Australian Government

Department of Education

Transforming engineering students into student engineers: improving learning outcomes and employability

Final report, 2019

Lead institution

The University of Adelaide

Partner institutions

Queensland Institute of Technology

The University of Canberra

Project leader

Associate Professor Bernadette Foley

Team members

Dr Tiffany Gill

Associate Professor Edward Palmer

Associate Professor Bouchra Senadji

Professor Elisa Martinez-Marroquin

www.aaee.net.au

Support for the production of this report has been provided by the Australian Government Department of Education. The views expressed in this report do not necessarily reflect the views of the Australian Government Department of Education.

2019

ISBN 978-1-76051-782-3 [PDF]
ISBN 978-1-76051-783-0 [DOXC]
ISBN 978-1-76051-784-7 [PRINT]

Acknowledgements

The project team wishes to acknowledge and thank the following individuals and institutions for their valuable contributions. Their participation in the project was greatly appreciated.

Mr David Wilson, Quality Manager, Kellogg Brown and Root Pty Ltd: Mr Wilson was instrumental in identifying the need for this project and provided ongoing support to the project team. His in-kind participation enabled the integrity of the industry connection to be maintained. He also obtained the necessary approval that allowed a number of corporate templates to be adapted for this project.

Dr Lincoln Wood, formerly of The University of Adelaide: Dr Wood provided access to the management system processes that he had adapted for use in the engineering curriculum.

Mr Mike Hurd, Director, Engineering. Systems. Management: Mr Hurd provided continued support throughout the project and also provided management system expertise for the developed resources.

SafeWork Australia: SafeWork Australia provided early in-kind support for the project.

Engineering academics: This project would not have been possible without the engineering academics who agreed to participate in this project and provide their feedback.

List of acronyms used

AAEE	Australasian Association for Engineering Education
ACED	Australian Council of Engineering Deans
MaSEE	Management System for Engineering Education

Executive summary

In the past 10 years, there has been an increasing need and emphasis on ensuring that curricula prepares graduates for successful careers. The present project builds on the Australian Government's Office for Learning and Teaching seed project (SD13-2878) entitled 'Promoting student engagement and continual improvement: integrating professional quality management practices into engineering curricula'. The seed project conceptualised the Management System for Engineering Education (MaSEE) as a framework under which engineering students would be provided with a suite of resources that would enable them to approach their studies as student engineers, rather than engineering students, and aid them in their transition to the profession.

The approach used by professional engineers is informed by management system frameworks that set out consistent protocols and processes for use. The ability to appreciate and work in accordance with these protocols and processes provides transferable skills that are directly related to the employability of graduates and engineers.

The MaSEE concept is predicated on similarities between industry management system processes, effective learning and teaching strategies and the development of employment capabilities. For example, adapted industry design verification protocols can be embedded into learning activities as a form of peer-generated cyclical feedback. This provides student engineers with the opportunity to use an adapted industry process and enables them to benefit from peer feedback in their learning.

The **aims** of this project were to:

- build an evidence base for using adapted industry management processes as learning and teaching tools
- ratify MaSEE as a conceptual framework
- develop resources for the use of student engineers to increase their exposure to industry
- explore the application of the framework to other disciplines.

The project team engaged with industry members and educators to review the MaSEE concept and develop a modular and flexible suite of processes that could be used by individual educators or scaffolded throughout a program. Six processes – design verification, design review, project minutes, document control, risk assessment and project planning were initially proposed and were later confirmed as appropriate processes by industry members through this project.

The format and structure of the developed resources were informed by engineering educators and include:

- *implementation guides:* These guides provide information to educators about the management system process, its value in industry and how it can be used as a learning and teaching tool. They include implementation suggestions and

assessment options and will continue to be developed as additional examples of use within the curriculum are identified

- *quick guides:* These one-page overviews for student use provide key information and considerations about the implementation and use of the associated management system process
- *templates:* These documents are for student use and were adapted from or by industry members. In some modules, a choice of templates may be available.

The **outputs** of this project include the resources that were created for the six identified processes. Further resources, including overarching management system resources, for six additional modules are presently in development. All of the resources will be available through the Australasian Association for Engineering Education (AAEE) from mid-2019.

The **impact** of the project is expected to increase as the outcomes are transferred. The resources are intended to be living documents that will be adapted, further developed and embedded within learning activities.

The project has enabled the MaSEE framework to be ratified and resulted in a number of resources being developed for use. The resources are focused on engineering education; however, they could also be applied to other professions and disciplines. Supporting and furthering this interdisciplinary transfer of outcomes is one of four recommendations of this project. The **recommendations** are to:

- continue to disseminate activities and actively support institutions to use resources
- further contribute to the evidence base supporting the use of adapted industry management system processes as learning and teaching tools
- review and leverage the outcomes of recent government-funded projects focused on employability within higher education
- support the transfer of the MaSEE concept to other disciplines.

Table of contents

Tables and figures

Tables

Figures

1. Introduction

The approach to work adopted by professional engineers differs to the general approach adopted by engineering students when learning the fundamental technical skills required to practise professionally. The approach used by professional engineers is informed by management system frameworks that provide consistent protocols and processes for use. The ability to appreciate and work within these protocols provides transferable skills that are directly related to the employability of graduates and engineers. These skills are recognised competencies and have been well defined for engineering programs.

This project builds on the outcomes of the 2013 Office for Learning and Teaching seed project (SD13-2878) entitled 'Promoting student engagement and continual improvement: integrating professional quality management practices into engineering curricula'. The seed project conceptualised the Management System for Engineering Education (MaSEE) and trialled the use of an exemplar management system process as a learning and teaching tool at two institutions. The outcomes of the seed project demonstrated that the exemplar process could be adapted for use in a manner that developed students' awareness of the process and increased their engagement with the technical course content. The present project sought to upscale the outcomes of the seed project to include additional processes by exploring and exploiting relationships between good-practice learning and teaching processes, learning outcomes and employability.

1.1. Project aims

The specific **project aims** were to:

- create an evidence base to demonstrate the pedagogic merit of using adapted industry protocols and management system processes as learning and teaching tools within the engineering curriculum
- refine and ratify the MaSEE as a framework for integrating adapted industry protocols into the curriculum as a scaffolded and flexible teaching resource
- increase exposure to and engagement with industry in the engineering curriculum to add value to work-integrated learning activities and to aid students' transition to employment
- provide learning activities that enable engineering students' professional identity to be developed such that, from their first year, students approach their learning as student engineers rather than as engineering students
- explore the application of the framework to other disciplines.

1.2. Background and context

Accredited tertiary engineering programs prepare graduates to enter engineering practice as professional engineers or engineering technologists. The skills required by the graduates are defined in Engineers Australia's competency-based assessment system, as the National Generic Stage 1 Competency Standards (Engineers Australia, 2011). The standards are comprehensive and cover competencies related to students' knowledge and skill base, engineering application ability and, importantly, their professional skills, values and attitudes. A combination of competencies in the 'application' and 'attitude' elements is often associated with broader understandings of students' employability and work readiness. These skills comprise the socio-technical and non-technical skills necessary to participate effectively in the workplace and include an ability to navigate protocols, interact with others and efficiently complete work. It is these skills that this project targets.

Over the past one to two decades, increasing emphasis has been placed on defining which competencies are required by engineering graduates, and by university graduates more generally. In the area of engineering, the first competency standard was introduced in 1993 and each subsequent revision (1998, 2003, 2006, 2011 and 2013) has shaped understandings of which learning outcomes need to be considered, developed and assessed within progressive engineering curricula. Significant revisions were made to the standards between 2006 and 2011. These revisions were informed by nationally funded projects that sought to define the future of engineering education, including King's (2008) landmark report entitled 'Addressing the supply and quality of engineers for the new century' and Wright et al's (2011) 'Threshold learning outcomes for engineering'. A key feature of the 2011 revision to the standard was the inclusion of specific 'indicators of attainment' for each competency, which were defined in more depth than they had been previously. In addition to providing guidance, these indicators explicitly characterise professional engineering practice.

The engineering curriculum was traditionally designed to develop the technical/analytical knowledge base that provides the foundation for engineering practice. Consequently, one challenge for engineering educators relates to the complexity of devising curricula to develop these non-technical competencies. Educators must consider numerous issues, such as which core technical knowledge content should be removed if more time is dedicated to the development of non-technical competencies, or whether an attempt should be made to simply condense the content so that everything can be covered. The answers to the questions raised by such issues are not clear. Thus, further investigations of the pedagogical approaches that appropriately blend academic and practical learning experiences need to be undertaken.

