LearnxDesign

Interact: A multi-disciplinary Design Course

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Abstract: *How can academic programmes prepare students to make the transition from education to work place? Is it possible to simulate some of the challenges that they will confront so as to equip them with the skills and confidence to approach these situations appropriately?*

This paper reports on a unique course that brings together third year undergraduate students of Architecture, Structural Engineering and Quantity Surveying from independent institutions to work together on a project, each representing their own discipline and in a format that role-plays real life professional situations.

INTERACT provides a forum for multidisciplinary group work, with teams developing a building proposal through the design stages. The end point requires each group to produce an outcome that meets criteria established by each discipline.

The aim of the course is to simulate a real life context, resembling that of practice, thus providing an insight into the next step as they graduate and move into a professional environment.

What is unusual about the course is that the students are primarily assessed on their interaction and communication skills in conjunction with the outcome that represents the product of the collaboration.

The course has now been running for over 20 years.

[197 words]

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Introduction

The design of buildings is a complex process and requires the collaboration of many parties in order to bring a design to fruition. The interaction of these autonomous groups is critical both during the design, and construction processes. It is therefore interesting to note that each of the key disciplines which make up this collaborative team are taught independently. The historical basis for the current teaching structure of each discipline as separate entities is embedded in the formation of each profession's Institution. In the 19th century, each evolved separately and this has resulted in schisms that promote ignorance and support prejudices within the construction industry.

Probably the first time that a student will have the opportunity to work within a multi-disciplinary team environment is when they have graduated and are working on their first design project within an office or site context, following completion of their education. Despite all the training they have received, it is unlikely that they will have experienced this type of team dynamic, and their understanding of the role of the other participants may not initially be clear. The success of the built outcome is, in part, a reflection of the success of the design team to work productively and empathetically together throughout the design and construction of the project.

This experience for many young graduates is often not a positive one, intimidation rather than collaboration is often felt. Coming away from design team meetings feeling frustrated by the conversations and lack of collaborative discussion regarding the design proposals, engineering content or costs can be common. Preconceived judgments of each other's professions don't help the situation, and only over time with experience and the benefit of hindsight can individuals reflect and learn from that initial baptism into the professional arena. Although this is not always the case, is it necessary at all, could better preparation for this type of collaborative working be introduced during the training of these young graduates to improve the process and equip them with the essential skills and knowledge that will allow them to operate with confidence when faced with the challenges of working in a multi-disciplinary team environment?

Interact is an innovative and unique multidisciplinary cross institution course, being the only one of its kind currently running in the UK. Its aims are to address such issues, and It brings together third year undergraduate students from four of Glasgow's educational institutions within the disciplines of Architecture (Glasgow School of Art), Structural Engineering (University of Glasgow and University of the West of Scotland) and Quantity Surveying (Glasgow Caledonian University), to work together over the course of a term and produce a complete design proposal, which has been fully structured and priced. It introduces students to the highs and lows of this collaborative environment and helps to prepare them for the encounters that they will inevitably experience when out in practice.

The course was initially developed in 1989 as a means of providing students in the construction industry professions' with information about each discipline, their roles and responsibilities, and to bring them together to meet, discuss and respect their differences through a short design project. The course has been running ever since and has developed significantly over that time to align with the shifting context of the professions, technological

development and educational advancements; but its aims remain constant. The main principle of the programme is to provide a controlled forum for the students from each discipline to come together and work on a design brief, role-playing a 'Design Team' scenario. Communication and collaboration are essential, as the Teams work towards refinement of proposals in a truly holistic manner, whilst being respectful of each individual's diverse challenges….poetics, costs and structural integrity. Supported by tutors from each discipline and external consultants, the teams work towards the preparation of proposals where architectural design, structural design and costs are worked through and finally presented for critique by their peers and tutors.

