Building Better Teams at Work using Self and Peer Assessment Practices

Keith Willey
University of Technology, Sydney, Sydney, Australia
keith.willey@uts.edu.au

Anne Gardner
University of Technology, Sydney, Sydney, Australia
Anne.Gardner@uts.edu.au

Abstract: *There is a reported competency gap between the teamwork skills required by employers and those developed by engineering students during their undergraduate courses. The University of Technology, Sydney is addressing this issue by combining project-based learning with self and peer assessment to determine an individual's team performance. A confidential online tool is used to collect and collate the student self and peer assessment ratings used both for formative feedback as well as assessment purposes. We found this approach improved student teamwork, engagement and satisfaction, while requiring only a small commitment of academic resources. We propose that using self and peer assessment would also be beneficial in industry to change workplace cultures, promote teamwork, individual skill development, engagement and productivity. Our implementation produces two assessment factors. The performance factor may be used by managers to coach staff to improve their performance, while the formative feedback factor will assist individuals to identify their strengths and weaknesses as perceived by their peers, facilitating ongoing skill development.*

Introduction

Recent Australian government and OECD reports note that professional skills, including teamwork, are valuable attributes required by the professional community (Pont 2001, DEST 2002). Professional engineers in addition to being technically competent, require skills of collaboration, communication and the ability to work in teams (Lang, Cruse et al.1999; Sageev and Romanowski 2001). Scott and Yates (2002) note that successful engineering graduates rated the ability to contribute positively to team-based projects as the most important of 49 possible reasons for their success. Technical expertise, while acknowledged as necessary, and receiving the greatest amount of teaching time during their degree, was rated a comparatively low 29th. However, there is a reported competency gap between the professional skills required by employers and the level of skills developed by engineering students during their undergraduate courses (Meier et al. 2000, Martin et al. 2005). The importance of such professional skills is demonstrated by their inclusion in the Institute of Public Works Engineering Australia (IPWEA) National Skills Shortage Project. This project lists required Demonstrated Competencies for engineers to include: "…manages conflict and differences, and contributes to the resolution of problems to maintain an effective working environment; demonstrates commitment to working both individually and as part of the Team to achieve the strategic goals for the City; contributes ideas and information; uses feedback to develop skills, behaviours and attitudes" (Usher 2006).

If Universities are to successfully achieve teamwork and professional skill development as learning outcomes, they need a method of assessment, auditing and feedback that promotes these outcomes. Within the engineering program at the University of Technology, Sydney, we are coordinating the use of self and peer assessment to develop professional competencies including teamwork skills, facilitate the provision of feedback and to promote lifelong learning in undergraduate engineering students.

Two challenges of using self and peer assessment are that the data collection and processing may be time-consuming especially for a paper-based approach, and secondly that participants often have concerns about the privacy of their ratings

Freeman and McKenzie (2002) developed a confidential online tool called SPARK (Self and Peer Assessment Resource Kit) to collect self and peer ratings and to calculate adjustment and feedback factors for every participant. SPARK solves most administrative issues associated with paper-based approaches such as data collection and analysis. It enables participants to confidentially rate their own and their peers' contributions to a team project online. Participants are assisted in making their self and peer assessments by a requirement to rate each other over multiple criteria which we maintain should include specific project tasks as well as demonstrated professional skills e.g. good team practices. SPARK automatically generates performance and feedback assessment factors, enabling participants to identify their individual strengths and weaknesses.

The Self and Peer Assessment or SPA factor is a weighting factor that can be used to determine an individual's overall contribution to a project. A SPA factor of one indicates that the participant's contribution to the project has been assessed as being the same as the average contribution of their team. A SPA factor less than one indicates a below average contribution to the project while an SPA factor greater than one indicates an above-average contribution to the project.

The second factor calculated is the Self Assessment to Peer Assessment or SAPA factor. It is the ratio of a participant's own rating of themselves compared to the average rating of their contribution by their peers. This has strong feedback value for a participant's ongoing development. The SAPA factor provides students with feedback about how the rest of the team perceived their contribution. For example, a SAPA factor greater than 1 means that a student has rated their own team performance higher than they were rated by their team peers. Conversely, a SAPA factor less than 1 means that a student has rated their own performance lower than they were rated by their peers.

In our previous research (Willey and Freeman (2006a), (2006b)) we found that the use of self and peer assessment improved students' group work experience, reduced the instances of free-riders and encouraged students to improve their professional skill development. Students reported that the use of self and peer assessment, together with criteria that particularly assessed teamwork processes, had encouraged team cooperation, commitment and increased individual student engagement.

