Chapter 12
The Enterprise Showcase Experience

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Abstract The School of Computing and Engineering at the University of Huddersfield have, for the last 2 years, been experimenting with an Enterprise Showcase Event, in which multidisciplinary teams of students work intensively on real-world projects for local companies, and then present their work at a day long trade-show style event. This paper outlines the rationale for the project, explains how the event operates, discusses the advantages of the approach over more traditional kinds of team project, and analyses the student feedback.

Keywords Group work · Team work · Enterprise showcase · Employability
Multi-disciplinary · Collaboration

12.1 Introduction

The School of Computing and Engineering at the University of Huddersfield is made up of two departments, Computer Science and Engineering. Students in both departments engage in group work at various levels within their respective courses, but the students do not normally engage in collaborative, cross-departmental project work. The work undertaken is mainly group work in years 1 and 2, followed by an individual honours project in the final year. Students on an Integrated Masters degree (MEng, MComp, or MSci) also undertake a group project in their additional Integrated Masters year. There is a rich body of educational literature in support of group work, and it is widely accepted that group work offers many advantages to the students. In the computing discipline, group work is seen as good for interpersonal skills including team working, project management, and presentation skills, as well as for the development of technical skills such as requirements capture, system

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design, coding, testing and evaluation. In the engineering discipline, students are encouraged to undertake group work from an early part in their undergraduate studies through several modules. This helps them develop interpersonal skills which are greatly desirable by prospective future employers. Through discipline, organisation and effective communication students learn from each other in modules such as professional development, in which they research and present on a topical issue such as sustainable transport. In a mechanical design module students collaborate to develop a conceptual design prior to developing various aspects of it to a detailed stage. The Enterprise Showcase Event, for the mechanical and electrical engineering students, is linked to the intermediate, year 2 module of manufacturing and enterprise. For these students the significance of the Showcase Event is that, post event, the students are expected to complete a business plan which outlines vital information that is required in order to bring the product to market. By this stage they have already been made aware of the commercial constraints associated with product development by partaking in the Showcase Event. Although teamwork in undergraduate studies is not new, what is unusual in this case is the operation of multi-disciplinary teams. This has allowed for learning from fellow students with disparate areas of interest and expertise within the technology sector. This emulates exactly what they are likely to encounter in a real world working environment, as they gain an appreciation of the required expertise for a balanced product development.

Effective collaborative problem solving and its benefits has been documented by many educational researchers (Nelson 1999), as has learning by doing (Schank et al. 1999). Group work is also a required component of many of our courses, by the British Computer Society (BCS) (Projects and Group Work 2018; Guidelines on Course Accreditation 2018) for accreditation of Computing degrees, and by the Institute of Mechanical Engineers (I.Mech.E) and the Institute of Engineering and Technology (I.E.T) for Engineering courses, as well as by our industry partners who require graduates with soft skills and capable of working in teams. Both Engineering Institutions, who are the main governing bodies for our accredited engineering courses, apply the UK Standard for Professional Competence (UK-SPEC) (UK Standard for Professional Competence (UK-SPEC) 2018).

The UK-SPEC is based on the demonstration of key competences and is the UK Standard for Professional Engineering Competence. It describes the Science and Mathematics, Engineering Analysis, Design, and Engineering Practice competences in the economic, legal and social, ethical, and environmental context that have to be met in order to attain Engineer status at Technician, Incorporated or Chartered level.

Over the past two academic years the School has been experimenting with an Enterprise Showcase Event, whereby students from both departments have been placed into multidisciplinary teams and set to work on real world problems put to them by our industrial collaborators. The event takes place in an intensive one week block and culminates in a trade-show style Showcase Event where the students present their work to both academics and to the industrial collaborators. In this

paper we outline the motivation for the Showcase Event (Sect. 12.2), explain how the event operates (Sect. 12.3), analyse the reaction and feedback from our students (Sect. 12.4), and outline several ideas for how we might improve the event in future years (Sect. 12.5).