The course is designed, managed, coordinated and run in an interdisciplinary manner with a tutor from each institution, representing their discipline. This management is reflective of the course itself and has to be able to flex to meet the very different requirements of each disciplines educational aims and objectives. Staff members are required to respect and accommodate issues that may be out with their discipline, and this requires patience, respect and understanding and an ability to be nimble within rigid educational frameworks. With four separate institutions participating this is a complex process considering the practical requirements of each institute's timetables and the demands of the each discipline's programme and learning outcomes. It demonstrates that good collaboration amongst the teaching staff is also required in order to maintain and develop the course. Regular meetings take place, and initially these establish the timetable of the course and the design proposal. Follow up meetings cover the particulars of the design brief to ensure that each discipline has the relevant information available to support their students. During the duration of the course the content of meetings shifts to cope with issues that may arise, and to ensure that appropriate support is available for tutorials, presentations and assessments. At this point the multi-disciplinary cross-school staff team is required to support all students. Having an understanding of individual student needs be they professional, cultural, economic or pastoral are essential to help maintain progress during the running of the course.
The teaching team meets again following the final presentations, when a short list of finalists is drawn up for the Interact Exhibition and Final. The meetings conclude with a de-briefing, and it is at this is point that reflection and discussion over refinement and development of the course takes place in preparation for the following academic session. Student feedback supports and directs the discussion at that time. Positive collaboration is necessary for the successful implementation and running of the course, and each year the team makes appropriate adjustment both within their own institution and across institutions to ensure that the course runs smoothly and efficiently and gives all students the possibility for a fulfilling and positive multidisciplinary experience.

The Structure of the Course

Over the 20 years of Interact, the course continues to be developed and has been refined to take on board all the external factors that impact on its running. Many of these are practical and revolve around timetabling and availability of tutors, students and external consultants. With over 200 students and staff involved this coordination is one of the many challenges. The development of technology has also had an impact on how teams communicate both with each other and at presentations, and the medium for these communications adjusts each year

as new possibilities and opportunities become available, and which the course and the students adopt. Presentation tools show an area of particular development with the use of computer models, power point presentations, films and soundscapes. Content has also changed to ensure that project work is current and aligned with the ever-changing professional landscape. Sustainability is one such area and all disciplines are required to respond to particular demands, be it in the choice of materials, carbon footprints, re-cycling, energy consumption or building running costs; all to be considered by each individual discipline and as a collective group.

Term times differ across the institutions as do points of assessment, and it is only due to the tutoring staff's commitment to Interact, and the belief in its benefits to the student body that it continues to takes place each year, a less tenacious group would have walked away from the many difficulties long ago.
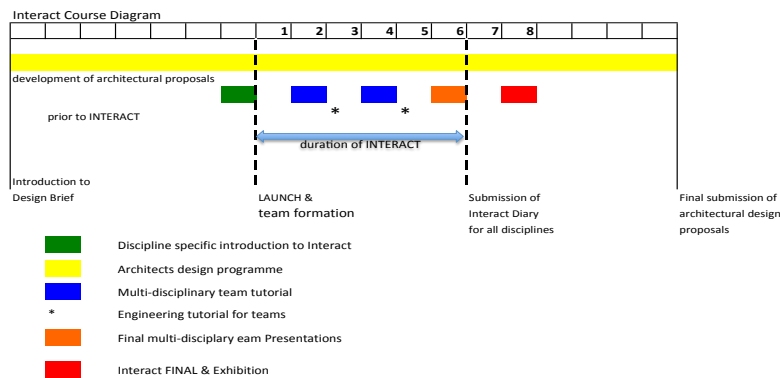

Figure 1. Course Diagram.
Source: Crotch, J.

Figure 1 outlines the structure of the course. The 'interaction' begins with the Launch, an afternoon and evening of talks, meetings and discussions. The formation of the Teams takes place and external guests make presentations regarding collaborative working, team building and the role of each member of the team. One such presentation shows an extract from the film 'Twelve Angry Men', staring Henry Fonda (Lumel, 1957).
. This has proved to be an effective and accessible way to expose the concept of team building and the process of forming, storming, norming and performing. During the course, as Teams work through the course, many students make reference to their own Team's journey recognising their location within the stages of team formation demonstrated in the film extract.