Educational Implementations

In educational environments students who undergo peer evaluation tend to achieve higher academic marks than those who don't (Topping 1998). This is probably in part due to the fact that having to undergo peer assessment means students spend more time on task allowing them to practise their skills and be more fully engaged. However, the fact that such assessment requires students to reflect on and critically evaluate their own performance together with the associated increase in responsibility and accountability will have also played a part. In essence the process of self and peer assessment, if well-designed, demands more of students. Their improved performance in part, probably results from their response to the bar being raised.

In our implementation students are provided with both the SPA and SAPA factors for themselves and each of their group members. After allowing sufficient time for students to personally reflect on the assessments, each group is guided through a feedback process. One benefit of providing all team members with the SAPA (formative feedback) factor, is that it encouraged more realistic and honest self assessments, as participants who inflated their self ratings are typically exposed by a high SAPA factor. Students also reported that the feedback factors challenged them to reflect on their strengths and weaknesses to assist changing their behaviour.

Feedback is provided multiple times during a semester, affording students an opportunity to reflect and **modify** their group behaviour or approach to the remaining parts of an assessable project. Hence they have an opportunity to **practise** and test what they have learnt. Many groups who performed poorly in the first part of their project responded positively to this feedback, significantly improving their performance in the remaining stages of the project. Currently our research is focusing on

improving both the feedback processes and support for academic users that are either inexperienced at using self and peer assessment processes or in the use of the software tool SPARK.

Last semester in the core Engineering subject Design Fundamentals, 67% of respondents (n = 95 from a cohort of 220) reported that multiple uses of self and peer assessment (implemented using SPARK) and the associated feedback sessions improved their ability to both assess their work and the work of others, while 70% agreed that it improved their ability to both give and receive feedback. Overall 55% of respondents felt that the regular feedback produced by this process helped them to improve their performance during the semester. Specifically, respondents felt that the process helped them to improve during the semester their team contribution (55%), interpersonal and teamwork skills (56%), and communication and conflict resolution skills (44%). When questioned about the best things about using self and peer assessment and the associated feedback sessions to develop professional skills, including teamwork in group projects, students typically responded with:

- it "…allows early problems with team members to be discussed, provides feedback about my performance…",
- it provides "…feedback on work done, encouraged an even spread of work",
- it "…gets people working, …realise your strengths and mistakes so you can learn from them",
- it "…allows for conflict resolution…",
- it "…encourages everyone to be involved, informs everyone where they stand in the group, encourages everyone to reflect",
- "…improved effective team communications",
- the "…anonymous marking scheme meant we could assess each other honestly…",
- it "…facilitated group work, promoted incentive for group members to work harder, rewarded good quality work and effort…",
- the "…feedback sessions allow each member to reflect on their contribution to the team…".

Using self and peer assessment also yielded efficiencies for the responsible academic in that relatively little time was spent acting as an arbiter in disputes between team members. This can probably be attributed to both the inclusion of instruction on the different aspects of teamwork and explicit criteria to assess these skills that provided incentives for teams to resolve teamwork issues independently. We would expect this efficiency to be replicated in a workforce implementation.

Workplace implementations

Professional skills including teamwork are important for working engineers. Previously new graduates often continued to develop these skills in the workplace guided by more experienced engineers. However, due to economic efficiencies in many industries there have been cutbacks in staff training and a reduction in the size of engineering teams. This means on the job mentoring is not always available and graduates do not automatically continue developing these required professional skills. To facilitate continuing skill development employees need regular and ongoing assessment and feedback.

The IPWEA forum (2005) 'Attracting Young People to Engineering' reported that workplace decisions of Generations X and Y are not based on salary alone, but on a range of other factors, including "…professional development, collegiate environment, good work-life balance, and respect and rewards" (Waugh 2005). It is not unreasonable to assume that organisations where these skills are proactively fostered will be preferred by Generation X and Y employees. The forum also sought to "…examine the need for soft skill training of senior engineers" (Waugh 2005). The use of self and peer assessment has the potential to address both of these issues.

It is often difficult for a manager to fairly assess the contribution of individual employees to a team project since most of the work may have occurred without their direct supervision. Accordingly,

assessing the contribution of individuals to a team task should arguably be handed over to the team members themselves since they have the most relevant information.

With the increasing focus on teamwork, employee development and performance reviews in the workplace many organisations have introduced 360 degree assessment. The 360 degree process involves providing participants with feedback from multiple sources: downward from the participant's supervisor, upwards from the participant's subordinates, laterally from the participant's peers, and inwardly from the participant's own self-analysis (Penny 2001).

