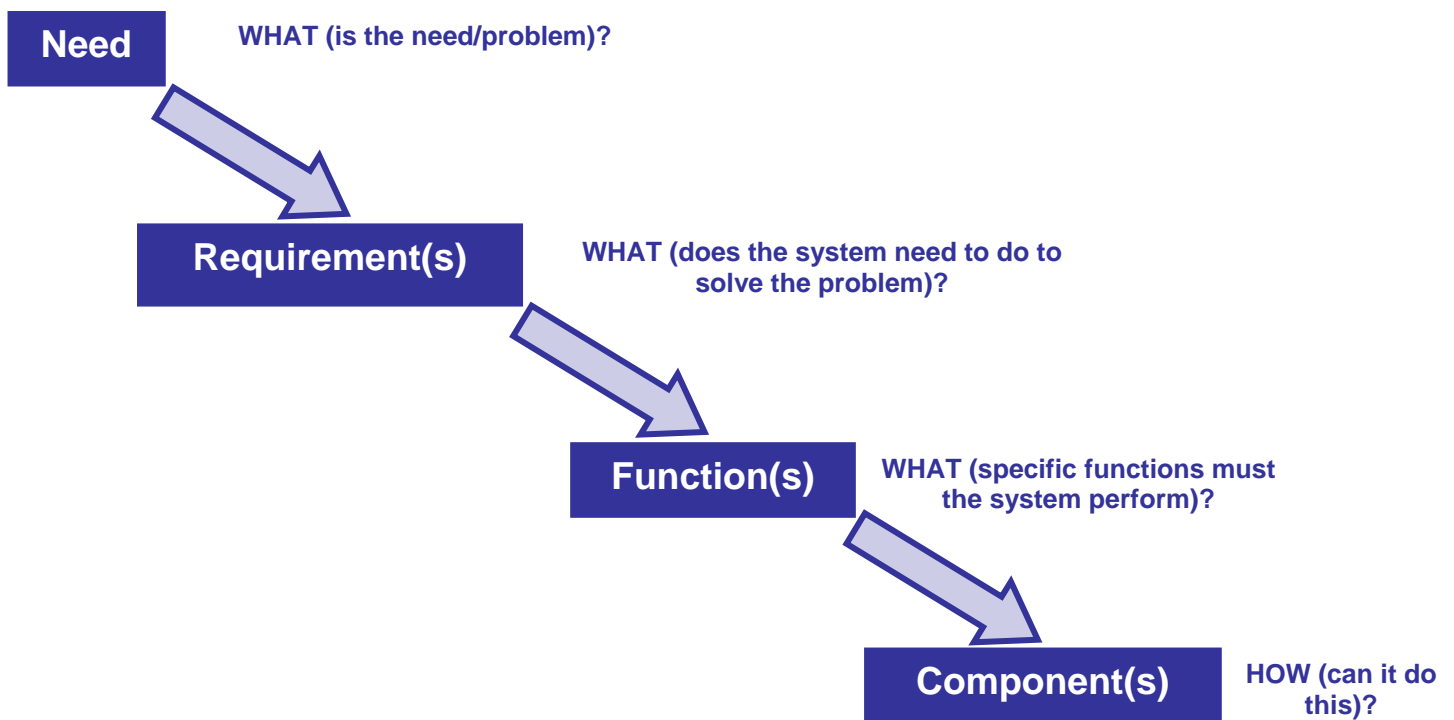
Project Management Process



Systems Engineering Process

Enterprising Approaches (to problem-solving)
David Cropley (UniSA)

Engineering Problem-Solving



- Need** "I need a device to help me talk to people over long distances".
- Requirement** "The system/product shall enable two or more users to communicate in real-time over distances of no less than X km".
- Function(s)** "The system shall <verb> + <noun> (What), and possibly also (How well).
eg verb = *apply*, noun = *torque*."
- Component(s)** Physical solution(s) that satisfy the identified function(s) eg *screwdriver*.