12.2 Limitations of Existing Project Work

Current approaches to team based project work suffer from several limitations and weaknesses. Timetabling restrictions make it difficult or impossible to schedule inter-disciplinary groups, so groups tend to be drawn from one course, one course suite, or at best one subject area. This means that the students are rarely, if ever, expected to work outside of their comfort zone in terms of working with students they don't know or working with students from different courses who bring a wide range of unfamiliar knowledge and skills. Additionally, when creating project ideas for students within a single discipline, the tendency is to come up with project ideas that fit the skill set of those students. This potentially stifles creativity and reduces the range of opportunities for learning afforded to these students. If we give the same problem to all students or groups within a module then there is little variation to keep the students interested and there is potential for collusion and plagiarism. If, on the other hand, we let students come up with the problems themselves then there tends to be a lot of variation in the level of complexity, making is difficult to keep the learning experience equitable and the marking fair. Students are unaware of what they don't know, so they tend not to consider projects outside their comfort zone. Similarly, students often have limited commercial and industrial experience, so are unable to easily consider realistic problems. Collectively considered, these issues often mean that the project work undertaken in team project modules is rather repetitive, unoriginal and unimaginative and does not provide the students with a realistic experience of working on commercial projects. An additional concern is that long time-scales (typically these modules are year-long, starting in September/October and due for submission in the following May) often implies that students postpone assignment completion until urgency hits, thus producing rushed and sub-standard work at a late stage. These projects do not reflect the "need it yesterday" urgency of many real commercial situations. Taken together these problems led us to reconsider how team-based project work, combined with activity based learning (ABL) and problem based learning (PBL) (Barrows 1985; Perrenet et al. 2000; Nkhoma et al. 2017), should operate, and led to the introduction of the Enterprise Showcase Event.

12.3 The Enterprise Showcase Event

12.3.1 Timetabling and Assessment of the Event

The University of Huddersfield introduced a "Consolidation Week" into the timetable several years ago. Consolidation Week is the first week after the Christmas vacation, when normal timetables are suspended to allow other activities to take place, such as in-class tests, catch-up and revision, and practical sessions before the start of term 2 teaching. The University has been keen to find interesting and innovative ways to utilise this time, and offered the opportunity to bid for small amounts of funding via the university's Teaching and Learning Institute (TALI) to support such projects. Our Enterprise Showcase Event has, for the past two years, taken advantage of this Consolidation Week. As normal classes do not operate in this week it gives us the opportunity to timetable events across subject areas or (as in this case) across the departments within the school. This allows us to create interdisciplinary teams made up of (almost[1]) all students in the Computer Science and Engineering departments. This includes students of Automotive Engineering, Electrical Engineering, Mechanical Engineering, Computing Science, Software Engineering, Computing, Information Systems, ICT, and Web Design and Technology, who can all be mixed together within the project teams.

All of the students involved in the Enterprise Showcase Event are already enrolled on year-long projects modules. This applies for all disciplines and provides a relatively simple way to build the assessment of the Enterprise Showcase Event into the curriculum. The event has been added as an additional assessment within those project-based modules (as a sub-element of the main in-course assessment). In the Computer Science department the students are all registered on module CII2350 Team Project. The Enterprise Showcase Event forms a sub-element of the module coursework assessment. Similarly, in the Engineering department the students are registered on either module NIM2220, known as Manufacture and Enterprise or NIE2208, known as Enterprise: Electronic Product Design and Manufacture. The former module is for undergraduate engineers studying either Mechanical, Automotive or Energy engineering. The latter module is for undergraduate Electrical or Electronic engineering students. All modules stipulate pre-requisite study that is more technically focussed. The modules associated with Enterprise focus on the commercial aspects of technological products and the soft skills required to develop these. Teamwork and inter-disciplinary awareness are therefore of the essence, which is why the Enterprise Showcase Event has been added as a sub-element of assessment within those modules.

For electrical and electronic engineering students the modules provide an introduction to business, finance, marketing, engineering management and design for manufacture (DFM) in the context of electronic product design and manufacturing.

[1] Students on the Computer Games Design and Computer Games Programming courses do not take part as they already have a range of activities taking place in Consolidation Week.

It is intended to promote an understanding of the lifecycle process of product design and develop the skills required by professional engineers to play an active role in that process.

12.3.2 Clients and Commercial Partners

One of the key objectives of the Enterprise Showcase Event has been to involve practitioner clients providing existing actual problems for the students to work on, in order to make the event as realistic as possible. The problems must have genuine commercial application, and the client companies are encouraged to work with the students with the best ideas after the Showcase Event in order to explore opportunities for further development and for commercial exploitation. The opportunity to develop a real commercial product as a result of the Showcase Event should act as a motivator both for the client companies and for the students themselves.

