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"Simulated Consulting": A Win-Win Experience in Transport Engineering Education

by

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ABSTRACT: Students undertaking a final year elective subject in Transportation Planning at Monash University in Melbourne, Australia, were given the opportunity to work on a practical project for which there was an interested outside 'client'. From the student's perspective, this was essentially a 'simulated' consulting project which focussed on transport planning issues faced by the City of Port Phillip, an inner metropolitan municipality in Melbourne. The overall experience, from everybody's perspective, proved to be so positive that the model for the project will be used in the course in future years. This paper has been written to inform other engineering educators of how the project was implemented and to highlight some of the educational issues which this type of experience raised. Of particular interest to educators are issues associated with the functioning of some of the student groups in the project and the opportunities provided by projects of this nature to establish strong industry links.

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1. Introduction

Much has been written in recent years of the different learning styles of students [1] and the increasing emphasis on project and problem based learning (PBL) [2,3]. This paper deals with the practicalities of applying these approaches in the context of transport engineering education. Importantly, the general model that was adopted would have application outside the transport field and the experience has highlighted issues that all educators need to keep in mind when incorporating these approaches into a course.

Students in the final year of their civil engineering course at Monash University in Melbourne, Australia, must complete at least three elective subjects covering different strands of civil engineering. One of those elective subjects, Transport Planning, attracts between 20 and 25 final year students. While project work has always featured in that subject, on this occasion the students were given the opportunity to work on a very practical project for which there was an interested outside 'client'. From the student's perspective, this was essentially a 'simulated' consulting project. The overall experience, from everybody's perspective, proved to be so positive that the model for the project will be used in the course in future years. This paper has been written to inform other engineering educators of how the project was implemented and to highlight some of the educational issues that this type of experience raised.

Key features of the case discussed in this paper are that:

- it deals with a very 'real' problem and therefore the students were aware that outside organisation(s) were interested in their results,
- it was a group project involving teams of four or five students, and
- the panel of assessors were intimately familiar with the study area which meant that the student's work had to have professional credibility to satisfy the assessors.

The outline of the paper is as follows. The following section (Section 2) discusses the relationship of the project to the course. Section 3 then considers then focus of the project, outlines its two phase structure and describes the assessment components. The outcomes of the project are then described (Section 4) as they relate to a win-win experience for the students and the outside organisations involved. A number of reflections on the group project approach are then considered (Section 5) before the conclusions are presented (Section 6).

2. Relationship of the Project to the Course

As summarised in Table 1, the subject has a number of specific objectives that relate to the development of the student's knowledge/understanding, skills and attitudes. All students have completed a prerequisite course in transport and traffic engineering in Level 3 of their degree prior to enrolling in this Level 4 (final year) elective subject. The subject covers a range of issues associated with transport planning, including the planning process, sustainability issues, data collection (transport surveys) and the matching of particular modes to the urban transport task.

Table 1 also highlights that the project was clearly related to the objectives of the course. It was regarded as critically important that the project link into a number of objectives for the subject. Importantly, it will be possible to replicate the model employed in this project in future years using a different project focus.

The subject is taught over a 13 week semester using a combination of lectures, tutorials, discussion sessions and an excursion. Assessment comprised an exam, a report covering attendance at a professional meeting and the project. The subject aimed to engage students in the material by ensuring overlap between the class material and the project. It was intended to be an integrative project that built on a number of components of the course and provided students with an opportunity to apply the material covered in class to a practical case study.

3. Project Focus and Structure

This section outlines the focus of the project and its structure. An explicit structure was developed for the project for two reasons. First, to maximise the educational value of the experience and second, to provide a management framework to ensure that the students would be able to produce useful/worthwhile outcomes within the one semester time constraint. In the following section the two phases of the project are described and then the assessment of the experience is outlined.

3.1 Project Context and Focus

The project was focused on the City of Port Phillip, in inner city municipality located approximately five kilometres from the centre of Melbourne, Australia. The City of Port Phillip is located in the north-eastern shore of Port Phillip Bay. It covers approximately 20 square kilometres and has a population of approximately 70,000. The City is relatively transport rich in terms of the number of train, tram and bus services that run through or terminate within the municipality. The wide streets, grid layout and general topography also provide a good environment for cycling through much of the municipality.