We believe that the use of self and lateral peer assessment (does not include assessment by supervisors) implemented using SPARK combined with regular facilitated feedback sessions could potentially be more effective in changing workplace culture and promoting productivity than existing implementations.

Research reports that self ratings tend to be consistently higher than ratings from a participant's supervisor. For example, Zenger (1992) studied hundreds of engineers in two 'high technology' companies and found that 32% and 42% of the engineers in each company rated their own performance as being in the top 5% of all engineers. Employees tend to hold overly inflated self views that are often only modestly related to their actual performance (Dunning, Heath et al. 2004). This disparity is exacerbated when the rating scale is ambiguous or ill-defined.

Many feedback systems tend to be ineffective because the feedback is often too infrequent, threatening, sugar coated or provided too late (Dunning, Heath et al. 2004). Managers often find it difficult and emotionally taxing to give people feedback. As a result they often choose to do it infrequently, perhaps only once a year during performance reviews. Some organisations, in an effort to avoid conflict, only provided honest feedback from evaluations to the high achievers who they wish to promote or the low achievers whose employment they would like to terminate (Dunning, Heath et al. 2004). This approach does not provide the majority of people in the middle with an evaluation that will help them develop their skills nor improve their performance or enhance their careers.

Brett and Atwater (2001) found that individuals may react with anger and discouragement if feedback is negative or not as positive as expected. Often negative feedback results in decreased performance. This suggests that if one is to avoid employees being defensive or alienated by the process a robust feedback framework is required. Using self and lateral peer assessment as opposed to the 360 degree model to produce evaluations allows the supervisor to move into more of a coaching rather than a judging role. That is, the supervisor does not have to be the bearer of bad news only the coach who supports the participant to improve their performance. This model allows supervisors to set the required team performance target and for teams to manage themselves to meet this target.

Regular feedback can often be viewed by an employee as coaching rather than as criticism or dissatisfaction. The use of online self and peer assessment means that feedback can be provided regularly, say once every three months, with minimal implementation or emotional burden for the supervisor. In addition, feedback provided as numeric or normative data (like that produced by SPARK) is reported to generate a more positive reaction than less precise text format (Atwater and Brett 2006) which can also inadvertently identify the source by the comments provided.

An additional advantage of using a numerical feedback system is that if multiple peers are used in the evaluation process any bias from any one member of the evaluation group tends to be averaged out. This is not necessarily the case for written feedback. For example, only one team member may provide free response comments, however the recipient would not be aware that all the comments come from only one peer and hence the chance of providing biased, unfair or non-representative feedback is increased.

Being an online criteria based system SPARK allows implementation flexibility to target a wide range of outcomes. That is, any performance criteria for example teamwork and other professional skills, productivity issues etc can be monitored and assessed by carefully choosing appropriate criteria. The new version of SPARK currently under development allows the provision of more extensive and targeted formative feedback to be provided in relation to individual professional skills. In addition, to our knowledge, SPARK is the only online tool available that automatically provides both summative

and formative numerical feedback factors. Our research has shown that the formative component is essential to not only promote honest assessment but is required to facilitate ongoing professional skill development.

In addition to providing fairer performance assessment, we expect that engaging with well chosen assessment criteria will assist employees to reflect on their performance promoting improvement and skill development.

The SPA factor can be used to provide aggregate performance feedback when an employee is involved with several projects within a review cycle. For instance let's assume that project 1 was rated as being a 110% success (finished early and under budget). Self and peer assessment could be used to rate an individual's contribution to this project. Let's say an employee received a SPA factor of 0.9, their overall contribution could be calculated as follows:

SPA * Project success metric = Individual performance metric

0.9 *1.1 = 0.99

Similarly if this employee was involved in three other projects during the performance review cycle their aggregate contribution could be calculated as shown in Table 1:

Project Number	Project Success	SPA Factor	Performance on Project
1	110%	0.9	0.99
2	90%	1.1	0.99
3	85%	1	0.85
4	100%	0.95	0.95
Performance Average Over All Projects			0.945

Table 1: Employee's aggregate performance contribution during a review cycle

The figures suggest that this staff member's overall performance is below the average performance of his fellow team members (0.945 which is < 1). While they outperformed their team on project two (SPA 1.1) and contributed equally in project three (SPA 1), their performance in project one and four was below par.