In the first year of operation one of our client companies, was a leading Health Care provider. They outlined the problems caused within the NHS and private health care by bed sores and ulcers resulting from prolonged periods of being bed-bound. The students were asked to think of innovative ways to minimise bed sores. Some groups focussed on high-technology solutions, such as sensors, monitors, and alarms; some turned to the use of novel materials or shapes and profiles for mattress design, or the use of springs within the mattress to keep a patient moving; some researched the impact of air-flow on bed sore formation and suggested fans or mattress covers designed to minimise moisture; some groups explored the role of Big Data and cloud storage in collecting as much information as possible via a range of sensors (such as temperature, pressure, humidity, and time intervals between the patient being moved) so as to build better models of the conditions that cause pressure ulcers; while some teams identified low-technology solutions such as simple timers to notify nursing staff that it is time to move the patient. The wide range of solutions suggested by the student groups impressed the company, who found several of the ideas worth further investigation.

One of the criticisms of the initial event was that by providing only one client with one problem we did not provide options to the students. In the second year it was therefore decided to seek several companies who could each pitch their problem to the students, thereby giving the students a choice of problems to work on, and making the event more appealing. Three projects were offered, two from local companies and one from the university's Students' Union. In summary these were:

- A local construction sector company presented a problem based on optimising the means by which roofing A-Frames are accommodated on a flatbed truck for delivery to a construction site, in a safe and efficient manner. Each set of A-Frame trusses is unique to the project to which it is intended. According to the company there is no off-the-shelf solution currently available for this problem. By failing to

utilise the entire space on the truck, a second truck would be required to be booked through a haulier, at considerable cost;
- A local software house with a passion for encouraging children from schools in the surrounding area to get involved with STEM (Science, Technology, Engineering, and Maths) subjects, and in particular to get them writing computer code. The brief here was very general, to come up with ideas and associated products that could be used with the children to inspire them to get involved with STEM subjects, code clubs, and "hackathons";
- A student society from the Huddersfield University Students' Union called Enactus. Enactus is a global student movement aiming to "use the power of entrepreneurial action to transform lives and shape a better more sustainable world" (Enactus 2018). The Huddersfield Enactus group had taken ownership of a run-down greenhouse on an area of land owned by the university. They were looking for ways to utilise the greenhouse in a cost-efficient way to bring benefit to as many people as possible. Their pitch asked the students to identify low cost ways to support this objective, with a particular focus on energy efficiency and sustainability, whilst also ensuring a secure site.

All of these clients were able to provide opportunities for further work and for the potential commercial development of the ideas generated. The students were happy to be given the range of projects to choose from. All of the clients were available on the first day to allow the students to discuss the projects, and to carry out some requirements capture. This alone, is an important part of the Enterprise Showcase Event, as students working on projects do not normally get the opportunity to perform requirements capture from real clients, nor do they often get to work on projects with such uncertain and volatile requirements. This is an important part of the 'real-world' experience which the Enterprise Showcase Event is designed to provide.

We again received a wide range of suggestions for each of the project ideas. These included:

- Use of 3D modelling software to help with the A-Frame loading problem. Some teams found open source software that could be enhanced or tailored towards the specific problem, while others set about developing prototypes of bespoke software built to solve the problem. One team suggested an Artificial Intelligence (AI) solution based on machine learning;
- Many varied solutions were suggested for the STEM project. These included 3D printed cogs and wheels to allow students to experiment with basic engineering; software development platforms aimed specifically at younger children to allow drag-and-drop development of code; and 3D printed build-it-yourself car kits and associated mobile apps to control the finished car, allowing children to experience both the physical building of the car and the software side of controlling it;
- Greenhouse monitoring and control systems based around Raspberry Pi or Arduino devices, with attached sensors and motors to automatically maintain ideal

conditions through automated watering and opening and closing of vents; intruder detection systems; and remote monitoring coupled with mobile apps to allow the greenhouse to be operated remotely.

The clients were all impressed by the range and diversity of the suggestions, as well as the level of technical detail achieved by many of the teams.