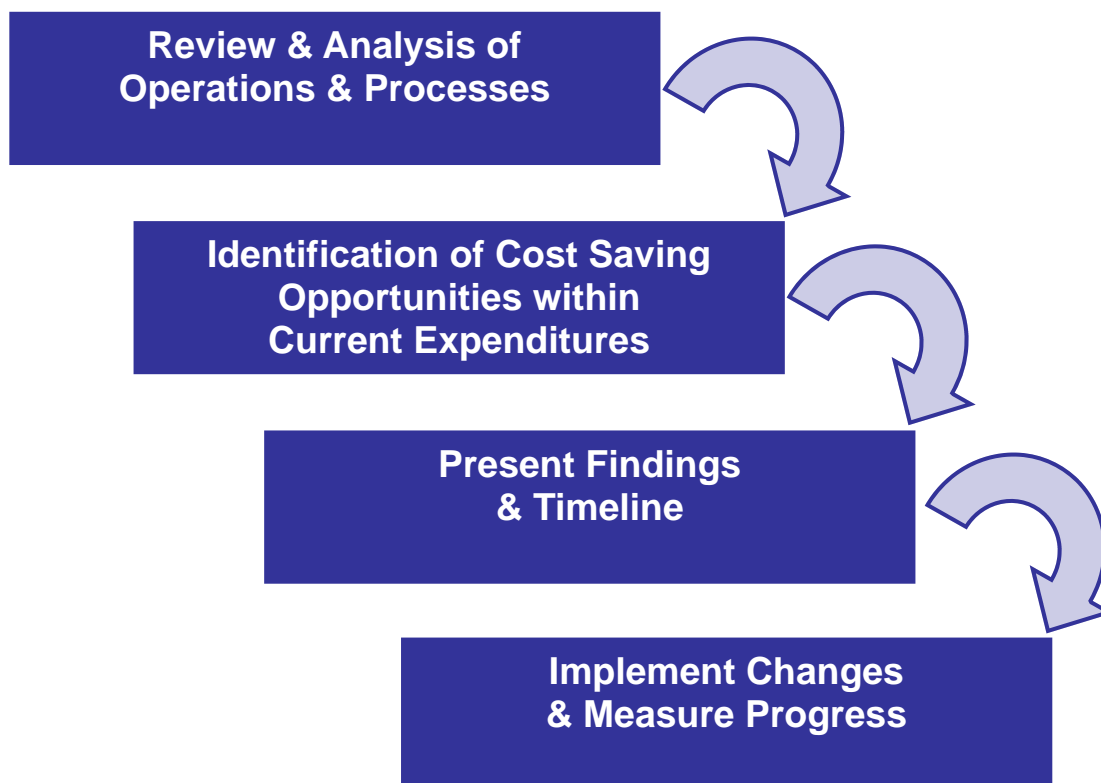
Lean Manufacturing Process

Lean manufacturing is a business practice aimed at waste elimination. A manufacturer that is 'lean' uses the minimum amount of manpower, materials, money, machines, space etc to get the job done on time.

As part of their C2C experience, students are required to participate in a lean manufacturing workshop based on GM Holden's lean manufacturing principles which are:

- People involvement;
- Standardisation;
- Built-in quality;
- Short lead time;
- Continuous improvement.

The workshop is facilitated by the C2C Coordination Team on school premises and should be undertaken as early as possible in the first semester. The workshop introduces students to lean manufacturing processes which they can then apply to their C2C projects.



6.1.2 Useful planning templates

This section contains templates than can be used in the project planning stage including:

- SWOT Analysis Template
- PEST Analysis Template
- Action Planning Template
- Project Proposal Template

PEST Analysis Template

Situation being analysed: _____

PEST analysis (political, economical, social, technological) assesses a market, including competitors, from the standpoint of a particular proposition or a business.