The City developed a corporate plan in 1996 and was in the process of turning to address strategic transport issues within the framework of the corporate plan. Consistent with its corporate objectives, the City wished to develop a series of related transport demonstration projects. These demonstration projects were to be designed to build on the city's transport strengths by making the existing transport system work better. However a very restrained budget environment meant that there was not sufficient resources available for demonstration project concepts to be developed either by in-house staff or by consultants. It was hoped that the insight provided by the student projects would enable an application to be made to the State government for funding to implement a number of the demonstration projects.

3.2 Two Phase Framework

The project was broken into two phases as shown in Figure 1. The first was fairly general and required students to conduct a scan of the current situation and make general recommendations regarding opportunities and areas requiring further work. The second phase was much more focused and required the students to examine issues related to a

particular transport mode. Assessment details for each of the components will be discussed shortly.
From the outset it was intended that students would work in groups on the project. After reviewing the scope of each phase of the project, and upon reflection on the experience which the lecturer has had with group work in the past, a group size of four was preferred. When the final enrolment was 21 students, five groups were formed, with one containing five members.

Students were not allocated to groups but were allowed to choose their group members. Since this is a final year elective subject it is quite common for the students to have developed close working relationship with some of their colleagues. Four of the groups formed immediately on the basis of strong friendships and previous work experience. The final group (of four) contained students who did not have close friends in this elective subject and hence these students did not have a history of working together. The difference in how this final group was formed ultimately had implications for how they functioned as a group. This issue is pursued further in Section 5 of the paper.

3.3 Project Briefs

In each of the phases of the project, the groups were given a project brief. These were designed to be fairly similar to the project brief which a consultant could expect to receive for a project of this type. However, the educational context necessitated that some sections be included which would not normally be in a consulting brief (See Table 2).

Phase I

The Phase I brief was intentionally broad. It was effectively a scanning phase where students were expected to:

- develop an appreciation of the broader policy context within which transport planning was undertaken in the municipality,
- undertake an independent scan of the current transport system in the municipality and its operation, and
- identify actions required to make public transport and bicycles modes of first choice within the city.

This first phase linked into the early part of the course which dealt with sustainable transport and the role of travel demand management initiatives. As part of the development of awareness of the broader policy framework within which planning takes place, the students were expected to review ‘Transporting Melbourne’ [4], the overall transport strategy for Melbourne.

This first phase was intentionally kept fairly brief with the elapsed time of three weeks. In the first week an excursion was arranged so that the students could begin to develop a ‘first hand’ feel for the transport system in the City of Port Phillip. Rather than travel on a chartered bus, the class travelled on public transport. This provided students with an opportunity to experience the light rail and tram services within the municipality as well as the tram, bus and heavy rail system outside the municipality. As part of this excursion a visit was made to the City Hall where the group was officially introduced to the project. As part

of that initial session, the students received a background briefing from professional officers of the City. This reinforced the practical relevance of the exercise and made clear that the city was interested in insight to be provided by the students. At this session the council officers also provided the groups with statistical information on population, employment and travel patterns throughout the municipality.

The first phase was much more general than the second phase. For undergraduate students, being exposed for the first time to transport planning, it was also expected to be more difficult for the students to come to grips with than the second phase. Never-the-less the first phase was important from an educational perspective. It required the students to develop an appreciation of the broader policy framework and identify broader types of initiatives which the City could pursue to improve the performance of sustainable transport modes. This first phase comprised one quarter of the assessment for the project. In contrast, in a graduate class, greater weight and emphasis would be given to this first phase.

Phase II

At the conclusion of Phase I, groups were assigned to a particular focus (tram, scheduled bus, community bus or bicycle modes) for Phase II. In part, the general areas for Phase II had been determined in advance by the lecturer in consultation with the City and a Consultant who participated in the project. The allocation of groups to topic areas was largely determined by the types of recommendations made by the groups in Phase I and after asking the groups about the areas where they would prefer to work. Only one group had identified the community bus service as an issue in the Phase I scan and they were keen to follow that issue so they were allocated to that topic in Phase II. Of the other groups, two expressed a particular interest in bicycle facility planning and the other two were particularly interested in public transport so it was fairly easy to allocate the groups to the topic areas identified in Figure 1. The two groups dealing with bicycle issues were assigned to work in separate sub-regions of the municipality.