One hurdle that the course addresses is that of group work. Working, as part of a team is an essential skill for each discipline, however its one that students generally avoid where possible. There seems to be a perceived fear that group members will let each other down and grades will be impacted. Assessment is always at the forefront of student's minds, and in this

course the students are assessed on how successfully they interact and communicate with each other as they work through the project. This is recognised through the tutorials and presentations complimented by the hard copy Diary and Design notebook submission that are made by each student at the end of the process. This encourages collaboration to take place, as students understand that performance, as a Team, is what they are being assessed upon. This is particularly unusual; the normal mode of assessment for work carried out by the students from each discipline is one that focuses on outcome of the process rather than the process itself.

In most cases it doesn't take long for the Teams to form and develop as efficient groups, although support is sometimes required to assist Teams that are having difficulties working together. When this happens anxieties can result between the members of the Team, and in these cases reassurance and encouragement from tutors is given. There have been rare instances when a Team has 'dismissed' a member for non-performance, however this is unusual, and normally conflict is overcome with the necessary input from tutoring staff. Another concern is when the flow of information stops. When this happens staff intervene to support the team where they can. Occasionally re-structuring of teams has to take place to support all the students involved and to make sure that they all have as equable a learning experience as possible, ensuring the provision of a structure for all to meet the assessed learning outcomes.

The Teams are encouraged to work in the physical studios of the architectural school, and it is here that peer learning and sharing takes place. All tutorials and reviews are held in these spaces and this forum allows teams to oversee the work of other Teams, and exposes different working methodologies across different Teams. Here successes and dysfunction can be shared and learned from, as Teams strive to find formation; this is all part of the learning process. The shared working environment gives individuals who are not having a positive collaborative experience the opportunity to observe other Teams who are working well, giving them an overview of alternative operating strategies.

It is hoped that through this process students will value the skill of listening to others, accepting responsibility and making group decisions, as they work towards a common goal. It requires recognition that all members are equal, and of the importance of expressing your opinion and being able to reason why whilst valuing conflict as a means to uncover ideas and information. Students learning within a particular discipline rarely have the opportunity to discuss their work to others out with that specific area. This course provides this and requires students to exercise patience and clarity as projects are presented and strategies developed within the multidisciplinary Team.

Following The Launch (Figure 2), each institute reserves the same time slot each week within their timetable across the duration of the course for Teams to meet; however the students are also encouraged to meet out with these times as and when required. Meetings are recorded, and a standard pro-forma is issued for logging the content of these meetings. Many Teams develop their own recording method, which includes the documentation of emails, phone calls and texts; as well as other means through social media; and each Team member takes a turn to be responsible for this. Along side the meetings each Team also receives two multi-disciplinary tutorials, and this is where tutors work with external consultants to support them through the process. Two presentations are also made; one interim, where written feedback is given, and one final, and it is at this point that part of the assessment is carried out. Each time the Teams meet with the same tutor/consultant group as this allows the interaction of the

Team to be monitored and consistent feedback given. At all stages during the process the teams are encourage to discuss their interaction and the development of the proposal that has resulted from this process, and it is this interaction that is being observed and eventually assessed, not simply the proposal. The multidisciplinary review panel use assessment forms to grade each Teams' presentation and interaction (Figure 3). The second part of the assessment is made following the submission of their Interact Diary and Design Notebook, this holds a record of the Team's collaboration plus drawings, sketches and a copy of their final presentation. Each discipline have their own Learning Outcomes for this physical submission and there is no cross disciplinary assessment for this component.

Each year around 80 Teams participate and the six top scoring of those are invited to make their presentations at the Interact Final. This is the climax of the course and this annual event showcases the selected finalists who present their design proposals, structural resolutions and cost plans to a public audience made up of their peers, tutors, external consultants and guests. The RIAS's (Royal Institute of Architects in Scotland) secretary and treasurer chairs the event, and this professional institution are in full support of this unique teaching initiative. A multidisciplinary judging panel formed from external consultants, one from each of the three disciplines, Architecture, Structural Engineering and Quantity Surveying review the work of the finalists both during the presentations and through the exhibition of work which includes drawings, diaries and meeting notes. It is the job of this panel to decide the top three Teams, and these are announced at the end of the evening. The work of all the students is celebrated at a party that brings together all participants.