<p>Criteria examples</p> <ul style="list-style-type: none"> ecological/environmental current legislation future legislation international legislation regulatory bodies and processes government policies government term and change trading policies funding, grants and initiatives home market pressure-groups international pressure-groups wars and conflicts 	<p>Political</p>	<p>Economical</p>	<p>Criteria examples</p> <ul style="list-style-type: none"> home economy economy trends overseas economies general taxation taxation specific to product/services seasonality issues market/trade cycles specific industry factors market routes trends distribution trends customer/end-user drivers interest/ exchange rates international trade and monetary issues
<p>Criteria examples</p> <ul style="list-style-type: none"> lifestyle trends demographics consumer attitudes and opinions media views law changes affecting social factors brand, company, technology image consumer buying patterns fashion and role models major events and influences buying access and trends ethnic/religious factors advertising and publicity ethical issues 	<p>Social</p>	<p>Technological</p>	<p>Criteria examples</p> <ul style="list-style-type: none"> competing technology development research funding associated/dependent technologies replacement technology/ solutions maturity of technology manufacturing maturity and capacity information and communications consumer buying mechanisms/technology technology legislation innovation potential technology access, licencing, patents intellectual property issues global communications

Note: PEST analysis can be useful before SWOT analysis because PEST helps to identify SWOT factors. PEST and SWOT are two different perspectives but can contain common factors. SWOT stands for strengths, weaknesses, opportunities, threats. SWOT analysis explanation and templates are at www.businessballs.com/swotanalysisfreetemplate.htm

© Businessballs 2009. A free PDF version of this tool and information about PEST analysis methods are available at www.businessballs.com/pestanalysisfreetemplate.htm A free resource from www.businessballs.com

SWOT Analysis Template

Situation being analysed: _____

This SWOT example is for a new business opportunity. Many criteria can apply to more than one quadrant. Identify criteria appropriate to your own SWOT situation.

<p>Criteria examples</p> <p>Advantages of proposition? Capabilities? Competitive advantages? USP's (unique selling points)? Resources, Assets, People? Experience, knowledge, data? Financial reserves, likely returns? Marketing - reach, distribution, awareness? Innovative aspects? Location and geographical? Price, value, quality? Accreditations, qualifications, certifications? Processes, systems, IT, communications? Cultural, attitudinal, behavioural? Management cover, succession? Philosophy and values?</p>	<p>Strengths</p>	<p>Weaknesses</p>	<p>Criteria examples</p> <p>Disadvantages of proposition? Gaps in capabilities? Lack of competitive strength? Reputation, presence and reach? Financials? Own known vulnerabilities? Timescales, deadlines and pressures? Cashflow, start-up cash-drain? Continuity, supply chain robustness? Effects on core activities, distraction? Reliability of data, plan predictability? Morale, commitment, leadership? Accreditations, etc? Processes and systems, etc? Management cover, succession?</p>
<p>Criteria examples</p> <p>Market developments? Competitors' vulnerabilities? Industry or lifestyle trends? Technology development and innovation? Global influences? New markets, vertical, horizontal? Niche target markets? Geographical, export, import? New USP's? Tactics: eg, surprise, major contracts? Business and product development? Information and research? Partnerships, agencies, distribution? Volumes, production, economies? Seasonal, weather, fashion influences?</p>	<p>Opportunities</p>	<p>Threats</p>	<p>Criteria examples</p> <p>Political effects? Legislative effects? Environmental effects? IT developments? Competitor intentions - various? Market demand? New technologies, services, ideas? Vital contracts and partners? Sustaining internal capabilities? Obstacles faced? Insurmountable weaknesses? Loss of key staff? Sustainable financial backing? Economy - home, abroad? Seasonality, weather effects?</p>

© Alan Chapman 2005-09. Free PDF version of this tool and information about SWOT analysis methods are available at www.businessballs.com/swotanalysisfreetemplate.htm. This is a free resource from www.businessballs.com, which contains lots more useful tools, diagrams and materials. Not to be sold or published.

Action Planning

NB This template could be used for student project proposals

ACTION PLAN

Concept

Team Name.....

Steps to achieve goal	Actions/Strategies to complete each step	Who is Responsible	Date set for completion	Completion signoff & date

A template for capturing project proposals and presenting to an approval committee

Project Title: _____

The Concept

In around 200 words (or through equivalent communication by sketches, models etc) describe your project: what it is, what it is used for, how is it innovative, are there other applications it could be used for etc. For examples visit the C2C website at:

www.concept2creation.com.au/projects_c2c_student_projects_-_examples

The Creation

Develop a Business Plan for presentation. This should include team membership and roles, a materials list, project budget, support required and timelines.

a) Team Member Role

b) Materials Quantity Source _____ Cost (\$)

c) Support Required

d) Timeline Specified Completion Date:

Approved/ Rejected (Circle appropriate decision)
Notes for adjustments required

Authorisation of Approval:.....