In many engineering programs, non-technical competencies are developed in 'professional practice', 'management' or 'communication' units of study (King, 2008). These competencies are bolted on to the core discipline knowledge and are often perceived by students as being less important than the development of technical skills (King, 2008). Chanda and Nicholls (2006) note that there is some merit to a bolted-on approach, but argue that there is greater value in a curriculum design that incorporates a mix of bolted-on, embedded and integrated approaches. An embedded approach incorporates non-technical competencies into curricula, but does not directly reference or assess the development of these competencies. An

integrated approach seeks to develop these competencies in parallel with technical content. For example, project-based learning is an integrated approach that has been shown to be appropriate for engineering (Maier, 2008; Mills & Treagust, 2003; Schaller & Hadgraft, 2013). The success of project-based learning activities may be related to the selection and authenticity of the project being undertaken. Notably, industry-inspired projects are generally preferred.

In accordance with a key recommendation of King (2008), Engineers Australia strongly advocates for the use of industry-inspired projects and greater engagement with industry more broadly. A number of Office for Learning and Teaching-commissioned projects include industry-inspired projects and industry engagement (Jollands, 2015). A recent publication entitled 'Best practice guidelines for effective industry engagement in Australian engineering degrees' details the outcome of an Australian Council of Engineering Deans (ACED) project (Male & King, 2014). The guidelines, which were well received, outline the need for and challenges related to industry engagement and provide best-practice examples of industry engagement. Of relevance to this project, the key considerations and constraints that can be taken from these guidelines include that:

- exposure to professional engineering practice is essential within the engineering curriculum to develop necessary employability skills
- action is required from engineering faculties (and academics) and industry and professional bodies
- engineering practice is poorly understood by academics (and students) and practising engineers who engage with learning activities may not have knowledge of pedagogy or effective curriculum design
- students need to develop professional identities consistent with professional practice
- further investigations need to be undertaken to determine how the necessary competencies can be developed more systematically.

1.3. Management System for Engineering Education (MaSEE)

The MaSEE provides the necessary framework and structure to allow students to use the adapted industry management system processes throughout their studies (Foley & Willis, 2015). The MaSEE is a resource for students and can be accessible for use in all relevant coursework. It has been designed in a modular form to allow for a scaffolded introduction and the incorporation of additional institutional processes, including additional processes related to institutional health and safety processes.

Figure 1 shows the MaSEE structure and demonstrates the progressive introduction of processes throughout a degree program. Once introduced, each process would become a requirement for appropriate tasks in later years to reinforce the process as a standard practice. For example, project meeting minutes could be introduced at level 1 and required for use in later years.

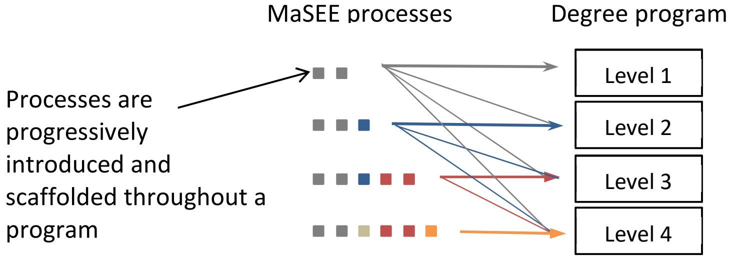


Figure 1: Use of the Management System for Engineering Education throughout a degree program.

As discussed, the concept is predicated on synergies between industry management system processes, effective learning and teaching strategies and the development of employability capabilities. Table 1 sets out the proposed processes for inclusion and the bases for the inclusion of each process.

Table 1: Identified processes in the Management System for Engineering Education

Industry process	Student use	Employability skills developed
Design verification	Provide/receive cyclical peer feedback	The ability to give and receive feedback/engage in collaborations
Design review	Provide/receive cyclical peer feedback	The ability to consider the socio-technical factors that affect work, including safety and end-user issues
Project minutes	Track group progress	The ability to engage in teamwork and be accountable for actions
Document control	Maintain version control and organise work	The ability to organise work to ensure traceability
Risk assessment	Identify factors that need to be considered—plan for uncertainty	An understanding of the role of protocols (uncertainty, management and safety)
Project planning	Identify and document assessment requirements and plan work to be completed within given time constraints	The ability to plan, communicate any requirements, organise and track the progress of work, self-manage and manage others

2. Project approach and methodology

The approach to the project was iterative and included several feedback loops as the resources were developed. The key steps included:

- establishing the project, including obtaining ethics approval
- reviewing previous resources
- engaging with stakeholders and end users
- further developing the resources
- finalising the resources.

The **establishment** of the project included confirming the project team, appointing a new project manager, branding the concept as MaSEE and seeking human ethics approval. The University of Adelaide's Human Research Ethics Committee (H-2017-001) granted ethical approval for this project for a period of three years. The approval covered a range of project activities, including:

- industry focus groups and surveys
- educator focus groups, workshops and participation
- student surveys.

In **reviewing previous resources**, consideration was given to the nature of the resources and how readily they could be adapted and used by others. The resources initially developed through the Office for Learning and Teaching seed project included online modules, detailed implementation plans and adapted industry templates. The authenticity of the processes and their educational merit were sound. However, the format of the online modules, which were created to provide guidance to students, were troublesome. The modules were developed using Articulate Storyline software; however, this software limited the adaptability of the modules by others and created numerous issues when these modules were uploaded to different learning management systems. Additionally, the long-term maintenance of the modules was deemed unsustainable. In investigating other options for the online development of the modules, emphasis was placed on end-product appeal and ease of use.

The next stage of the project was critical to refine and ratify the MaSEE concept and confirm that the six proposed processes were appropriate. This stage included **engaging with stakeholders and end users**. The critical stakeholders were industry members, as the aim of using the processes was to allow engineering students to approach their studies as student engineers. Thus, endorsements of the key processes that graduates would use across all engineering disciplines were vital to this project. In addition to industry representation in the reference group, a focus group was held with an industry advisory board, and an online survey was administered to gain further feedback. Holding the focus group enabled detailed discussions to take place, and conducting the online survey enabled a larger number of individuals to participate in the project. Table 2 shows the distribution of participants who completed the online survey in relation to discipline, location and sector. A copy of the

survey questions can be found in Appendix B. The results of the focus group and online survey confirmed that the six proposed processes were applicable across all engineering disciplines and were representative of graduate needs (Foley et al., 2017).

Table 2: Distribution of industry responses (*n* = 43)

Discipline	% of participants*	Location	No. of participants	Sector	% of participants
Civil	34.9	ACT	3	Engineering consultant	32.6
Mechanical	34.9	NSW	3	Government	9.3
Electrical and electronic	39.5	Qld	4	Large corporation/ multinational	25.6
Chemical	11.6	SA	3	Small business	5
Petroleum	4.7	Vic	5	Utility	7
Mining	14	WA	7	Other	14
Software	14	National	16		
Other	34.9	International	2		

* The participants could identify more than one discipline.

During this stage, **engaging with end users** was also a critical part of the project. Discussions were held with educators who had used the previously developed resources or were interested in using the resources developed by this project. A workshop held at the 2017 AAEE conference provided a key way of engaging with end users. Ten participants attended the workshop, including a reference group member. Three project team members facilitated the workshop. The project evaluator was also present at the workshop. The workshop focused on if and how the resources could be used. Sample resources in different forms were provided for discussion. The workshop confirmed that:

- the six proposed processes were valid
- there were similarities between the industry processes and the learning and teaching strategies
- one-page quick guides for students were preferable to online guidance modules
- it was essential that there was the flexibility to use one or many of the processes, as each participant noted that they would use the resources differently.

All of the participants at the workshop were provided with a USB stick with background information about the project and the draft resources discussed.

After this engagement period, the **resources were further developed** with the objective of creating a flexible, modular quick guide approach. The development of the resources

included a broad literature review to validate the pedagogic merit of using the adapted industry management system processes as learning and teaching tools. The results of the literature review were included in the developed resources. Additional input into the development of the resources was provided by a cohort of Master of Education students. This cohort had previously worked as engineers in the industry and had returned to university because they wished to change the direction of their careers. They provided invaluable insights into the authenticity of the processes and how they were being used as educational resources.

The input and feedback enabled the **resources to be finalised** as modules (section 3.1). To finalise the modules, the project team engaged an industry management system consultant to collate and complete the resources. During this process, overarching supporting modules and additional specific modules were also identified and developed.