The event is a fitting climax, as it assembles together all the students, staff and consultants who have been involved during the running of the course and hands over the final decisions to the external judging team.

It is the understanding of all participating institutions that all students are winners in the process and not just those selected for the final. Each student who has participated has been involved in their Teams formation and performance, and through this process has gained valuable insights into group dynamics and the benefits of a positive collaboration.

Figure 2: Around 200 students gather for the first time at the Launch.
Source: Crotch, J.

Figure 3: Team presentations require all the team members to present to a public
audience.
Source: Crotch, J.

Through the eyes of the Architectural Student

The introduction to Interact is an eagerly awaited event by the third year students of
architecture at the Mackintosh School. The shared studios provide the forum for Team
tutorials, meetings and presentations that take place each year, so the first and second year
cohorts are aware of the course, as their studio become a temporary home for students from
the other institutions during the running of Interact. All students are invited to attend the final
and view the exhibition of work, particularly those in their second year, as this helps to give
the course context when they themselves encounter Interact in their third year.
The building design, which forms the vehicle for Interact, is the main design project that the
students work on during their third year. Interact occurs approximately midway through the
project. This means that the architectural students have sufficient design information to
present to their team members, allowing the process of structural strategies and costs to be
developed. Interact runs in parallel with the design studio, and student are encouraged to be
mindful of the development of their designs through Interact, as they also work on their
architectural proposal independently. Initially students find the idea of the two parallel
courses confusing, but when they are briefed on the aims and objectives of Interact they are
able to see it as a separate course, and one that can contribute to their own design work. In
MSA's course descriptor for 'Interdisciplinary Design' the aims state the following (Glasgow
School of Art, GSA, 2015):
 'To gain an understanding of the process of architectural design as a multi disciplinary team
activity, in order to work effectively with co-professionals from the construction industry.'
The Learning Outcomes for the course are broad and align with ARB/RIBA Graduate Criteria
for Validation (ARB/RIBA, 2011). A number of these are met specifically through the Interact
course and include:
'An understanding of the value and the ability to collaborate with peers and others, to develop
design ideas and make public presentations.'
and:
'An understanding and knowledge of the scope, main areas and boundaries of the discipline.'

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It is interesting to note that generally the Interact process has a positive impact on the designs, establishing a thorough structural proposal that is empathic, and cost parameters that can help to 'tighten up' many proposals.

At the architects introduction and briefing, prior to The Launch, students are briefed on the course, its aims and objectives, learning outcomes and mode of assessment and are given the opportunity to review presentations given during previous Interact events, examine diaries from previous years and ask questions.

Communication is key, and preparation for The Launch is vital as this is the first time the students will meet their Teams face to face and is the first Team meeting at which the architect's proposal is presented to the other members and a transfer of information between each Team member is made. Initial anxieties tend to be similar each year and focus on concerns of compatibility and nervousness over the Team being empathic about the design proposals. The students are encouraged to welcome the opportunity to discuss their designs with a captive audience, and discover and work through aspects of their projects that they may not have considered or fully resolved.

The Teams are established prior to the Launch. The number of students from each institution and discipline varies so Teams can be of two; architect & engineer; three; architect, engineer and quantity surveyor, and in some instances architect and two engineers. As social media now allows, as soon as the Team lists are posted, students make contact with their new colleagues prior to the first meeting. These initial connections help to reduce the anxiety of the first meeting. This has been a development from previous years when the architects presented their proposals, and the engineers and surveyors picked the architect that they wished to work with, neither a pleasant nor realistic team formation method. The extract below is from a blog produced by an architectural student; it summarises the 'atmosphere' experienced prior to the launch, and is a typical observation of the mood in the architectural studio prior to the launch. Formal feedback, which often contains a similar 'spirit' of anticipation is returned through the course QLT (Quality of Learning and Teaching) feedback surveys (Timofejev, 2012):

"So, the Interact Project: a collaboration between 4 universities………we learn what the 'others' do – but only in theory; yet we have heard all the clichés…Interact aims to teach us otherwise, by putting us into mixed teams with a common aim: to deliver a 'buildable' building that will be graded by each of the professions/universities. At the end of the project, each team presents what they have achieved, and the best ones are selected to compete in the Final. Sounds great.