A Sample Checklist for Final Presentations at Expos

Teams will be provided with a trestle table and a pin-up display space to present their project. All team members are to wear their C2C polo shirts and be prepared to talk about the project.

Questions

Some consideration should be given to commenting about:

- What was your concept?
- How you identified the concept?
- What processes did you follow to take it from concept to creation?
- How do you think your project relates to Advanced Manufacturing? This might include comment on the quality and quantity of processes and products.
- How and why did you choose and organise your team?
- How did you use other supporters (ie teacher, Mentor, Other?)
- What has it taught you about yourself, others, career choices and the relevance of subjects?
- What important skills and attributes would you identify as key for successful projects?
- If you did it again what would you do differently? Why?

Presentation

- The prototype and/or concept plans and drawings should be on display to assist you in describing the product and your development process.
- Copies of a small brochure might be produced for distribution.
- Photographs might be displayed to capture different stages of the process.
- Posters should identify the concept, it's purpose, the steps of the engineering and project management processes that were followed.
- Copies of Technical Reports and Evaluations. These could range from some simple poster comments to detailed extended reports for more advanced C2C+ projects.

Preparation

- Please create a checklist of what needs to be covered to ensure a quality presentation of your concept.
- Allocate responsibilities to various team members and set a timeline.
- Make a checklist of what you need to bring on the day and consult with your teachers to ensure that it all comes together.

Other templates & tools

The Teachers' section www.concept2creation.com.au/teachers on the C2C website features tools and documents to assist in the preparation of curriculum, projects and SACE assessments.

Teachers are encouraged to share the knowledge and experience they have gained during their C2C experience with other schools. NICDA awards are allocated to teachers at C2C schools to facilitate curriculum development that enhances the C2C program for industry and schools alike. Some of the valuable resources that have been developed through the NICDA awards can be downloaded from and may be helpful in managing or developing projects.

www.concept2creation.com.au/teachers_tools_and_resources

6.2 Sources of materials and information

Materials

- Electronics
Electronics components are available from Jaycar (Adelaide, Clovelly Park, Gepps Cross or online) or Aztronics (Adelaide).
The University of South Australia can supply a control board that has a range of applications see <http://who.is-an-engineer.com/asistm/>
www.sparkfun.com
www.littlebirdelectronics.com
- Remote control planes etc
www.Hobbycity.com
www.diydrones.com
<http://supercubclub.proboards.com/index.cgi>
- Microcontrollers
www.picaxe.com.au
www.picaxeforum.co.uk
www.arduino.cc
- The junkyard challenge mentality can source great materials from sheds and recycling operations;
- Discount shops stock simple appliances that can be stripped to be used for other applications. One example is the technology in solar garden lights;
- If your school does not have equipment, you may source this through networking with other C2C partners. NAMIG has a small milling machine located in Electrical Engineering at the University of South Australia, Mawson Lakes.

6.2 Sources of materials and information (cont/d)

Information

- The Technology Industry Association site www.tia.asn.au has details of the (ei)² program.
- The University of South Australia provides some project ideas on their website <http://who.is-an-engineer.com/asistm/>
- Engineers Australia are conducting a Make It So campaign that prompts creative thinking www.makeitso.org.au

C2C Website

The Concept2Creation website www.concept2creation.com.au is aimed at providing C2C students and teachers with the tools required to make the most of their C2C experience. The website will enable students and teachers to gain information on industry partners, learn from the experiences of other schools and to download templates and tools.