Throughout the project, there was narrow opportunistic use of the resources by project team members and others at their institutions. The availability of the resources will provide further opportunities to examine different aspects of the full suite of resources, including:

- users' experiences of the process(es)
- the extent to which the process(es) are understood
- the effects of the resources on students' learning
- users' perceptions about the value of the process(es)
- users' views on how the provided learning resources could be further refined.

3. Project outputs and findings

The outputs of the project enabled the MaSEE concept to be refined and include the educational resources for use and the online repository and numerous project publications. The educational resources are considered living resources that can be used and further adapted by engineering educators.

The project leveraged existing knowledge, networks and the results of other funded projects. The collaborative linkages with researchers, stakeholders and projects are expected to continue. In addition to detailing the project outputs, this section discusses the project's linkages, critical success factors and challenges.

3.1. Educational resources

The developed resources have been designed as a modular set of adapted industry processes that can be used at the individual course level or scaffolded into a degree program. The modules developed include overarching management system documentation and adapted industry processes (Figure 2).

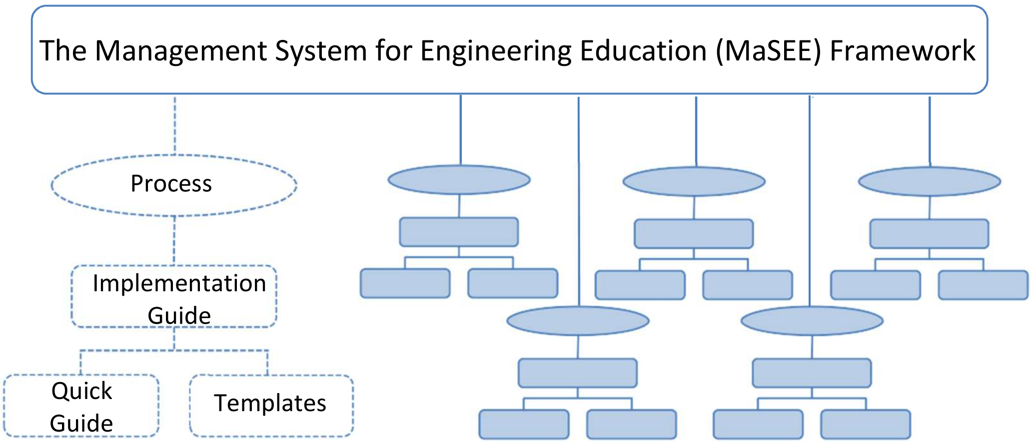


Figure 2: The Management System for Engineering Education modular resource framework.

The developed modules are included in Table 3 and are branded by colour (Figure 3). The modules include the:

- *implementation guides:* These guides (branded orange, for educator use) provide information for educators about the management system process, its value to industry and how it can be used as a learning and teaching tool. They also include implementation suggestions and assessment options. These guides will be further populated as additional examples of use within the curricula are identified
- *quick guides:* These one-page overviews (branded blue, for student use) for student use provide key information and considerations for the implementation and use of the associated management system process

- *templates:* The templates were designed (and branded blue) for student use. In some modules, a choice of templates may be available. These templates have been adapted from or by industry members.

Table 3: Available education resources

Module	Module series number	Available resources			Status
		QG	IG	TP	
Engineering Management Systems	01	x	x		For use
Lifecycle Design	02	x	x	x	Draft
Project Planning*	03	x	x		For use
Managing Project Risk*	04	x	x	x	For use
Hazard Identification	05	x	x	x	Draft
Design Review*	06	x	x	x	For use
Design Verification*	07	x	x	x	For use
Design Validation	08	x	x	x	Draft
Engineering Project Meetings*	09	x	x	x	For use
Document Management*	10	x	x		For use
Requesting Information	11	x	x		For use
Engineering and the Law	12	x			Draft

* Initially proposed resource.

QG, quick guide. IG, implementation guide. TP, template.

Figure 3: Management System for Engineering Education branding.

The quick guides and templates can be adapted for use by institution(s) and/or engineering program(s). Alternatively, the design of a new template for local use could be used as a standalone learning activity.

To model appropriate document management, each resource is coded to indicate its type and revision status. For example, module 09, Engineering Project Meetings, includes the following resources on minutes:

MaSEE-QG-091-C	Quick Guide to Engineering Project Meetings Rev. C
MaSEE-IG-092-B	Implementation Guide to Engineering Project Meetings Rev. B
MaSEE-TP-093-A	Meeting Agenda Template Rev. A
MaSEE-TP-094-B	Meeting Minutes Template Rev. B
MaSEE-TP-095-A	Meeting Minutes Template Rev. A
MaSEE-TP-096-A	Meeting Minutes Template Rev. A

In the above example, there are three minutes templates to choose from: 094, 095 and 096. This module is provided in Appendix C for reference.

The project proposal identified six management system processes for development; however, as the project progressed, a further six modules were identified. These modules are in various stages of development.

3.2. Online repository

The project resources will be available from the AAEE from early to mid-2019 and can be accessed with a Creative Commons license. This site was selected following discussions with members of the Associate Dean Learning and Teaching network in 2018. The AAEE is the home of engineering educators and is currently under redevelopment by the AAEE. One objective of the redevelopment project is for the website to be a repository for resources, such as those developed by this project. Access to and maintenance of resources from funded projects remains a challenge. A number of previous repositories suggested for this project are no longer supported and a standalone website would require ongoing directional links and overall site maintenance. Hosting a page(s) within a site designed for the targeted end users of the resources will enable ongoing dissemination with sustainable maintenance.

The project will have a public-facing page on the website with an overview, context, links to sample resources and the project team's contact details. This will enable the resources to be publicly accessible through the project team. In addition, a members-only resource page will include:

- all the resources
- a feedback portal
- a page through which additional/modified resources can be uploaded
- information regarding the ongoing trials of the resources.

Membership to the AAEE is sponsored by ACED for engineering educators. The structure of the website will enable meaningful data on resource use to be collected.

3.3. Publications

As a component of the project's dissemination strategy, conference papers and workshops constituted the primary mechanism for communicating the outcomes of the project. Notable publications include:

> Foley, B., Howard, P., Toft, Y. & Hurd, M. (2016). Increasing safe design practice within the engineering curriculum. 27th Australasian Association for Engineering Education Annual Conference. Coffs Harbour, NSW.
>
> Foley, B., Gill, T., Senadji, B., Palmer, E. & Martinez-Marroquin, E. (2017). Developing a Management System for Engineering Education (MaSEE). 28th Australasian Association for Engineering Education Annual Conference. Sydney, NSW.
>
> Foley, B., Gill, T., Palmer, E., Eglinton-Warner, S., Senadji, B. & Martinez-Marroquin, E. (2018). Embedding a Management System for Engineering Education (MaSEE) into curricula. 28th Australasian Association for Engineering Education Annual Conference. Hamilton, New Zealand.

The AAEE annual conference is the largest forum for engineering educators in Australia and typically has over 250 attendees. Most higher education providers (with undergraduate engineering programs) have representatives attend the conference. The attendees range from individual early career engineering academics to program coordinators and international leaders in engineering education.

The first paper presented at the 2016 AAEE conference (Foley et al., 2016) focused on approaches for increasing safe design practices in the curriculum. The paper referenced processes within the MaSEE as potential tools for use by educators.

The second paper (Foley et al., 2017) provided an update on the project, the development of the resources and reported on the outcomes of an industry online survey that validated the relevancy of the proposed resources to industry. This paper was complemented by a workshop at the conference at which end-user feedback on the resources being developed was sought.

The third paper (Foley et al., 2018) explored the educational benefits of a subset of the adapted processes and how the use of the resources by student engineers could enable the development of non-technical attributes and account for diversity.

Further publications are planned for 2019. These publications will seek to extend the resources to domains outside the engineering education domain.