In reality, there was quite a bit of drama. The fears, stories and excitement about Interact had started long before the project itself. We remembered the previous years, where several architects had broken down and were seen crying, or instead commanding their scared engineers around. My course-mates were speculating who they would get; whether they prefer a boy/girl engineer; some where sharing winning tactics whilst others organised a massive architects+engineers+QS party. As soon as our team lists were up, everyone rushed to Facebook to find out who they will be working with. I tried to get some tips from an engineering friend who had participated in Interact a year before, and he promised to help if there was any trouble with my engineer. In short the atmosphere was quite tense even before we started."

Following the Launch there are several supporting lectures and then the groups are left to work through the programme. Tutorials and interim presentations allow tutors to keep the groups on track and monitor the interaction process.

The architectural students present their design ideas communicating a narrative of their proposal along side the many practical demands of the design brief. Through this conversation and negotiation the architects try to ensure that the poetics of their designs are retained whilst grappling with the imposed cost parameters insisted by the QS and the very real implications of a structure that not only has to work, but has to embrace the aesthetics and concepts of their design. Discussions, negotiations and compromise ensue and occasionally some external support is called for. Generally the students embrace this challenge with a professional attitude that is admirable, arguing their corner and yet being accepting of the constraints of costs and gravity.

It is important that at this moment in the process that students recognise, accept and explore the options expressed by others in the team who may have a greater understanding and knowledge of a particular area of construction. The architectural students are often reluctant to accept this, particularly if it has a visual impact on their proposals, debate and discussions result. In most cases a resolution is found amongst the group, but occasionally the intervention of one of the teaching team as an arbiter is necessary to help the group through 'heated' discussions to point of acceptable resolution.

It is a difficult process as proposals are constantly under review and refinement in order to align with the requirements of the other disciplines. Designs alter, sometimes for the better but often compromise causes a dilution of the original scheme. This is where a positive interaction can really impact on the design, where negotiations of the different aspects of the proposal are worked through to some sort of conclusion, where all the Team members' views are heard and considered.

During the process observation of how interaction occurs is fascinating. Students with good interpersonal skills are able to navigate through the challenges and remain in control of the important elements of their proposals whilst also being able to accept others opinions and ideas and make change. This is often an arena where students who may not usually excel in design can come to the fore and really embrace the course and its objectives, as design per se is not under the microscope and the ability to communicate, listen and negotiate become the critical skills required for a successful outcome.

A further extract from a blog remarks on one such typical negotiation:

"Although all the technical details were really important at the time and I've learnt a lot about how an engineer understand a building, it's the human interaction that really made Interact memorable. One of the highlights was an argument with my engineer about how the concrete part of the building was going to be constructed: pre-fabricated or cast in-situ. That night, I took out a pile of books about concrete and spent the night writing a 1,500 word email about this, which started with: "I want to reinforce again that I am not stubborn and uncompromising, but…" Later, we found the whole episode quite funny and included a screen shot of the email in our presentation – the audience found the image of an angered architect, passionate about his concrete, rather entertaining."

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As with all MSA courses written feedback from the participating students is collected as part of a wider Quality of Learning and Teaching practice, this takes place towards the end of the course.

Students are generally very positive about their experience, even if it hasn't resulted in what may be perceived to be a positive outcome. Many express how they enjoyed and learnt from the process, and also how much time this collaborative way of working consumes, much more than many anticipated. Shortly after Interact the architectural students embark upon a professional 'year out'. Feedback from students has highlighted how many of the offices that they have been interviewed by or have worked for have been interested in the Interact course, and impressed that students are able to present and discuss not only their design proposals but proposed costs and the impact of these on their designs alongside reasonably comprehensive structural proposals, and this is in addition to the collaborative experience which one professional consultant referred to as "the nearest thing to reality"(Crotch, 2010).