12.3.3 Organisation and Operation of the Event

The Showcase Event is designed to run in a short, intensive time-scale of one working week. The students are placed into groups in advance of the start of the event. Groups are announced at the outset. The students arrange themselves into their groups, and the industrial partners then immediately pitch their problems to the teams. The industrial partners then remain on site during the first day (for at least half the day) to enable the students to ask questions, discuss the problem and any initial ideas they may have for potential solutions, and to carry out some requirements capture. Students then organise themselves in terms of tasks and priorities in order to meet the required outcomes by the end of the week. Initially they are expected to brainstorm ideas and potential solutions, carry out research in the university library or on-line, and to develop their ideas.

The first deadline the students are expected to meet is to submit an electronic copy of an A2 poster to showcase their ideas. This is required during the second half of the week. The poster should visually represent the group's idea or proposal, and will be displayed at the Showcase Event at the end of the week. Note that this is not a formal assessment point. If teams successfully submit by the deadline then the department will arrange and pay for the printing of the poster ready for the Showcase Event. Any team that fails to submit their poster by the deadline will be required to arrange and pay for printing themselves. This 'soft' deadline is in part intended as an encouragement to the students to start work as quickly as possible and make initial progress.

As well as working on the poster, the teams are also required to start work on their prototype product. For this we have available a range of kit that the students can sign out and borrow for use on the project. The kit includes Raspberry Pis, Arduinos, breadboards, a range of sensors such as temperature and humidity measures, motion sensors, cameras, indicators and LCD displays. 3D printing facilities are also available. When designing artefacts for 3D printing, the teams must ensure that the print time is limited to one hour maximum, and that their designs are suitable for the size of printer available. The necessary details are included in a briefing pack given to each team at the start of the week. There is also a small budget available, so the students can reclaim up to £20 per team if they need to purchase any specific equipment which we are unable to provide. For this receipts must be presented, along with a description of the use of the item. Only one member per team can claim back the expenses. The teams have the rest of the Wednesday and all day Thursday to work on their prototype

product in preparation for the Showcase Event on the Friday. Students are therefore required to work to constraints and learn by doing (Schank et al. 1999). The learning benefits of undertaking problem-based tasks have been well documented (Barrows 1985).

To ensure fair access to support for all teams there are drop-in advice sessions scheduled throughout the week, where the students can consult academic staff. These sessions are supported by Computing and Engineering academics, who will help the students by providing advice and guidance, suggesting changes or improvements to an idea, directing the students to relevant resources, or whatever other help they may deem appropriate. The details of these sessions, which run for an hour per day on the Tuesday, Wednesday, and Thursday, are again included in a briefing pack provided to each team.

The Showcase Event itself takes place in a large room organised along the lines of a trade fair. Each team has a pre-allocated stand. The posters have been printed and are ready to be displayed. The students bring their prototype product and are given time to set up and prepare for the event. Academic staff and industrial partners visit stands, observing and scrutinising posters and prototypes, listen as the students pitch their ideas, question the students, and then give immediate verbal feedback. The Showcase Score Card used for the event is included in Appendix. The final mark awarded to each team is the average of the best three marks on the day. In the first year that the event operated each member of academic staff was asked to walk around and look at as many projects as possible. This did cause some problems, as the teams at the front of the room found it much easier to get three academics to mark their work than the groups towards the back. To improve this, in the second year of operation each academic was randomly allocated five teams that they were required to visit and assess, and were then encouraged to walk around and look at as many more teams as possible. In this way every team was guaranteed a visit by at least three academics in order to ensure the marking could be completed. Another change in the second iteration of the event was to ensure that the academics could not see the marks awarded earlier in the day by their colleagues. This was to ensure each mark was awarded entirely impartially, and staff were not swayed by the grades awarded by their colleagues. One of the interesting things to emerge was the way in which the teams were able to take on board the feedback given by the academic markers throughout the day to improve their pitch and therefore improve the marks received as the day progressed. Many teams commented on how they welcomed the immediate feedback and the opportunity to use this to refine their pitch (and in some cases the idea itself) so as to maximise their grade.

As with any group work, the students are encouraged to play to their strengths, and so to give team members the roles that they can best fulfil, be it development, documentation, or presenting the idea. Some teams do this well, and ensure that the idea is pitched in a positive light by a team member with good presentation and marketing skills. It can be a valuable lesson to some students to realise that a good idea described badly can accrue a lower grade than an average idea pitched in a positive and enthusiastic manner. However, as can be seen from Appendix A, the academic assessors are required to consider Research, Innovation, Manufacture/Execution,

Marketing, Costing, Commercial Potential, and Teamwork. The feedback provided and the grades awarded should therefore summarise all of these areas, and should not be too heavily swayed by the presentation skills of the team members.