Furthermore in addition to overall aggregate SAPA and SPA factors, individual factors can be provided for each category of criteria. For example let us assume that the assessment criteria were divided into a number of categories including Engineering Technical Knowledge, Engineering Technical Ability, Teamwork Skills and Professional Skills. By producing individual performance and feedback factors for each category participants are better able to identify and hence work on improving their individual strengths and weaknesses. In addition, this information will help supervisors to better target resources to promote staff development in required areas.

Category of Criteria	SAPA Factor	SPA Factor
Engineering Technical Knowledge	1.2	0.9
Engineering Technical Ability	0.9	1.1
Teamwork Skills	1	1.2
Professional Skills	0.98	0.95
Aggregate Performance Factors Over All Categories	1.02	1.04

Table 2: Employee's feedback and performance factors for individual categories.

Let us assume that Table 2 reports the feedback and performance factors for an employee named John. Referring to the above table it can be seen that the aggregate performance factor (1.04) indicates that John is performing well, contributing slightly higher than the average performance of his team peers.

There is no indication as to what areas if any John may need to improve his performance. The formative feedback or SAPA factor of 1.02 indicated that John's opinion of his own performance matches the average opinion of his performance by his team peers. However, further insight is gained by looking at the individual factors for each category. These report that:

Engineering Technical Knowledge: John's contribution to the teams required Engineering Technical Knowledge is below the average of his team peers (SPA = 0.9). Furthermore and perhaps more importantly the SAPA factor of 1.2 indicates that John is unaware that his peers feel he is underperforming in this area. John feels he has made a much greater contribution.

Engineering Technical Ability: John's Engineering Technical Ability contribution to the team is above the average of his team peers (SPA = 1.1). Furthermore the SAPA factor of 0.9 indicates that John underrates the significance of this contribution to the team and may not be aware that his team peers highly regard his contribution.

Teamwork skills: John's teamwork skills are significantly higher than the average of his team peers (SPA = 1.2). In addition, the SAPA factor of 1 indicates that John is aware of this and sees his teamwork skills as one of his strengths in contributing to the team.

Professional skills: John's contribution to the team using his professional skills is below the average of his team peers (SPA = 0.95). Furthermore the SAPA factor of 0.98 (very close to 1) indicates that John is aware that this is one of his weaknesses.

In summary, analysis of the individual factors indicates that John strengths are his Engineering Technical Ability and Teamwork Skills, while his weaker areas of contribution to his team are his Engineering Technical Knowledge and Professional Skills. Furthermore prior to receiving this feedback John was unaware that he was underperforming in his technical knowledge contribution and did not appreciate how highly the team rated his technical ability.

This feedback allows John to build on his strengths and address his weaknesses. In addition, being able to identify individual strengths and weaknesses helps supervisors to provide better coaching and target resources (eg additional training) where required. Furthermore, ongoing recording of these metrics provides a means for both staff and supervisors to track an employee's ongoing skill development.

Workplace Implementation Considerations

As previously stated careful design is necessary to extract the full benefits from using self and peer assessment. Our research has identified some of the most important considerations to be:

- To begin the process by deciding what you are trying to achieve before deciding how you are going to achieve it. The action of writing the assessment criteria is often effective in forcing the supervisor to think about what is important for the group/committee to be successful.
- To promote staff engagement, seek their participation in deciding the desired outcomes and selecting the appropriate assessment criteria. This leads to a shared understanding of what the group is trying to achieve, and focuses the group on the desired outcomes.
- Use assessment criteria relating to both specific engineering project tasks and importantly to team maintenance, team building and professional skills. The latter criteria are intended to encourage participants to work as a team, promote ongoing individual skill development and to encourage self management of team issues.
- Be mindful that participants in self and peer assessment may find the process stressful. We maintain that to encourage development of the full range of professional skills, participants should be prepared by providing instruction and practice in teamwork and conflict resolution before undertaking self and peer assessment for the first time.

- Support the self and peer assessment processes with a framework for facilitating both the provision and receiving of feedback by team members on each member's performance. In addition these feedback sessions should be used to resolve any team issues and to agree on a process for how to improve both individual contributions and future teamwork.
- To be successful a workplace assessment evaluation system needs to be seen as being mutually beneficial to both employee and employer. Employees should be able to identify how such processes will be part of their self-development, providing an opportunity to not only improve and develop their skills but also to demonstrate this development.

In designing an implementation one needs to consider that self and peer assessment is not a hands-off process that will automatically produce benefits if introduced. Thought must be put into the implementation. Careful implementation should not only increase staff engagement and facilitate ongoing skill development but increase staff satisfaction assisting in the retention of staff. Whenever you train staff there is the risk of them leaving the organization, but "…the only thing worse than training people and having them leave is not training them and having them stay." (Luthy 2004).