3.4. Project linkages

The project was founded on previous work that sought to explore and exploit the relationships between good-practice learning and teaching processes, learning outcomes

and employability. Authentic assessments and practices are critical to this relationship and require strong links with industry to be established. Projects funded by the Australian Government and stakeholders that have informed and/or will enable further work to be undertaken include:

- 2012 Office for Learning and Teaching innovation and development project (ID12-2495): Assessing final year engineering projects (FYEPs): ensuring learning and teaching standards and AQF8 outcomes
- 2013 Office for Learning and Teaching-commissioned project (SP13-3256): Developing graduate employability through partnerships with industry and professional associations
- 2013 SafeWork SA innovative practice grant: Embedding Safety in Design (SiD) into the engineering curriculum (Foley & Willis, 2013)
- 2014 ACED-sponsored project: Enhancing industry engagement in Engineering Degrees Project (Male & King, 2014)
- 2014 Office for Learning and Teaching National senior teaching fellowship: Assuring the quality of achievement standards and their valid assessment in Australian higher education
- 2015 Office for Learning and Teaching seed project (SD13-2878): Promoting student engagement and continual improvement: integrating professional quality management practice into engineering curricula (Foley & Willis, 2015)
- 2016 Office for Learning and Teaching national senior teaching fellowship: From theory to practice: equipping and enabling Australia's educators to embed employability across higher education
- 2016 Office for Learning and Teaching innovation and development project: Virtual work-integrated learning for engineering students
- 2016 Office for Learning and Teaching national senior teaching fellowship: Professional identity and agency: changing the way STEM students think about their learning and development
- 2016 Office for Learning and Teaching national senior teaching fellowship: Transforming graduate capabilities and achievement standards for a sustainable future (Scott, 2016).

The 2012–2014 projects informed this project. Specifically, these projects helped to identify the need for the project, created a readiness for change and provided exemplars of practice. Many of the projects also informed how this project was undertaken, the form of the resources and also provided technical content. This is significant because the diversity of the student cohort, program structure and intended outcomes requires the creation of flexible resources that can be adapted by different educators and institutions. This essentially led to a toolkit (or many toolkits) of considerations, outcomes, examples and resources.

The projects referred to above were undertaken at the same time as this project. As these projects are finalised, further opportunities will arise for synergies to be leveraged and transferred to other disciplines.

3.5. Critical success factors and challenges

This report represents the final submission for the funded project; however, the project itself is far from complete. The initial seed project and the present project enabled the MaSEE concept to be refined and ratified. It is now at a stage of development where educators are actively seeking to use the resources and there is momentum for the outcomes to be transferred and built upon. A number of factors have been critical to the success of the project, including:

- the initial Office for Learning and Teaching seed project that explored the concept
- the recognition of the need for students to engage with professional practices to enhance their employability
- the development of a dissemination strategy (section 4.2) that focuses on the transfer of outcomes
- a willingness to explore the form of resources that end users were seeking and would use
- a strong engineering education community that shared a common desire to create meaningful student outcomes
- access to funding, which enabled national collaborations and interdisciplinary exposure.

The project faced a number of challenges, including those related to:

- project team members changing roles
- the windows for the trialling of resources being limited by different educators and institutions preparing for teaching at different times (in some instances, there was only one window per year)
- low student feedback response rates.

As the project moves into the next phase, there will be further opportunities to continue trials with a greater number of educators and institutions. This project led to the development of survey question sets that can be used in the future.

4. Project impact, dissemination and evaluation

4.1 Project impact

The Impact Management Planning and Evaluation Ladder model (Hinton, 2014) was used to assess the impact of this project across seven levels (Table 4).

Table 4: Project impact ladder

	Impact of project (at completion)	**Anticipated impact (two years post completion)**
1. Team members	• Demonstrated **increased capacity** to contribute to engineering education research. • Three team members **promoted** within project time frame.	• Further **funding opportunities** identified to transfer outcomes to other disciplines.
2. Immediate students	• Access to adapted **industry processes**. • Increased understanding of **industry work practices**.	• Students can **apply industry** management systems processes **within their learning**. • Graduate are better prepared for industry. • Graduates can **critically** plan, review and document work.
3. Spreading the word	• **Three** conference papers. • **Visibility** of project within industry. • **Dissemination** at the national associate dean level. • Requests for future **national roadshows** and workshops to aid adoption.	• Additional national/**international conference** presentations. • **International journal** publication • Resources actively sought through **AAEE website**. • Referral to resources by educators outside the project team.
4. Narrow opportunistic adoption	• **Use of developed resources** by project team members and some workshop participants who attended individual courses.	• Resources **scaffolded** through a program. • **Additional resources** developed.
5. Narrow systemic adoption	• **Additional institutions** seeking to use resources in 2019.	• Educators actively volunteering to **trial resources** to support the ongoing development of an evidence base. • **Exemplars of use** by others disseminated.
6. Broad opportunistic adoption		• Educators **expand use** beyond a single engineering discipline. • Regular contributions of **additional/modified resources** posted on AAEE website.
7. Broad systemic adoption		• Concept adopted by **other disciplines** and further resources developed/adapted.

4.2 Project dissemination

The project team planned dissemination activities for the entirety of its life cycle. This project represented the second phase of a larger dissemination strategy for the MaSEE concept and was developed using the *D-cubed guide: planning for effective dissemination* (Hinton et al., 2011). The first phase of the dissemination strategy was the completion of the Office for Learning and Teaching seed project (Foley & Willis, 2015) to enable the MaSEE concept to be to be refined and piloted. The seed project informed change enablers and started a conversation that cultivated a **readiness for change**.

During the present project, change enablers, targeted potential adopters and end users were **engaged** to gain an understanding of how impact and momentum can be sustained after the completion of the funded project. Figure 4 provides an overview of the key agents within the dissemination strategy.

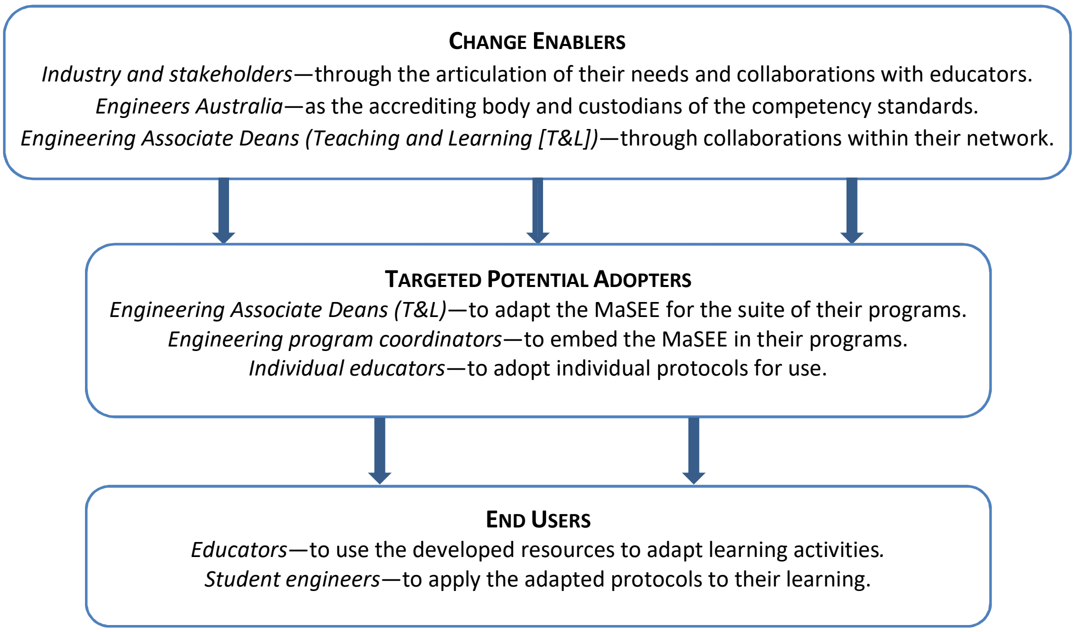


Figure 4: Dissemination enablers, adopters and users.

The dissemination activities on this project have included:

- a formal industry focus group (Queensland University of Technology)
- an online industry survey to gain input (advertised through Engineers Australia's networks)
- the engagement of a management system professional consultant (Engineering. Management. Systems. Pty Ltd)
- informal discussions with industry and educators at network events as different opportunities arose
- a formal project update to ACED

- verbal project updates at associate dean (teaching and learning) network meetings in June and December each year
- a workshop at the 2017 AAEE annual conference with potential adopters
- AAEE conference networking with potential adopters and end users in 2016, 2017 and 2018
- AAEE conference papers and presentations in 2016, 2017 and 2018 (section 3.2).