Phase II was designed to be more specific than Phase I with the students expected to produce workable transport engineering solutions to the problems they identified. The phase II briefs were developed to ensure that the tasks were appropriate for an elapsed time of eight weeks and also to ensure that the workload across groups was fairly even.

Two groups focused on on-road bicycle facilities. In Phase II these groups were required to:

- undertake on-road surveys to provide a basis for the development of an on-road bicycle network in the identified precinct,
- prepare street design proposals which would enable the provision of on-road facilities using line marking and minor works, and
- undertake a multi-modal travel time study (considering car versus public transport versus bicycle) considering key destinations within the city and beyond to produce travel time contours comparing the performance of the three modes.

The groups dealing with the regular public transport (tram and bus) services were allocated to a particular route and asked to:

- undertaking a comprehensive travel time and delay study on the route,
- clearly identify the cause and magnitude of delays,
- assess the implications for running times of reducing delays, and
- identify and evaluate actions needed to reduce delays and thereby recommend preferred concept designs for route improvements.

The community bus group was asked to address the following issues:

- measure current ridership levels and assess the current user's perceptions of the service and the value which they place on the service,
- assess the extent to which users would be prepared to pay a nominal fee for the service,
- identify and assess actions which could increase ridership on the existing service, and
- examine options for integration with a similar service which operated to a nearby market.

The need for each group to collect field data provided an opportunity for the students to apply the material presented in class on transport surveys. Working in their groups the students had to design their data collection system, undertake the survey, collate and analyse the results.

3.4 Assessment Components

In each phase of the project, students were assessed on the basis of written submissions and oral presentations. Each member of the group contributed to the oral presentation at the conclusion of either Phase I or Phase II.

The assessment panel was smaller in Phase I than Phase II (See Table 3). This difference was partly because of the more focused nature of the deliverables from Phase II and also because of the availability of panel members to travel to the university to attend the assessment sessions. It is important to note that, except for the lecturer, the assessment panel were intimately familiar with the study area and the transport services in the area. This meant that they functioned very much like a real 'client'. The students were aware of who was serving on the assessment panel and they knew that their results needed to have professional credibility.

In Phase I, the groups were required to produce a brief written report (on the order of 5 pages) and make a 10 minute oral presentation to the assessment panel. The written report was submitted the day before the oral presentation and copied to all members of the assessment panel in advance of the presentations. Following the oral presentation a 15 minute period was allocated for questions from the panel. Questions were directed at all team members so that individual contributions and understanding could be gauged.

At the conclusion of Phase II the groups were again required to submit a written report. Copies of these reports were distributed to the assessment panel prior to the oral presentation. In the second phase, each group was asked to speak for 15 minutes and then participate in a 20 minute question and answer period.

As noted by [5], a 'PBL approach which incorporates some component of peer assessment is, in effect, an elaborate simulation of real life performance in a professional situation'. In

this case, the peer assessment took the form of a confidential assessment sheet that was completed by each student and then returned to the lecturer in charge of the subject. On the sheet the students were required to assess all members of the group (including themselves) on three issues:

- first, whether the person completed their allocated tasks for the project in the agreed time,
- second, whether the person made a worthwhile contribution to the group's submission and
- finally allocating a mark out of 10 for each person's contribution to the group's submission.

The confidential assessment sheet concluded with an open question inviting comments about the assignment in general or the group's performance in particular. This confidential assessment, in conjunction with the opportunity to ask detailed questions of individual students after the group oral presentation, proved to be an effective way of identifying the contribution which each student made to the group's performance. The grades given to students reflected their contribution.

At the conclusion of each phase feedback was provided to each group. This took the form of a detailed written feedback report. In an overall Course Evaluation, conducted in the final week of the semester by the University's Professional Development Centre, students specifically commented that:

> *"Tailored feedback for the groups is fantastic. The effort is appreciated."*
> *"A lot of time went into marking the assignments. Very helpful advice given on*

While it took time to prepare these reports it was reassuring that the students found them valuable.