Key sections of the website of interest to teachers are:

- *Calendar of events* - located in News/Media section of the website. The calendar of events includes a schedule of C2C teachers' meetings for the school year.
- *Projects* - this section includes examples of previous C2C projects. Teachers are encouraged to submit projects for consideration using the online template.
- *Student Tools* - this section includes an "ask an expert" function together with information on commercialising a new product, marketing and lean manufacturing.
- *Teachers* - this section includes SACE assessment plans, tools and resources, sample documents and templates and information on teacher professional development opportunities. Many of the tools and resources have been developed by C2C teachers.
- *Tours* - booking form and list of current industry tours (a copy is included in this guide, however as this may be updated periodically it is recommended that you check the website for an up-to-date list of tours).

6.3 C2C Engagement Protocols for Students, Schools, Industry Partners and Resource Providers

Occupational Health and Safety:

C2C students will undertake an OH&S Introduction Workshop before going on industry tours. The OH&S Workshop can be facilitated by either the school or the NAMIG Coordination Team. However schools are well resourced to deliver this training.

Schools should be made aware of and adhere to the OHS&W Basic General Requirements Check List.

Industry Partners may also have further OH&S requirements of which schools will be notified before students visit industry facilities.

Duty of Care and Child Protection: PLEASE NOTE THIS IMPORTANT INFORMATION

It is the responsibility of the school and teachers to ensure the proper Duty of Care is taken with respect to the students they are responsible for. This includes safe and responsible behavior when engaged in any C2C activity including industry tours or workshops.

Teachers are required to be present at workshops and on tours and at no time shall anyone participating in the C2C Program be alone with a student or students without a responsible teacher present.

Neither the industry partners nor the Coordination Team can be responsible for students.

No one outside the respective school shall be given student names unless there is prior written parental permission or if it is required for security reasons such as a tour of facilities.

All persons dealing directly with students shall have a current police clearance or have other safeguards in place as agreed by the respective school to ensure students are not placed at risk.

No student contact details shall be given to anyone involved in the C2C Program unless written consent is given by a parent or guardian.

At no time shall a student and a person participating in the C2C program have any direct contact that is not through the responsible teacher.

6.3 2C Engagement Protocols for Students, Schools, Industry Partners and Resource Providers (cont/d)

Workplace Requirements:

An important element of the C2C Program is the development of employability skills. Some of the Industry Partners have expressed a wish to specify appropriate attire and safety or security restrictions. Industry Partners should communicate these specifications to the Coordination Team and to be forwarded to schools at least three days prior to students entering Industry Partner facilities.

Protocols for Industry Assistance:

Please ensure that all requests for assistance and arrangements for tours, workshops or meetings go thorough the Coordination Team in order to ensure coordination of activities, adherence to the C2C Program purpose and management of the budget.

As the C2C programs progress this policy will be revisited and revised as agreed by all parties.

Please contact the Coordination Team if you have any questions about these matters.

OCCUPATIONAL HEALTH & SAFETY CHECKLIST

When entering Industry Premises the following conditions will apply for Occupational Health & Safety.

- Closed in shoes with covered toes and heels are required
- No cameras will be allowed on site
- No mobile phones
- No mobile phone cameras
- No PDA's with cameras
- No touching of equipment
- No smoking on premises
- Respect Confidentiality
- Stay within designated areas

6.4 C2C Student Industry Tours

The information below details the student tours on offer to C2C students (as at February 2011):

In addition to this list, **there is a network of partners who can be sourced to meet the particular interests of schools.**

Please note that as we need at least three week's notice to arrange tours, schools are required to contact the Coordination Team to arrange their tours as soon as possible before the second semester.

Please remember that your students must complete your school's OH&S Workshop followed by the Lean Manufacturing Workshop. Both workshops must be completed before going on an industry tour.