The project will now transition to the third phase of the dissemination strategy and will focus on **transferring the outcomes** of this project to adopters and end users. During the present project, the following preparation and planning activities for the third phase of this project occurred:

- Developed resources were specifically produced to ensure that one resource or all of the resources could be adopted by an individual educator or an institution. This approach was adopted based on feedback provided by educators at the 2017 AAEE project workshop and also addresses feedback received at similar workshops attended by members of the project team.
- A repository for the resources was chosen to provide ongoing, ready, access to the resources for engineering educators. The resources will be available through the AAEE website (section 3.2).
- The savings made on the project, particularly those related to travel expenses, have been committed to future dissemination and trial activities in 2019. This will include holding familiarisation workshops, providing support to new adopters of the resources and holding additional educator/student focus groups to evaluate the resources.

In addition, project team members will continue to provide in-kind support for the transfer of outcomes, as the development and use of these outcomes are directly related to their substantive roles.

The ongoing activities planned for transferring the outcomes should enable the MaSEE concept to be embedded within engineering education and provide a platform for its use in other disciplines.

4.3 Project evaluation

The project was evaluated by Associate Professor Sally Male. The evaluation report, available separately, summarises the key evaluation activities. These activities included a review of the proposed activities, an evaluation of the focus groups, attendances at several dissemination activities and discussions with project participants.

The evaluation of the project was positive. This supports and encourages the further development of the resources, ongoing dissemination activities and additional contributions being added to the evidence base for use.

References

Chanda, D. & Nicholls, G. (2006). Teaching transferable skills to undergraduate engineering students: recognising the value of embedded and bolt-on approaches. *International Journal of Engineering Education*, *22*(1), 116–122.

Engineers Australia. (2011). *Introduction and background to the Stage 1 Competency Standards*. Engineers Australia. Retrieved from www.engineersaustralia.org.au/About-Us/Accreditation/AMS-2019

Foley, B., Gill, T., Palmer, E., Eglinton-Warner, S., Senadji, B. & Martinez-Marroquin, E. (2018). Embedding a Management System for Engineering Education (MaSEE) into Curricula. 28th Australasian Association for Engineering Education Annual Conference. Hamilton, New Zealand.

Foley, B., Gill, T., Senadji, B., Palmer, E. & Martinez-Marroquin, E. (2017). Developing a Management System for Engineering Education (MaSEE). 28th Australasian Association for Engineering Education Annual Conference. Sydney, NSW.

Foley, B., Howard, P., Toft, Y. & Hurd, M. (2016). Increasing safe design practice within the engineering curriculum. 27th Australasian Association for Engineering Education Annual Conference. Coffs Harbour, NSW.

Foley, B., & Willis, C. (2013). A framework for the development of a Management System for Engineering Education (MaSEE). *Proceedings of 24th Annual Conference of the Australasian Association for Engineering Education (AAEE2013), 8–11 Decembe*r. Gold Coast, Qld.

Foley, B. & Willis, C. (2015). *Promoting student engagement and continual improvement: integrating professional quality management practice into engineering curricula: final report 2015*. OLT seed project SD13-2878. Canberra, ACT: Office for Learning and Teaching.

Hinton, T. (2014). *Impact Management Planning and Evaluation Ladder*. Sydney, NSW: Abound Consulting.

Hinton, T., Gannaway, D., Berry, B., & Moore, K. (2011). *The D-cubed guide: planning for effective dissemination*. Sydney, NSW: Australian Teaching and Learning Council.

Jollands, M. (2015). A framework for graduate employability adapted for discipline differences. In T. Thomas, E. Levin, P. Dawson, K. Fraser & R. Hadgraft (Eds.), *Research and development in higher education: learning for life and work in a complex world.* Vol. 38, pp. 246–255. Melbourne, Vic: Higher Education Research and Development Society of Australasia.

King, R. (2008). *Engineers for the future addressing the supply and quality of Australian engineering graduates for the 21st century. Report for the Australian Council of Engineering Deans*. Retrieved from www.aced.edu.au/index.php/blog-3/projects

Maier, H. R. (2008). A hybrid just-in-time/project-based learning approach to engineering education. Proceedings of the 19th Annual Conference of the Australasian Association for Engineering Education. Yeppoon, Qld.

Male, S. & King, R. (2014). *Best practice guidelines for effective industry engagement in*

Australian engineering degrees. Australian Council of Engineering Deans. Retrieved from www.aced.edu.au/index.php/blog-3/projects

Mills, J. E. & Treagust, D. F. (2003). Engineering education—is problem-based or project-based learning the answer? *Australasian Journal of Engineering Education*, Online Publication 2003–04.

Schaller, C. & Hadgraft, R. (2013). Developing student teamwork and communication skills using multi-course project-based learning. Proceedings of the 24th Annual Conference of the Australasian Association for Engineering Education. Gold Coast, Qld.

Scott, G. (2016). *Transforming graduate capabilities and achievement standards for a sustainable future: key insights from a 2014–16 Office for Learning & Teaching National Senior Teaching Fellowship*, May 2016. Canberra, ACT: Office for Learning and Teaching.

Wright, S., Hadgraft, R. & Cameron, I. (2011). *Engineering and ICT: Learning and Teaching Academic Standards Statement: December 2010*. Sydney, NSW: Australian Learning and Teaching Council.

Appendix A—Project certification

Certification by Deputy Vice-Chancellor (or equivalent)

I certify that all parts of the final report for this OLT grant provide an accurate representation of the implementation, impact and findings of the project and that the report is of publishable quality.

Name: *Professor Philippa Levy (Pro Vice Chancellor, Student Learning)* Date: *07/03/2019*

Appendix B—Online industry survey

1. Developing a Management System for Engineering Education (MaSEE).

Dear Participant,

You are invited to participate in this online survey in relation to the research project described below. It is envisaged that the survey will take approximately 5 minutes of your time, depending on the length of your responses.

The project is developing and trialing the use of adapted industry management system processes within the engineering curriculum as learning and teaching tools and builds on a pilot project which trialed the use of an adapted industry design verification template by students, to provide peer feedback prior to the submission of selected assessment tasks. The design verification trial was undertaken as a part of the Australian Government Office for Learning and Teaching Seed Grant: SD13-2878. The final report can be accessed from http://www.olt.gov.au/resource-promoting-student-engagement-and-continual-improvement-integrating-professional-quality-man

This project extends the previous work and will introduce up to six management system processes for use during 2017 and 2018. The management system processes will be selected based on their applicability to those entering the profession. Each of the processes will be validated by industry and adapted such that they can be integrated as learning and teaching tools. The project is being undertaken as part of the Australian Government Department of Education and Training Innovation and Development project ID16-5400 "Transforming engineering students into student engineers: improving learning outcomes and employability".

The information provided by you will be used by the project team to develop/improve teaching resources. The information will not be identifiable to you or your organization. Should your organization wish for their participation to be acknowledged in the developed resources, further consent will be obtained. The outcomes of the project will be published as part of the final report for the project and will be publicly available. All information/data and Intellectual Property (IP) obtained/created from this project will be transferred to the Australian Government Department of Education and Training, as a requirement of the funding agreement. The project team is able to provide additional information on this aspect should you require it.

The project is being conducted by Ms Bernadette Foley and Dr Edward Palmer from the University of Adelaide, Associate Professor Bouchra Sendaji from Queensland University of Technology and Professor Elisa Martinez Marroquin from the University of Canberra. Should you have any questions or concerns about this project please email bernadette.foley@adelaide.edu.au or phone Ms Foley on (08) 8313 0689. This survey has been reviewed and approved by the University of Adelaide Human Research Ethics Committee. Should you have concerns about the conduct of the research and wish to discuss your concerns with an independent party please email hrec@adelaide.edu.au or phone the Secretariat on (08) 8313 6028 and refer to approval number H-2017-001.

Participation in this survey is voluntary. By completing and submitting the survey you are giving your consent for your data to be used by the project team. You are free to withdraw from the survey at any time by exiting the survey or simply leaving your responses blank. Once you have submitted

the survey you will not be able to withdraw your consent for your data to be used, as your data cannot be identified.

Thank you for your participation.

Bernadette Foley

Associate Dean, Education
School of Civil, Environmental and Mining Engineering,
The University of Adelaide

Support for this project has been provided by the Australian Government Department of Education and Training (formerly the Office for Learning and Teaching). The views in this project do not necessarily reflect the views of the Australian Government Department of Education and Training.

2. Survey questions

* 1. What sector do you work in?