4. Project Outcomes: A Win-Win Experience

The project was unquestionably a 'win' for all parties involved.

The students benefited from working on a 'real' project. There is no doubt that this project developed their knowledge, skills and attitudes in preparation for professional practice. Indeed, many consulting firms would be pleased to have staff perform as well as a number of the groups did on the written reports and oral presentations.

As noted earlier, at the conclusion of the subject a formal course evaluation was undertaken through the Professional Development Centre at Monash University. In the course evaluation, a number of students commented specifically about the project

> *"Great stepping stone to professional work - very relevant"*
> *"I really enjoyed the opportunity and challenge involved in the project"*
> *"The opportunity to work outside the university bounds on a major project was very*

One of the factors that a number of students commented about was the fact that it was a 'real' project. They genuinely enjoyed the challenge of producing a professional standard product and were excited about the prospect that the results from the project would actually be implemented. This distinguished the project from many others they had worked on at university where the exercise was by its very nature an 'academic' one with no prospect that their recommendations would ever be implemented.
From the external organisation's point of view they benefited from the insight provided by the students. Specific outcomes flowing from the student's reports are as follows:

- Community Bus Service: final report was actually submitted to the City of Port Phillip Council as part of a review and assessment of the service
- The City Traffic Engineer has taken on board the recommendations made by the bicycle groups and the intention is for that work to be the basis for re-linemarking of a number of roads in the municipality to provide safer facilities for cyclists
- The recommendations made by the two groups examining public transport are being considered further by the City of Port Phillip, the State Road Authority (responsible for traffic signal priority for public transport) and transport operators and a number of the recommendations already appear feasible for implementation.

From the educator's perspective the exercise was a win because it provided a perfect mechanism for students to apply the knowledge they learned in class and to develop their skills. This meant that the student's motivation remained high because they saw the practical benefit and application of the material being covered in the class.

There are few experiences as stimulating and rewarding to an educator than to have a group of students clearly motivated about the work they are doing and striving to produce a professional result. The project has also served to build an important link with a number of outside organisations. Those organisations were so enthusiastic about the experience that they are keen to be involved in other student projects. A number of topics for final year research projects were generated by this exercise and the outside organisations have expressed a desire to be involved in those projects. This ongoing industry involvement will not only help to maintain the relevance of the courses and projects but is certain to maximise the satisfaction that the students gain as well.

5. Reflections on the Group Project Approach

The responses from students to the questions on the confidential assessment highighted underlying issues for some of the groups. As noted earlier, for each question, students were asked to respond separately for each member of the group. Figure 2 shows the responses to the question where each student was judged on whether they completed their tasks on time. The responses for Groups 1 and 3 stand out as being more variable compared to the other groups. Similarly, responses in Groups 1 and 3 are less homogeneous in Figure 3 which summarises the response to whether the individual made a worthwhile contribution to the group's submission. The final component of the confidential assessment required that each student be given a mark out of 10 for that person's contribution to the group' submission. Table 4 summarises the results and again Groups 1 and 3 stand out for the higher degree of variability in the marks given to group members.

In all bar two cases the groups worked very well as a team. Each team highlighted different issues in group dynamics and management that have relevance to group projects.

One group which did not perform as well as the others was group 3. It was the one which was the last to form and comprised students who did not have a close working relationship with other students in this elective subject. Clearly this group had to go through the normal processes of group formation: forming, norming, storming and performing [6]. This put them at a disadvantage relative to the other groups who had already completed at least the first two steps of group development and were therefore able to perform very quickly. This experience has highlighted the importance of group dynamics [7] and the need to appreciate that all groups may not be at the same stage of development when the project begins. In future it would be desirable to monitor those groups who fit this profile and ensure that adequate time and staff support is provided to ensure that they reach the performance stage as soon as possible.