Conclusion

The literature reports some problems with currently available workplace performance assessment implementations. We believe the thoughtful use of self and peer assessment processes, implemented using the online tool SPARK, as described in this paper will address many of these issues. Our research suggests that while the use of multiple and appropriate assessment criteria motivates the development of professional skills, well supported formative feedback would be required to successfully change workplace culture. This change is initiated by facilitating individual self reflection and ongoing improvement while encouraging teams to resolve team issues independently.

Our approach maintains confidentiality and provides both performance and formative feedback factors. The formative feedback metric promotes honest assessment by identifying participants who submit self-inflated assessments. Furthermore, the fact that these metrics can be produced for different categories of targeted criteria allows not only individual strengths and weaknesses to be identified but for supervisors to target coaching and resources where required.

References

Atwater, L. and J. Brett (2006). 'Feedback format: Does it influence manager's reactions to feedback?' *Journal of Occupational & Organizational Psychology* 79(4): 517-532.

Brett, J. F. and L. A. Atwater (2001). '360 Degree feedback accuracy , reactions and perceptions of usefulness.' *Journal of Applied Psychology* 86: 930-942.

DEST (2002). 'Employability skills for the future: project final report.' Accessed at: http://www.dest.gov.au/archive/ty/publications/employability_skills/final_report.pdf last viewed May 2007.

Dunning, D., C. Heath, et al. (2004). 'Flawed Self-Assessment.' *Psychological Science in the Public Interest* 5(3): 69-106.

Freeman, M. and J. McKenzie (2002). 'SPARK, A Confidential Web-Based Template for Self and Peer Assessment of Student Teamwork: Benefits of Evaluating across Different Subjects.' *British Journal of Educational Technology* 33(5): 551-69.

Lang, J. D., S. Cruse, et al. (1999). 'Industry expectations of new engineers: A survey to assist curriculum designers.' *Journal of Engineering Education* 88(1): 43.

Luthy, J. F. (2004). 'The Great Escape: How retirement, recruitment, and retention are impacting the field of public works.' Accessed at: http://www.apwa.net/Publications/Reporter/ReporterOnline/index.asp?DISPLAY=ISSUE&ISSUE_DATE=122004&ARTICLE_NUMBER=942 Last viewed May 2007.

Martin R. M. Bryan, Case J., Fraser D. (2005), 'Engineering graduates' perceptions of how well they were prepared for work in industry,' *European Journal of Engineering Education*, vol. 30, pp. 167 - 180.

Meier R. L., Williams M. R., & Humphreys M. A. (2000), 'Refocusing our efforts: Assessing non-technical competency gaps', *Journal of Engineering Education*, vol. 89, pp. 377.

Penny, J. (2001). 'Differential item functioning in an international 360-degree assessment: Evidence of gender stereotype, environmental complexity, and organizational contingency.' *European Journal of Work and Organizational Psychology* 10.

Pont, B. (2001). Competencies for the knowledge economy, in OECD, Education Policy Analysis. Paris, OECD.

Sageev, P. and C. J. Romanowski (2001). 'A message from recent engineering graduates in the workplace: Results of a survey on technical communication skills.' *Journal of Engineering Education* 90(4): 685.

Scott, G. and W. Yates (2002). 'Using Successful Graduates to Improve the Quality of Undergraduate Engineering Programs.' *European Journal of Engineering Education* 27, 4(363-378).

Topping, K. (1998). 'Peer assessment between students in colleges and universities.' *Review of Educational Research* 68: 249-276.

Usher, R. (2006). *Guide to Retaining the Current Workforce.* Institute of Public Works Engineering Australia, National Skills Shortage Project.

Waugh, F. (2005). 'Identifying the Target Audience.' *Proceedings of the Forum 'Attracting Young People to Engineering'* Institute of Public Works Engineering Australia, Sydney.

Willey, K. and M. Freeman (2006a). 'Completing the learning cycle: The role of formative feedback when using self and peer assessment to improve teamwork and engagement'. *Proceedings of the 17th Annual Conference of the Australasian Association for Engineering Education,* Auckland, New Zealand.

Willey, K. and M. Freeman (2006b). 'Improving teamwork and engagement: the case for self and peer assessment.' *Australasian Journal of Engineering Education.*

Zenger, T. R. (1992). 'Why Do Employers Only Reward Extreme Performance? Examining the Relationships Among Performance, Pay, and Turnover.' *Administrative Science Quarterly* 37(2): 198-219.