- ◯ Engineering consultant
- ◯ Government
- ◯ Large corporation/ multinational
- ◯ Small business
- ◯ Utility
- ◯ Other (please specify)

2. What state does your organisation predominantly operate in?

- ◯ Australian Capital Territory
- ◯ New South Wales
- ◯ Northern Territory
- ◯ Queensland
- ◯ South Australia
- ◯ Tasmania
- ◯ Victoria
- ◯ Western Australia
- ◯ National
- ◯ Other (please specify)

3. Please indicate the engineering discipline area you work in. (tick all that apply)

- ☐ Civil (including structural, water. environmental, urban)
- ☐ Mechanical
- ☐ Electrical and/or Electronic
- ☐ Chemical
- ☐ Petroleum
- ☐ Mining
- ☐ Software
- ☐ Other (please specify)

4. Which of the following does your business have? (tick all that apply)

- ☐ Quality management systems (e.g. ISO9000)
- ☐ Environmental management systems (e.g. ISO14000)
- ☐ Work Health and Safety management systems or standards (e.g. AS/NZS 4801)
- ☐ Integrated management system (e.g. custom or inclusive of all aspects)

Any other details you would like to provide?

5. How important is it that graduates entering your organisation can operate within a management system framework?

Very important	Important	Neither important or unimportant	Unimportant	Very unimportant	Unsure
○	○	○	○	○	○

* 6. Please rank the following activities, in order of importance, for graduates to be able to do when they enter your organisation (1 most important, 6 least important)

- ☐ Participate in a design review process
- ☐ Undertake design verification
- ☐ Complete project risk assessment(s)
- ☐ Apply appropriate document/version control
- ☐ Accurately record meeting outcomes
- ☐ Assist in project planning/preparation

7. Please list any other activities within a management system context, that are as important or more important, than the six above, for graduates entering your organisation?

8. Please explain why these activities are important.

9. Do you have any other comments to make about the value of graduates being able to operate within a management system framework?

10. Would you be interested in being contacted by the project team to review the resources that are developed?

◯ Yes

◯ No

3. Contact details

11. If you are interested in being contacted please provide your email address below.

Appendix C—Engineering project meetings module

MaSEE-QG-091-C	Quick Guide to Engineering Project Meetings Rev. C
MaSEE-IG-092-B	Implementation Guide to Engineering Project Meetings Rev. B
MaSEE-TP-093-A	Meeting Agenda Template Rev. A
MaSEE-TP-094-B	Meeting Minutes Template Rev. B
MaSEE-TP-095-A	Meeting Minutes Template Rev. A
MaSEE-TP-096-A	Meeting Minutes Template Rev. A

QUICK GUIDE TO ENGINEERING PROJECT MEETINGS

MaSEE
Management System for Engineering Education

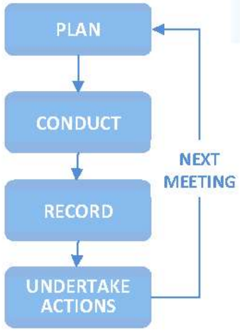
Project Meetings

Project meetings and their minutes are common communication and record keeping tools used during engineering projects.

Meetings are held so that project team members can **align understanding** between or amongst each other, and consult and cooperate to reach decisions and achieve outcomes. Meetings enable people to share knowledge and experience.

Engineering projects have different types of meetings, including:

- **Kick-Off Meetings:** held at the start of a project (or of a project phase or activity), involving all relevant stakeholders, to ensure alignment and understanding of project objectives and deliverables.
- **Progress Meetings:** to discuss the status of the project, identify issues and assign actions.
- **Problem-Solving Meetings:** to identify potential causes of a problem, and thus evaluate solutions and revise plans.



Effective Meetings

Meetings are effective when:

- They are well planned and have an agenda.
- The agenda is followed. Other topics can be added to the next agenda or discussed if time allows.
- Responsibilities are clearly assigned. Everyone knows why they're attending and their responsibility.
- The Chair keeps discussion on topic and encourages participation from all.
- There is active participation. Agree on the rules of the meeting before starting.
- The right participants attend. Consider the agenda and who needs to be there.
- Participants have the authority to make decisions.
- Participants come prepared. Give participants adequate notice of meeting details and agenda.
- All required supporting information has been gathered and is to-hand.
- Discussions result in clear decisions or actions.
- Participants' time is respected. Start on time, keep on topic and finish on time.
- Minutes are prepared and distributed to all participants soon after the meeting.
- Minutes are objective, and outline the decisions and actions to make the right progress.
- Design discussions are followed with: "Does that affect hazard exposure?"

Meeting Minutes

The minutes of a meeting are the written record of what was raised, discussed and agreed during the meeting. The minutes detail the decisions and actions that participants committed to, bringing accountability and helping drive actions to completion. The minutes are the official record of the meeting and can be called upon as evidence during investigations and audits.

Unlike legal 'records of proceedings', minutes do not need to capture the detail of who-said-what or how they said it. Clear, unambiguous outcomes are recorded.

Engineering project meetings minutes are objective and action-oriented. Minutes should focus on **'what'** was the decision or action, or **'why'** an outcome was (or was not) agreed upon. For example:

Jane to meet with SolarCom on Friday to confirm lead-time arrangements.

Safe design legislative requirements to be summarised [Action: Robert, by 28/03].

Many companies have a template for recording minutes. As a minimum, minutes should include:

- Meeting details (where, date, time)
- Attendants (present, apologies and absent)
- Purpose of the meeting
- Key decisions / discussion points
- Update on hazards and applying the hierarchy of controls
- Assigned actions (what is the action, who will complete it, target / planned completion date)

Preparing an Agenda

An agenda should include the following content, as a minimum:

Meeting Details –

- Meeting title
- Objective
- Meeting details (time, date, location)
- Participants required
- Chairperson
- Minute taker

Meeting Content –

- Welcome and apologies
- Confirmation of previous minutes
- Update on previous actions
- Discussion item 1
- Discussion item 2, etc.
- Hazard identification and controls
- Any other business
- Next meeting

Include supporting documentation in an appendix or attachment to the agenda.

MaSEE-QG-091-C

IMPLEMENTATION GUIDE TO ENGINEERING PROJECT MEETINGS

MaSEE
Management System for Engineering Education

THIS GUIDE IS FOR EDUCATORS AND IS TO BE READ IN CONJUNCTION WITH QUICK GUIDE TO ENGINEERING PROJECT MEETINGS

Pedagogical Advantages

The ability to capture decisions and track progress for projects is essential in professional practice.

The skills needed to draft agendas and write up minutes are also applicable to note taking and summarising required throughout an undergraduate degree – identifying key and relevant points, expressing them concisely and clearly in written form. In the undergraduate learning environment students are often called on to work in groups and teams to complete tasks, modelling the work of project teams.

Skills required for planning and conducting team/group meetings, which are akin to preparation of agendas and minutes, include; being able to identify what is important in the discussions, negotiations and arguments, keep a focus on the purpose of the meeting, and use of respectful and professional language.

The capability to conduct, and record the decisions of, project meetings exercises and develops students' study skills as well as their interpersonal and communication skills. This practice may also aid the development time management and personal organisational skills as team members must identify who will do what by when, then take responsibility for completing agreed actions, within agreed timeframes.

Assessment

The skills for conducting and minuting Project Meetings are best assessed as an element of a project which is to be completed over time, e.g. several weeks/lessons, so students can have at least two meetings – one for planning the project and one for tracking progress of the project, i.e. following up on agreed actions and decisions. (See Indicative Assessment)

Note that the Assessment is both a learning activity and a means of evaluating progress and performance.

Marking can be limited to confirming whether decisions, actions and progress were recorded appropriately using a rubric (see Indicative Rubric). Teacher time can then be used to design robust design task that also assess technical knowledge and competencies, and to provide informal feedback on how plans relate to practice as students conduct project meetings.

Assessment loadings should reflect time students are expected to take to conduct and record meetings.

Sample instructions

As a team, organise a time for the initial meeting. Meetings may be face to face or virtual (e.g. via phone, online platform e.g. Facebook or Wiki or discussion space on MyUni, Facetime, Skype or similar). At the initial meeting:

- organise times and mode of communication for subsequent mid-point and final meetings
- for this and subsequent meetings, appoint a person to chair/convener, a minute taker, and a person to distribute the minutes
- ideally each team member should have an opportunity to take a different role for each meeting
- either the minute taker or the chair/convenor can write up agendas for subsequent meetings
- prepare an agenda for the initial meeting, based on the provided template
- develop an action plan for your project.

Include teacher in distribution of all agendas and minutes.

Submit all agendas and minutes with other documents related to this project. If there are attachments to the minutes or agendas, also submit these.