12.3.4 Outstanding Issues

As with any new idea or novel event there have been some issues which we need to address going forward. These include: communication of team allocations and other required information; dealing with students who fail to attend or contribute to their groups; the layout of the room for the Showcase Event; and ensuring the industrial partners know which teams are working on their projects. Here we briefly address each of these concerns:

- Communication: Some students complained that the team allocations were not made clear, or that students arriving just a few minutes late on the Monday morning were unsure which team they had been allocated to. We feel that it would not be appropriate to announce the team memberships before the Monday morning, as we want to ensure all teams have a similar experience, and we do not want students to get together in advance. Part of the idea is that the students are working with people they do not know, so we feel it is sensible to keep the team memberships secret until the event begins. We do, however, need to make sure the team allocations are complete before the event begins, and that the information is ready to be given out at the outset of the event;
- Students who don't engage: The overwhelming majority of students did participate in the event. However, as with any student activity, there are always a few who do not. This year we experimented with a reporting system to allow groups to notify the project coordinator of any students who failed to engage. The coordinator then contacted these students to inform them that, if they did not take part in the event, they would receive a mark of 0% for this component of their relevant module. This approach did help to bring a few students into the event, but did not address the issue of students attending but making little real contribution. In future we are likely to adopt the use of Peer Group Assessment, whereby the members of each team rank the contribution of their peers at the end of the project, as this is our established vehicle for managing group work. The perceived difficulty, and the reason we did not try this before, is that the interdisciplinary nature of the teams makes it difficult for the team members to get together after the Showcase Event has finished. We will therefore have to ensure that it is done on the Friday before the event closes;
- Layout of the room: We need to ensure that no team is 'hidden in a corner' or feels that their location at the Showcase Event puts them at a disadvantage when it comes to attracting academics to evaluate their work. This was much better the second time around, when academics were allocated teams to see, as it ensured that all teams saw a minimum of three assessors. There were also some issues

where teams needed access to mains power for their prototype devices, which led to power extension cables being laid across the floor. We need to think carefully about this in order to find an ideal layout for future years;

- Industrial Partners: The industrial partners attend the Showcase Event on the Friday to see the students' work, discuss it, and provide feedback. This year, with three client companies involved, we realised too late that we were unable to tell each company which teams had elected to work on their particular problem. The representatives of the companies therefore had to walk around and identify relevant teams for themselves. This had not been a problem the year before, as we only had one company involved. Next year we will use the Poster Submission on the Wednesday to collect data about which team is working on which project, so that we can then provide a list of relevant teams to each company.

12.4 Student Feedback

Feedback from participants was sought in the form of comments after the event. There was therefore no formal feedback questionnaire to qualify learners' own perceived learning outcomes. The feedback comments were therefore based entirely on learner comments reporting on the experience of participation and engagement. A selection of comments relating to the activity were as follows:

'Very good idea with the enterprise project, given a chance to apply practical skills and improve presentational skills. Nice range of work, offers more information and practical applications than most other modules'.

'Working with students from other courses was a necessary and valuable experience. Support, when questions were asked and answers were required, has been excellent'.

'Facilities are very good and the enterprise activity was a good experience especially in working with people from other disciplines'.

'Provided a positive experience in working within a team-based structure to research, design and develop a product'.

'I had a good team that really wanted to deliver something great to the rest of the class and enjoyed helping create this'.

'I really enjoyed working with other student[s] from different courses and to me it was more interesting than the other assignment in the module'.

Overall, the comments that were received from students were positive and favoured the practical aspect and group work. There were however a number of negative comments which were received by students who could not see the relevance of the practical aspect of the industrial partner's problems to their particular course and discipline—typically such comments came from web design students. Some students were also critical of the structure, organisation and what they considered as erratic scoring depending on assessor. The negative comments were mostly received during the first year of delivery of the Enterprise Showcase Event. We took on board the comments regarding structure and organisation and made improvements

for the second event delivery, including the choice of projects. The scoring of posters and prototype solutions by various tutors can by nature be erratic, as what constitutes a good and viable solution to a practical problem can be a subjective matter. It is for that reason that the average of the best three scores is determined and allocated as the final score.