Interact from a Structural Engineering perspective

For the structural engineering students, Interact can be broken down into a series of four sequential, inter-linked stages.

Familiarisation & information gathering stage

The engineering students' fundamental roles during Interact are to advise on, and assist in devising and developing, an appropriate structural solution for the scheme, based around the existing and developing architecture. Whilst architecture students are aware of the importance of precedent, engineering students typically spend most of their earlier years looking at the technical design of individual structural components and so often lack a proper appreciation or understanding of whole buildings, often seeing them as simply an assembly of successful individual components. In an attempt to address this, engineering students are required to spend some time familiarising themselves as to how professional structural engineers have organised "similar" (form, function or material) buildings, through a search for structural precedents. Live construction projects are perfect for this but more typically students rely on web images and descriptions to inform them. Here it is important for them to differentiate between skeleton & skin, as many images show only finished buildings and so are relatively uninformative structurally. Close-up detail is also particularly good for offering ideas and possibilities. Having completed this process, engineering students are more informed, confident and prepared to develop an appropriate structural system for their building. For some students the value of this approach is immediately clear and forms a continuing thread through the remainder of Interact (and all projects beyond).

Conceptual structural design & refinement stage

This is the stage of the Project where the most important team-interaction work takes place and where most student time & effort is spent. During this key design stage, engineering students are expected to respond dynamically to evolving and developing architectural and

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cost-related issues. But they should also be pro-active in offering sound engineering contributions to the development of the design. At the beginning of this stage, the structural system as defined by the architecture students can often be fairly vague and unresolved. The major initial task for the engineering students is to ask some fundamental questions about what the architect is trying to achieve in the building. Typical discussions here would involve clarifying the form & nature of the key structural parts of the building (roofs, floors and walls), perhaps in terms of external & internal visibility, in an effort to clarify what constraints and freedoms the engineers may have. A common example here is where all students finally realise that some fully enclosed volume, say a roof, can be formed in many different ways and so is really a structural engineering issue more than one of architecture. Overall structural stability is a vital engineering concern but, at this stage, rarely considered or resolved by the architecture students. Once the engineers explain the consequences of instability, from, at best, poor performance and some loss of function, to, at worst, total building collapse, the architects usually listen! Yet the visual and spatial impact of providing stability measures can prove highly controversial and often a major discussion point within the team, requiring considerable negotiation and compromise for an acceptable solution to be achieved - the very spirit of Interact! Structural "load-paths" are then identified and clarified; and approximate sizes of the main structural members are proportioned from established "rules-of-thumb". If the structural members concerned are visible, these sizes can sometimes prove unattractive to the architects and so some re-working of the basic structural spans need to be undertaken to achieve a resolution. Discussions regarding the form of a structure must also consider the proposed materials since an architectural preference here might lead more naturally to a certain form of structure; or some preferred architectural form may only be possible with a certain material. Also of particular importance at this stage is the structural integrity of the whole building. This integration of all component parts into a fully functioning whole building is clearly essential and is easily achieved with similar materials but becomes more difficult at mixed-material interfaces.

Detailed structural analysis & design stage

Since all structural design work so far has been based only on tried & tested rules-of-thumb, towards the end of the Project engineering students are asked to consider, discuss and agree on some key part(s) of their structure to take through to a more detailed analysis and design, in order to become more certain of its structural behaviour and sizing. This is more familiar territory for the engineers, where the precise structural loading is considered and the resulting accurate stresses and deflections are checked against limits. Analysis can be through traditional hand calculations or using the computer for more complex systems. Member sizing and design is undertaken and refined using familiar (Euro-code) design routines. In addition to strength and deflection calculations, overall structural stability can be checked through a computer model. The outcomes of this work are normally fed back to the Team for completeness.