Agendas and minutes must be in an approved format – either the provided template or an approved template. The format of the agenda and minutes must be action focussed – recording actions and decisions rather than the details of who said what.

The agendas must be structured so standing items can be tracked from meeting to meeting. The minutes must reflect the purpose of each meeting.

Implementation

Project Meeting Minutes can be assessed after at least two meetings, e.g. any two of the following - at the beginning of a project, partway through project, or at the end of the project. Assessment tasks that require meetings at all three points in the project life are preferable. Where practicable the teacher should observe at least one project meeting to enable informal feedback on the conduct of the meeting: that is, how the agenda and minutes are reflected in the way the meeting is conducted. The formal assessment of the Meeting Minutes should emphasise the clarity and conciseness of expression and the completeness of the document, i.e. is all the required information present.

It should be noted that if the agreed actions have not been completed in the agreed timeframes, this should not impact on the assessment of the Project Meeting Minutes provided this non-completion is recorded appropriately. Non-completion of agreed actions may be addressed in another aspect of the assessment of the project as a whole.

MaSEE-PR-092-B Page 1 of 4

Indicative Rubric (Process: Project Meeting Minutes)

	Not Satisfactory	*Satisfactory*	*Very Good - meets Satisfactory criteria plus…*
Agenda	☐ Not provided for each meeting ☐ Incomplete ☐ Format inappropriate for purpose ☐ Template not adjusted to reflect project team membership or project focus	☐ Provided for each meeting ☐ Complete ☐ Format appropriate for purpose ☐ Template adjusted to reflect project team membership and project focus	☐ Effectively helps Chair/convenor manage the conduct of the meeting
Minutes	☐ Not provided for each meeting ☐ Incomplete ☐ Format inappropriate for purpose ☐ Template not adjusted to reflect project team membership or project focus ☐ Actions not recorded or don't include who is responsible for completion of the action or the date by which it must be completed ☐ Decisions not recorded ☐ Summary of key points of discussion that lead to decisions not recorded ☐ Details of who said what; not included	☐ Provided for each meeting ☐ Complete – all required information recorded ☐ Format appropriate for purpose ☐ Template adjusted to reflect project team membership or project focus ☐ Actions recorded and include who is responsible for completion of the action or the date by which it must be completed ☐ Decisions recorded ☐ Summary of key points of discussion that lead to decisions recorded	☐ Meet industry standard for clarity and conciseness of expression ☐ Complement and support Action Plan and other project documentation ☐ Effectively informs discussion and decision making at subsequent meetings ☐ Decisions and actions can be traced through a series of meetings ☐ Are auditable by others
Meeting observation	☐ No clear designation of responsibilities ☐ Inappropriate behaviour, e.g. bullying, disrespectful language used, abusive language used, individuals not given opportunity to express views or contribute appropriately to discussion ☐ Discussions don't conclude with decisions ☐ No actions agreed on ☐ No agreed person allocated responsibility for actions ☐ No time frames for actions agreed on	☐ Clear allocation of responsibilities across group for Chair/convenor, minute taker and distributor of documents ☐ Chair/convenor ensures meeting keeps to time and agenda is followed ☐ Chair/convenor ensure respectful discussion and fair opportunity for all voices to be heard and all members to contribute to discussions and decision-making ☐ All participants behave professionally and respectfully in their interactions and communications	Conduct of meeting meets industry standard in terms of: ☐ Time allocation and time management ☐ Professional and respectful communications

Frequently asked questions

1. ***Which are better - face to face or virtual meetings?***

   Face to face is recommended for the initial meeting as there are many decisions to make. Face to face meetings, which may include use of technology such as Facetime or Skype, allow for more effective observation of reactions and non-verbal cues which, in turn, make communication more effective. In face to face meetings it is also commonly easier to 'get to know' the other members of the project team, which also helps effective communication. Use of technology, though is commonly used in industry to manage access and time. Trying to find a time and place for a physical face to face meeting is very challenging and can be expensive. The common practice of not having everyone in the same room at the same time means that having effective documentation, including Agendas and Minutes, becomes even more important.

2. ***What is meant by "industry standards" for agendas, minutes and the conduct of meetings?***

   Each organisation will have its own processes and tools. As outlined in the Quick Guide, the focus is on capturing decisions and actions. A summary of discussions should only be included if necessary to provide essential background to decisions. With experience, project managers and project team members develop the 'right' balance between sufficient and too much detail to track project implementation and to inform the implementation of actions. Meetings should only be all long as they need to be, i.e. focussed on the specified purpose and agenda. If a matter needs more discussion it is scheduled for another time or context. So, purposefulness, focus, relevance and effectively concise and clear expression of discussions, decisions and actions are the key features to look for.

3. ***When should it be conducted in the assessment cycle?***

   It is best that the preparation and conduct of project meetings is an integral element of a project. Therefore, the assessment should be a discrete element of the larger project assessment. Ideally students will have the opportunity to practice meeting preparation and conduct in a situation where they can receive informal/formative feedback before preparing, conducting and submitting minutes and agendas for a series of meetings that will contribute to final marks. For later years, it may be appropriate for minutes to form a component of a project portfolio, with individual records not assessed, but used as evidence of appropriate project management.

4. ***How much guidance should be given to students upfront?***

   Ideally, in addition to providing and explaining the use of appropriate templates and explanations of expectations, students will be able to see how they are used in the context of a project meetings should be available to students. This might be by the teacher or might be a video resource. A suggestion is to request samples of engineering project meeting minutes from members of an industry advisory board.

5. ***What if students can't organise meetings, make decisions, take minutes or follow the agenda?***

   If practicable, observing meetings or speaking with teams between meetings is desirable. This gives the teacher the opportunity to provide constructive feedback informally and to suggest strategies to help the team meet the standard. Ideally, students will have previously learnt about how to work effectively together. If not, time may need to be taken to address this set of competencies, particularly if there are widespread significant problems in teams working together. An alternative strategy could be to have higher year level students to mentor or chair meetings on behalf of a team. The level of support may need to be higher in early year levels.

Frequently asked questions

6. Does this make a difference to students?

Preparing for, and conducting meetings effectively, are essential skills for practicing engineers. Doing so in an educational setting allows guidance to be provided to develop the interpersonal and communication skills needed to work collaboratively and cooperatively with others. Problem/Project-Based Learning (an example of a "Just-in-time" approach) reflects the natural model of lifelong learning professionals will apply throughout their careers to maintain currency of knowledge and competency (Biggs & Tang 2007). It also develops skills in expressing ideas concisely and effectively in summary.

7. What adjustments can I make for students with a variety of capabilities and challenges that impact on their learning?

All teachers should assume all students are individuals who bring with them a range of experiences, characteristics, motivations, capabilities, strengths and challenges. However, over and above these, some students will have specific categories of challenges which need particular attention. These include students who have vision, hearing or mobility challenges, or who have specific information processing challenges, or who are not yet proficient English language readers, speakers or writers. For these students the principals of 'reasonable adjustment' can be applied: that is, within practical limits of the available resources, including time and money, relevant adjustments can be made to the presentation of information, to the manner in which students interact and communicate with each other and you, and to the format used for them to present evidence of learning. As the focus of this module is communication and interpersonal skills, the following examples of potential adjustments may be considered:

- students who are not proficient readers of English, particularly academic or technical English, may have additional time to review written material to allow time for translation
- students with a vision impairment can have an audio version of written materials and may be able to present their contributions orally
- students with a hearing impairment may be allowed to record discussions using auto-transcription or voice-to-text technology
- students who have been identified on the autism spectrum may require specific strategies for managing discussions where conflicting ideas are presented or exchanges are rapid

Setting up reasonable adjustment is best done in consultation with the student and, where required and appropriate, other team members.

Further Reading & References:

- Biggs, J and Tang, C. (2007). Teaching for Quality Learning at University, 3rd edition. Open University Press McGraw-Hill Education, UK
- Dandy, G, Daniell, T, Foley, B, Warner, R. (2018). Planning and Design of Engineering Systems. 3rd edition. Taylor and Francis, US
- Wolfe, J. (2006). Meeting Minutes as a Rhetorical Genre: Discrepancies Between Professional Writing Textbooks and Workplace Practice Tutorial. IEEE Transactions on Professional Communications. 49(4) pp 354-364.