12.5 Conclusions and Further Work

Our experiences in the first two years of operation of the Enterprise Showcase Event have been highly positive. We believe we have identified benefits to our students, benefits to our industrial collaborators, and benefits to the school. We have also identified some areas in need of further work and improvement.

12.5.1 Benefits to Students

The students are given the chance to work in interdisciplinary teams, learn new skills, and experience 'real world' short-term intensive project work. This is particularly useful for their CVs and for discussion at interviews. Several of the students have reported back to us that, during employer interviews for placement jobs, they have been able to draw upon their experiences in the Enterprise Showcase Event to provide examples of working to tight deadlines, working in teams with people they did not previously know, and working on 'real' projects. In several cases the students believe that this has been key to their securing an offer of a placement job as they were able to confidently discuss their role and contribution as part of a team in order to help solve a practical problem. The experience has therefore provided a range of opportunities for the students to impress potential placement or graduate employers. The event also gives the students the opportunity to make new friends and create contacts outside of their usual peer group, and simply to learn a little about the focus and content of courses from across the School of Computing and Engineering. Overall the experience has provided many positive benefits to the students who have taken part.

12.5.2 Benefits to Our Industrial Collaborators

There are also many benefits to the industrial collaborators. These include the opportunity to receive original input to a problem or business need, including the potential to take this further and develop a new product or solution in collaboration with the students involved; the chance to see and meet potential (placement or graduate) employees; and the chance to get involved with the university, which could then lead

to a range of other opportunities for collaboration, including student placements, Knowledge Transfer Partnerships, or an invitation to become more actively involved with our Industry Panel, affording the opportunity to contribute to course and curriculum development. To date the industrial partners have all expressed satisfaction with the event, and have found it to have been a worthwhile experience.

12.5.3 Benefits to the School

There are also a range of benefits to the School and to the Departments therein. These include opportunities to build or enhance links with local companies, which could in turn lead to a range of other opportunities for collaboration as mentioned above; the chance to collect and document useful and novel experiences for discussion at professional body validation visits, university subject reviews, quality audits, etc.; and the chance to provide students with opportunities not usually available to them. We can then include this information in marketing materials, and for discussion at open days and applicant visit days. The opportunity to engage in 'real' projects has been popular with applicants and with their parents and guardians as examples of such activities are often discussed during applicant visit days. The overhead in terms of running the event is relatively low compared to the range of potential benefits to be accrued.

12.5.4 Areas to Improve

While we, our students, and our industrial collaborators all feel that the events to date have been highly successful, we are aware of a number of areas that could be improved. There is the need to address peer assessment, to ensure the marking is fair and that the students who make the greatest contribution to the projects do receive the recognition they deserve. We must also ensure the layout of the room is clear, that there are no advantages or disadvantages to individual groups based on their location within the room, and that power can be supplied safely to the groups that require it. We must also ensure that our industrial collaborators are able to easily identify and locate those teams which are working on their particular problem. We do feel, however, that none of these issues are particularly complex, and we are confident that we can improve the event year on year.

Acknowledgements Many thanks to our colleague Dr. Leigh Fleming, who came up with the original idea for the Showcase Event and who worked very hard to make it so successful.

Appendix: The Showcase Score Card

Showcase Score Card

Your mark will be based on the assessment of 3 judges, if you are able to attract more than three academic judges to your stand, the average of the top 3 marks will be calculated and taken as your assessment mark.

Feedback on this element of assessment will be verbal during the showcase event.

Judges will be looking for the following attributes:

Research—Background to the project and demonstration of understanding of the problem
Innovation—Your innovative and creative approach to solving the problem
Manufacture/Execution—How well the project has been carried out by the team
Communication—How effectively you communicate your ideas through the poster and orally
Marketing—How well you sell your idea
Costing—Demonstration of an appreciation for the cost and methods of production
Commercial potential—Potential for a commercial market and consideration of pricing
Teamwork—Demonstration of good team-working and overall effort

Print Name	Signature	Mark (--/100)
Comments		

When a judge has completed their scorecard, please place in the envelope provided to ensure that subsequent judging remains impartial.

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