Adtech Engineering manufactures precision tooling for the automotive and defence industry. Adtech is part of the Precision Engineering Group and is based at Elizabeth West. This company was previously known as NTS Tooling <http://www.ntstooling.com>

BAE Systems manufactures for the defence industry. BAE offer student tours on a Thursday between 1pm & 3pm at their Edinburgh Park facility. Special tours can also be arranged of BAE System's Optical Plant at Holden Hill and also their Land Division. The Land Division is a leader in civilian support and Army vehicle maintenance, with extensive facilities for design, assembly, modification and maintenance of all land-based military and commercial vehicles. Please note that due to security issues certain areas may not be available. <http://www.baesystems.com/Businesses/BAESystemsAustralia/index.htm>

Classic Jet Fighter Museum is situated in the Parafield Airport Precinct. They have a number of RAAF aircraft from the past. This is a great interactive display. Open Wednesday to Friday from 10am – 4pm. NAMIG is happy to incorporate this tour with Flight Training Adelaide, Mincham Aviation or TAFE Parafield Campus. <http://www.classicjets.com/>

Clipsal Australia is a market leader in electrical accessories, data communications, industrial and home automation markets. Clipsal Australia's vast product range is largely manufactured at Gepps Cross http://www.clipsal.com.au/homeowner/about_clipsal

Coles Logistics at Edinburgh Park is the new state headquarters and it is very interesting to see how the products are delivered to Coles stores across the state. Article on the new Coles Mega Centre's at: <http://www.theage.com.au/articles/2004/07/21/1090089216029.html>

Department of Transport, Energy & Infrastructure is the State Government department responsible for key infrastructure projects in South Australia. Tours can be organised to view projects such as the Port River opening bridges, rail and road extensions and the Traffic Management Centre http://www.dtei.sa.gov.au/about_us

Flight Training Adelaide teaches international students to fly commercial aircraft over a twelve month period and is a live-in campus. <http://www.flighttrainingadelaide.com/>

6.4 C2C Student Industry Tours (cont)

Futuris Automotive manufactures all the seats and other interior products for Holden
<http://www.futuris.com.au/>

GM Holden Ltd manufactures Commodores in Adelaide for the Australian and world markets
<http://www.holden.com.au/>

JS Sport is a leading manufacturer of school wear, sportswear and work wear and have been supplying schools, clubs and business throughout Australia since 1987 <http://www.jssports.com.au/>

Les Brazier Special Vehicles - modify vehicles for wheelchair access and provide other modifications and products to assist in mobility for the disabled.

Mincham Aviation - caters for the aircraft & defence engineering industries. They specialise in the manufacture & repair of advanced composite, sheet metal, welding, machining, cylinder grinding, heat treatment, painting and project management. <http://www.minchamaviation.com/>

RAAF Edinburgh - the opportunity to visit the base of the RAAF in South Australia.
http://www.defence.gov.au/RAAF/organisation/info_on/bases/edinburgh/units.htm

TAFE Parafield Campus – where TAFE SA run their transport engineering course which gives students the opportunity to work in the aviation or the automotive retail, service and repair sector of the automotive industry. <http://www.tafe.sa.edu.au/Default.aspx?tabid=930>

Other Tours - in addition to the list of established tours above, NAMIG has a network of partners who can be sourced to meet particular interests of schools. All schools need to do is identify their particular area of interest and the Coordination Team will endeavour to arrange a suitable industry experience.

6.5 Student Tour Booking Form

Please fully complete the form below and then forward to info@concept2creation.com.au

Date of proposed tour:
School:
Request tour of:
Number of students:
Time:
Bus required:
Name of teacher booking tour:
Teacher email:
Teacher mobile:
School phone number:

Please ensure that the names of students attending the tour are supplied to the NAMIG office five days prior to the tour. This will ensure that the industry partner has the details for security well before the tour.

Confirmation of the tour will be sent to you by email as soon as it is confirmed with the industry partner.

Please refer to http://www.concept2creation.com.au/teachers_documents_and_templates for the documents on

C2C Engagement Protocols
 C2C School Consent Form
 C2C Student Questionnaire

Email completed form to: info@concept2creation.com.au

6.6 Student Workshop & Tour Planning Form

Please fully complete the form below and then forward to info@concept2creation.com.au