Presentation, completion & assessment stage

The final stages of the project are mostly about communicating the Interact journey and outcomes and this is done in a variety of ways. The early-stage work of research, investigation

& conceptual design is all recorded in an Engineering Design Notebook, which should be a record of all their thoughts, and ideas and students are encouraged to explain these mostly through annotated sketches and diagrams. Loose sketches, pictures, data tables and so on can be pasted into the Book. Final detailed structural analysis & design calculations are presented as a compilation of their technical work. It is also important that students are able to explain the engineering of their building and its structural system visually, through a drawing, which should: show the main layouts and structural systems and all critical details; be fully annotated and dimensioned; include clear descriptions of all load paths, structural actions and material choices; have very clearly described ideas on strength, stiffness and stability. Finally, each student Team must formally present their final scheme via a short AV presentation to a panel of academics from each Institution. (Assessment contributions for structural engineering students consist of: 60% for Notebook; 20% for Presentation; 10% for Calculations; 10% for Drawing.)

Interact: The Q.S's experience

Quantity Surveyors are a rather unusual breed. Popular here in the UK, commonly used in USA and Asia, but they tend to do without them in most of Europe. Popular is perhaps the wrong adjective, but it is certainly believed that they play an important role controlling and reporting on cost within the process that leads to the successful completion of a building project; one that matches the brief while remaining in budget. It is this ultimate outcome that Teams in Interact strive to achieve. There is no hiding from the fact that cost is a determining factor on whether a project ever gets off the drawing board and there are very few clients who do not have a budget linked to an overall business plan. Interact fosters an understanding among the disciplines of one another's goals and leads each member of the Team to recognize the difference between cost and value when addressing the budget.
The initial Team meeting at The Launch holds similar fears for the Quantity Surveying students as it does for the engineers. QS's are intrigued to discover what their architect is going to present them with. They have access to the architectural brief in advance and from reading this may have noted the appearance of vocabulary such as "innovative ". This strikes a chord of fear in that the design may incorporate features out with their limited construction knowledge, as well as ringing up pound signs in their head. What they underestimate is the very steep learning curve that not only they, but also all members of the design Team are on. The QS students leave that initial meeting with outline design information of their project. There is always a variance in the depth and quality of the data circulated by the architects, but there should be sufficient information for all participants to work towards a very basic cost plan. This budget cost is often based on a rate of £ per m2 of gross floor area provided by the envelope of the building. Students at this point moan and console one another in respect of the ridiculous task they have been set. One of the most common complaints heard is that they don't have enough information, and the first tutorial is swamped with attendees claiming they are unable to do anything. At this point we ask the students to look at what they can do instead of what they can't. Time can be used effectively researching comparative costs for particular types of foundations, external finishes, heating systems etc., that are being considered, this can provide cost implications when making a decision. This type of activity

often occurs while the firm detail of design and specific specification catches up with the architect's concept.

Early Team meetings can leave the QS students feeling isolated as the architect and engineer spend time working together ensuring that any engineering challenges can be met. Although they often report back that it was a waste of time being there, they are encouraged to attend, explaining that listening to discussion as the design evolves, and observing the interaction between the other disciplines provides them with a deeper understanding of the project. It highlights the architects desire to retain key features and the engineers dilemma providing a structural solution. This will serve them well in later stages of the project and their understanding of future projects.

Listening is a very important skill and at this stage major cost centers often become apparent within discussions. As the design settles and is embellished with further detail the QS begins to build a cost, although they are still working under the heading of " budget " cost providing only a round figure without too much detail. At this junction students submit an Interim Report offering a snapshot of progress to date. This accounts for 20% of their overall module mark. With this outline project cost students are asked to submit details to back up the costs, and a diary of activities that should include an element of reflective comment (Glasgow Caledonian University, GCal, 2015). This regularly highlights issues of information flow. Tutors mark comparatively softly to other assignments with the intention to encourage students and build confidence.

The preparation of this "budget" cost can be the start of tension among the group particularly if cost exceeds budget. The QS may say "it's too big, make it smaller ". The architect resists as their personal relationship with the design begins to show. The engineer is often aghast as they contemplate changing all their calculations. This dimension of the interaction hopefully leads to compromise and change that is empathetic to one another's disciplines and goals, and the QS should learn the importance of being strong and realistic when reporting impact on budget. It would be unprofessional and a disservice to any client to allow a design to be progressed heading towards being over budget.