TEMPLATE EXAMPLE: Meeting Agenda

MaSEE
Management System for Engineering Education

Meeting Information			
Project Name:			
Meeting Name:			
Meeting Purpose:			
Venue:			
Date:		**Time:**	
Facilitator:		**Scribe:**	
Required Participants:			

Agenda Items				
1.	**Welcome to Country**	We acknowledge and respect the traditional custodians whose ancestral lands we are meeting upon here today.		
2.	**Welcome and Apologies**			
3.	**Work Health and Safety**	*All meetings should start with a short (need to know) discussion on WHS requirements associated with the venue, for example: location of emergency assembly point, location of nearest exit etc.*		
4.	**Previous Minutes**	*If there has been a prior, related meeting, it may be appropriate to review, acknowledge and/or accept the previous minutes. It may also be appropriate to go through (discuss) action items from previous meeting/s.*		
5.	**Hazard Register Status**	*If the meeting relates to an active engineering project, it may be appropriate to review the Hazard Register (e.g. Safe Design Hazard Register and Action List) to check the status of actions associated with hazard controls.*		
6.	**New Business / Required Discussion**			
	6.1	**Agenda topic / discussion item: Title here**	*Initial of person/s leading discussion on this topic*	
	6.2	**Agenda topic / discussion item: Title here**	*Initial of person/s leading discussion on this topic*	
	6.3	**Agenda topic / discussion item: Title here**	*Initial of person/s leading discussion on this topic*	
	Etc........insert agenda topics as required. ***NOTE:*** *If there is a specific decision to be made at the meeting, this should be communicated in the agenda so that participants come prepared and informed, to provide input in to decision making process.*			
7.	**Any Other Business**	*Provide opportunity for participants to raise additional relevant topics and discussions items.*		
8.	**Next Meeting**	*Provide details of the next meeting (when and where).*		

MaSEE-TP-093-A

Page 1 of 1

MaSEE
Management System for Engineering Education

TEMPLATE EXAMPLE: Meeting Minutes

Meeting Information			
Project Name:			
Meeting Name:			
Meeting Purpose:			
Venue:			
Date:		**Time:**	
Facilitator/Chair:		**Scribe:**	
Meeting Attendees:			
Apologies:			

Minutes			
Work Health and Safety	*Some companies start all meetings with a short (need to know) discussion on any unique WHS requirements associated with the venue, for example: location of emergency assembly point, location of nearest exit etc. Alternatively, 'safety moments' may be requested to focus attention on the importance of health and safety.*		
Previous Minutes	*If there has been a prior, related meeting, it may be appropriate to review, acknowledge and/or accept the previous minutes. It may also be appropriate to go through (discuss) action items from previous meeting/s.*		
Hazard Register Status	*If the meeting relates to an active engineering project, it may be appropriate to review the Hazard Register (e.g. Safe Design Hazard Register and Action List) to check the status of actions associated with hazard controls.*		
New Business *(as per agenda)*			
1.	**Agenda Topic / Title here**		*Initial of person/s leading discussion on this topic*
Discussion:	*Summarise discussion points here*		
Conclusion:	*Summarise outcomes and decisions here. NOTE: If an important decision has been made by the meeting participants, it may be necessary to obtain signatures from the decision-makers (participants) as a formal record of agreement.*		
Action Items		**Responsible**	**Complete By**
Action Item 1 described here		*Person/s responsible for action/s*	*Target / planned completion date*
Action Item 2 described here			
etc. insert or delete rows as required			
2.	**Agenda Topic / Title here**		*Initial of person/s leading discussion on this topic*
Discussion:	*Summarise discussion points here.*		
Conclusion:	*Summarise outcomes and decisions here*		
Action Items		**Responsible**	**Complete By**
Action Item 1 described here		*Person/s responsible for action/s*	*Target / planned completion date*
Action Item 2 described here			
3.	**Agenda Topic / Title here**		
	........etc........insert agenda topics as required.		

Meeting Close	*Record time that meeting ended*
Next Meeting	*Provide details of the next meeting (when and where)*

MaSEE-TP-094-B Page 1 of 1

MEETING MINUTES

MaSEE
Management System for Engineering Education

Page 1 of 2

Course Title	Meeting no. 4
Assignment Title	Date of meeting 1/01/16
Group Name / No.	Time meeting started
Location	Time meeting ended
Recorded by	
Chair	Checked by Chair / other???

Purpose of Meeting

Name	Initials	Name	Initials
Attendees			
Person 1	P1		
Person 2	P2		
Apologies			
Absent			

Item no.	Description of discussion	Agreed action by	
		Person	Date
4.1	**Confirmation of previous minutes** ***Blue text has been provided for guidance – delete the blue text before using this template.*** *This area of the template is setup as a table and each new item number should be a new row.* *Note here any corrections required to the previous meetings or indicate 'Minutes of meeting xxxx confirmed with no corrections'*		
4.2	**Update on action items from previous meetings** *For each action identified in the previous meeting provide an update here. It is best to refer to the action using the item number, and for meetings that are part of a series it is recommend that the item numbers are*		

MaSEE-TP-095-A Page 1 of 2

MEETING MINUTES

MaSEE
Management System for Engineering Education

Page 2 of 2

Meeting no. 4

Date of meeting 1/01/16

Item no.	Description of discussion	Agreed action by	
		Person	Date
	sequenced using the meeting number. For example, 'Item 3.2 – Architectural drawings provided to xxx on 21/11/2016.' The descriptions only need to be brief.		
4.3	**This heading should be replaced by the item on the agenda** *The minutes should be decision or action oriented. All actions should have a responsible person and a date by which the action should be complete. Documenting why a particular decision was not made can be as important as why a particular decision was made.* *For meetings in a series (e.g. project progress meeting) it can be useful to have the same agenda each meeting. For each meeting item 3 (4.3 here because it is the fourth meeting) may always be progress on the 'stormwater layout' for example. It then becomes easier to track to progress over time as each meeting is providing a consistent update.*	*P1*	*22/03*
	Date, Time and Location of Next meeting *Add the date and time of the next meeting so that all participants can add it to their calendars* *There is often a need to distribute minutes to parties that were not required to attend the meeting. If this is the case then the names should be added below. All participants should automatically be on the distribution list.*		

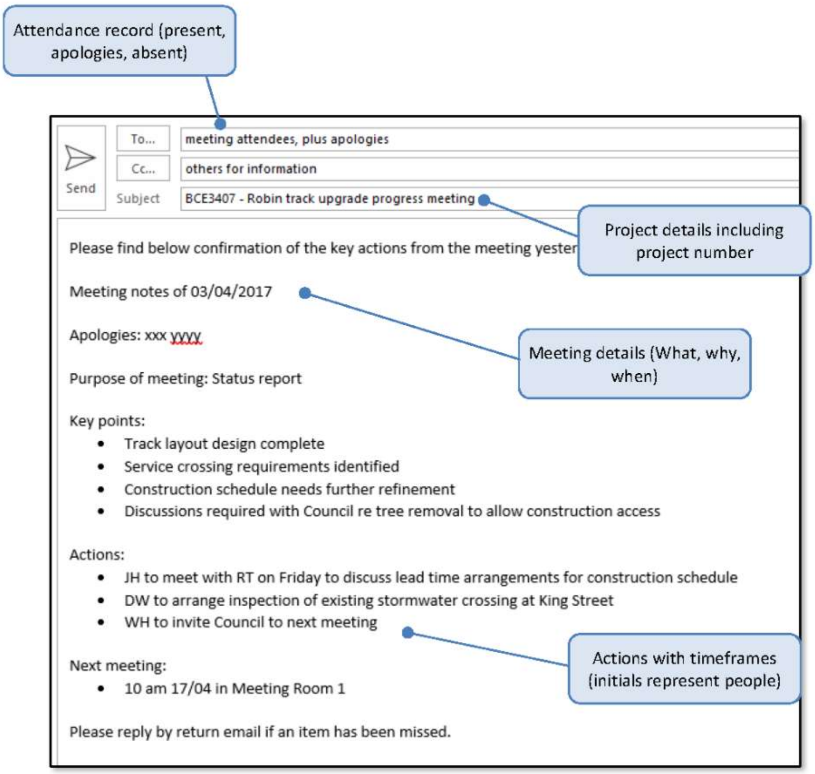
DISTRIBUTION

All attendees plus: Date of Distribution: Distributed by:

MaSEE-TP-095-A Page 2 of 2

MEETING MINUTES EMAIL TEMPLATE

MaSEE
Management System for Engineering Education



MaSEE-TP-096-A

Page 1 of 1