The other group which did not perform well was group 1. It suffered due to the limited contribution to the project made by two group members. This lack of contribution was mainly a problem in the second stage of the project. This was obvious from the responses by those two group members to the questions in the interview session at the end of phase 2 and also through the responses on the confidential assessment sheets. While this made it possible for adjustments to be made in the grades for those students it never-the-less meant that it was not as positive a group experience for the other members of the group.

It is acknowledged that not all group experiences have to be positive and a lot of learning can still occur in a group that does not perform well. The concern here was that this was not intended to be a course in group dynamics and the poor group dynamics meant that the group learned less about the transport engineering issues which were the focus of the subject. To overcome these problems, a policy has been adopted in subsequent years of including one or two formal group ‘interviews’ during the project. Although discussions were held with each group on more than one occasion during this project, those discussions tended to be fairly informal. It is clear that some of the internal problems that the group was having were not made apparent. A formal group interview provides an opportunity to explore performance within the group. From experience in subsequent projects, it seems ideal if one meeting can be held fairly early in the process, to discuss general group dynamics, and a second interview slightly later to focus on more technical issues related to the desired project outcomes. It is recognised that this level of interaction between the lecturer and the groups takes time. However, PBL exercises such as this, replace lecture times and so the group interaction need not be considered as an activity which takes place in addition to the traditional components of the subject.

6. Conclusions

Setting up and managing this project took a good deal of time on the part of the lecturer concerned. However this effort all seems worthwhile given the educational results achieved by the exercise.

The ‘simulated’ consulting experience proved to be a very positive one for all involved and a very professionally relevant experience for the students. The exercise has highlighted some of the challenges of group projects. In particular there is a need to recognise that all groups

may not be at the same stage of development at the beginning of the project and that monitoring of progress is needed to highlight problems with student performance within groups.

Since students will work in groups most of the time after graduation then there are clearly benefits associated in ensuring that their education prepares them to work in that environment. The benefits will outweigh the costs associated with constructing this type of exercise. In addition, exercises of this nature have the secondary benefit of building stronger links between academia and industry and that is almost certain to be in the best long term interests of the education process.

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Table 1: Relationship of Project to Course Objectives

Subject Aims/Objectives	Relevance of the Project
To develop: *Knowledge/Understanding* • knowledge of the performance, impacts and costs of various urban passenger transport modes and the factors influencing the level, pattern and trends in urban travel demand	✓✓✓
• an appreciation of the issues relevant to selecting a mode for a particular urban passenger transport task	✓✓✓
• an understanding of the role of the analytic methods used in transport planning	✓
• an understanding of the factors to be considered in conducting transport surveys including sample design, questionnaire design and survey administration	✓✓
• an appreciation of the range, and potential impact, of supply and demand oriented solutions which can be used to address transport and associated environmental problems	✓✓✓
Skills • an ability to apply analytic network modelling methods to practical problems	✗
• communication skills	✓✓✓
Attitudes • the confidence to be able to discuss contemporary issues and procedures used in transport planning	✓✓✓

Key: ✓✓✓ highly relevant
✓✓ relevant
✓ somewhat relevant
✗ not relevant

Table 2: Contents of Project Briefs

PHASE I PROJECT BRIEF	Phase II Project Brief
• Background • Project Aims and Scope • Project Structure • Phase I Deliverables • Study Time Frame • Assessment	• Background • Project Scope • Key Project Tasks • Submission Details

Table 3: Assessment Team Members

Phase I Assessment Team	Phase II Assessment Team
• Lecturer • Transport Planning Consultant • Senior Traffic Engineer from City of Port Phillip	• Lecturer • Transport Planning Consultant • Senior Traffic Engineer from City of Port Phillip • Elected Councilor from City of Port Phillip • Chief Service Planner, National Bus Company • Operations Manager, National Bus Company

Table 4: Variability in Peer Assessed Grades

Group	Mean Peer Assessed Grade	Standard Deviation of Grades
1	8.1	1.36
2	9.5	0.52
3	9	1.86
4	9.8	0.44
5	9.8	0.44