C2C TOURS & WORKSHOPS	
<p>Before commencing their C2C project, it is essential to create a context for students and to provide them with the opportunity to gain an awareness of industry. Industry tours are an integral part of the C2C experience, providing students with an insight into how advanced manufacturing techniques are integrated into the workplace. Prior to going on an industry tour students MUST complete an OH&S Workshop (1 lesson duration) followed by NAMIG's Lean Manufacturing Workshop (2 lessons duration).</p>	
C2C WORKSHOPS	
<p>Indicate that the school will provide OHS&W training for the students prior to commencing C2C projects</p> <p>Otherwise nominate 2 alternative preferred dates/times (1 lesson duration) for NAMIG Coordination Team to conduct an OHS&W workshop at the school for <u>each</u> class undertaking C2C in 2011 *</p>	
<p>Nominate 2 alternative preferred dates/times (duration- 2 consecutive lessons) for the NAMIG Coordination Team to conduct a Lean Manufacturing Workshop at the school for <u>each</u> class undertaking C2C in 2011 *</p>	
<p>NB Schools will be contacted by NAMIG to confirm arrangements or to organise alternative times if necessary</p>	

INDUSTRY TOURS	
<p>Circle which tour(s) your school would be interested in (refer Appendix A for full details of available tours)</p>	<p>BAE Systems: Edinburgh Parks OR Land Division OR Optical Plant</p> <p>GM Holden</p> <p>Futuris Automotive</p> <p>Adtech Engineering</p> <p>Clipsal Australia</p> <p>Coles Logistics</p> <p>Department of Transport, Energy & Infrastructure</p> <p>Flight Training Adelaide</p> <p>Mincham Aviation</p> <p>Les Brazier Special Vehicles</p> <p>J S Sports</p> <p>RAAF Edinburgh</p> <p>Classic Fighter Jet Museum (in conjunction with a tour of Flight Training Adelaide)</p> <p>TAFE Parafield Campus (in conjunction with a tour of Flight Training Adelaide)</p>
<p>In addition to this list, we have a network of partners who can be sourced to meet particular interests of schools. Please indicate areas of interest if appropriate</p>	
<p>Indicate 3 suggested dates/times for an industry visit(s) during the first semester for each class undertaking C2C in 2011 *</p>	
<p>NB Schools will be contacted by NAMIG to confirm arrangements or to organise alternative times if necessary</p>	

7. *What NAMIG gives and gets*

The GIVING:

NAMIG provides the following forms of assistance to enable schools for delivery of C2C projects:

- Professional Development Workshops for teachers. This includes day or part-day workshops the provide introductions to C2C projects, Project Management, Lean Manufacturing and Occupational Health & Safety and other relevant topics that will enhance their preparation for delivering projects;
- Short Courses for teachers. These might include Electronics, Computer Aided Design and Systems Engineering;
- Contributions towards TRT allowance for the above activities and participation in challenge components of projects;
- Student workshops in relevant topics that provide preparation for successful projects.
- Tours that create an authentic context for projects;
- Contribution towards transport to tours;
- Provision of some catering at student and teacher workshops and tours;
- A subsidy for each student undertaking a project at C2C and possibly higher levels of the program;
- Provision of project support through undergraduate and industry mentors and an online 'Ask an Expert' facility;
- An opportunity to present at the major C2C Expo held in November each year;
- A school plaque and awards to celebrate the experience;
- Opportunities for tertiary scholarships;
- Active relationships with industry and tertiary partners;
- Reimbursement for data collection and reporting.

The GETTING:

- Schools are required to complete a Memorandum of Understanding prior to commencement of the program or provision of any assistance;
- This MOU registers agreement that schools will undertake all components of a project. These include allowing a minimum of 10 weeks preparation prior to 10 weeks for project delivery, whole school commitment and support for the program, participation in workshops and tours, legitimate use of mentors and participation in the C2C Expo;
- There is also a requirement for schools to provide relevant representation at the occasional but highly important separate meetings of teachers and school leaders;
- NAMIG is required to submit prompt and comprehensive reports to its funding bodies. Therefore, participating schools are required to be supportive of this requirement to ensure that the program can be sustained;
- An important component of the program is the evaluation. This work is contracted to a reputed organisation and can generate information that can be utilised by all participants, particularly for continuous improvement, marketing and development of curriculum and teaching methodologies. Therefore, prompt and quality responses are required by schools in return for an incentive payment to assist with this task.