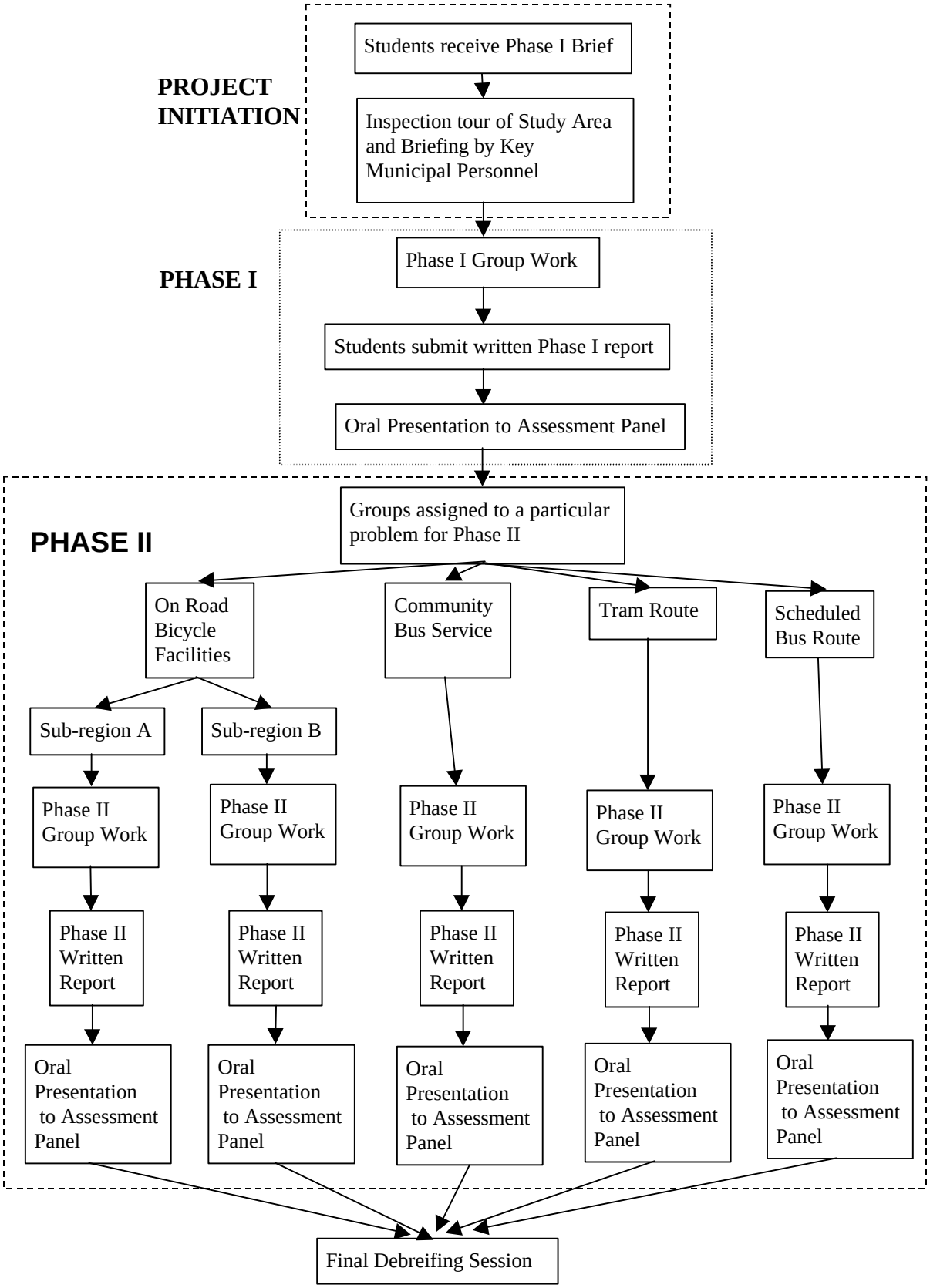
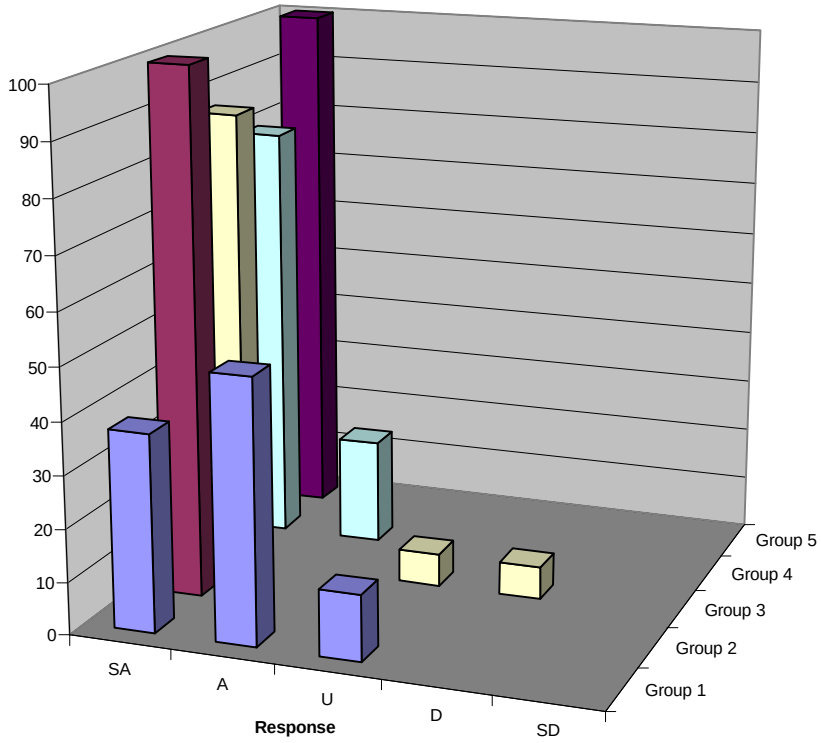
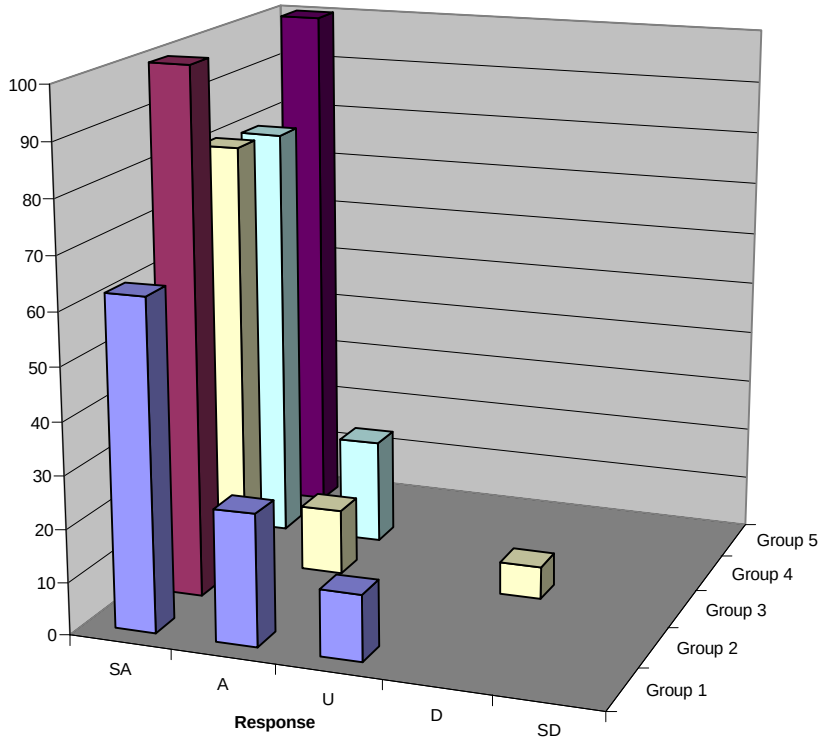


Figure 1: Overall Study Framework



Key: SA=Strongly Agree, A=Agree, U=Undecided, D=Disagree, SD=Strongly Disagree

Figure 2: Responses to Question regarding Task Completion on Time



Key: SA=Strongly Agree, A=Agree, U=Undecided, D=Disagree, SD=Strongly Disagree

Figure 3: Responses to Question regarding Contribution to Group's Submission