Students now progress to preparing a detailed elemental cost plan, which forms part of their final submission. This cost plan breaks the building into individual elements such as roof, external walls and floor finishes. Each element is quantified in m2 and a rate attributed to it reflecting the cost of its' form and specification. (Kirkham, 2007) To do this they need detailed information provided in sufficient time to achieve the deadline for the Team presentation. This area causes QS students considerable stress. The QS is at the end of the line, relying on the architect and engineer to make clear decisions, produce relevant information and submit it to them with sufficient detail to do their job. Time lost in late issue of drawings or late changes cannot be absorbed by the QS without impact on the programme or the quality and accuracy of cost produced. Many lessons that will serve them well are learnt during this stage. Students cannot sit back and wait. They learn to communicate their requirements for information and if they are not matched, they should raise and record the issue. This final detailed cost is then incorporated in the Team's presentation to tutors and consultants.

It is difficult to make a table of numbers exciting and the QS is often the last and shortest part of the presentation. They must understand and illustrate to their audience the path that the design and consequential costs have taken from initial scheme to final design. This validates the interaction that has taken place.

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Students are afforded two weeks following their Interact presentation without any more meetings or changes to prepare their final submission. This is an appropriate time frame as it constitutes the remaining 80% of their module mark.

Interaction, essentially, must contribute to the students module mark but the weighting is balanced to not bias those who met greater challenges within their group. The interim submission and the final submission have 20% of the total mark attributed to interaction. This is assessed from three components, the interaction evident among their team when they present to tutors, a diary detailing meetings and their outcomes, and a Reflective Report providing a personal narrative of their experience .

At the end of the Interact experience the student's strongest and most obvious emotion is relief, but this is quickly replaced by a huge sense of achievement. They realise the importance of their contribution to the design phase of a project, and that the costing exercise they have navigated through is not just a number crunching exercise, but requires an element of creativity from them, making them truly a part of the " design " team.
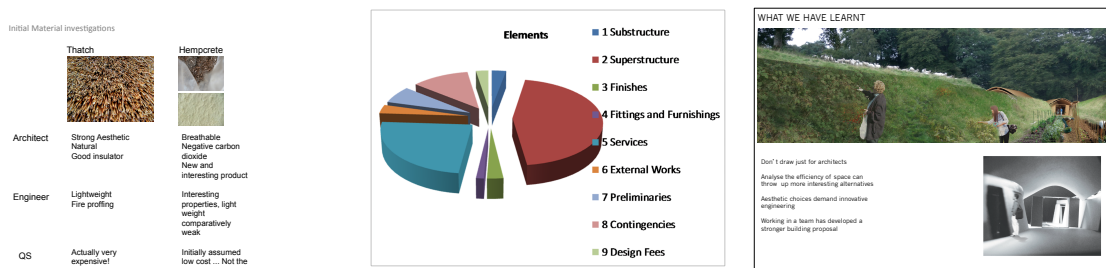

Figure 4: Three slides from one presentation demonstrating the diversity of information presented.
Source: Team 44. (2010)

Conclusion

Interact is a unique undergraduate course within the UK, providing what is believed to be both a necessary and useful learning and teaching tool for students who will after graduation move into a professional context where multi disciplinary team work will be the norm. It attempts to simulate a working design team scenario in a supportive and secure forum where advice can be given during and after the process and allows individuals to encounter and value the benefit of good team dynamics.

The skills gained include understanding the value of good teamwork and how this can be achieved, presenting and explaining ideas to others out with the profession, the importance of working to fixed deadlines, an understanding of each individuals contribution to the process and final outcome, and the knowledge that all involved are working towards a common goal. This is invaluable in the professional context within which these students are likely to operate, but are also essential life skills.

The course is often mentioned as 'an example of good practice' by External Examiners and the Joint Board of Moderators for the degree programmes at the University of Glasgow specifically

highlighted Interact as "an example of best practice" in their most recent accreditation visit. (Glasgow University, GU, 2010)

Most importantly, students who have been through the Interact process have made comment through feedback that they have enjoyed, learned and felt the benefits from the course. Interact is highly regarded by the professional bodies involved, for its significant educational benefits in the promotion of good and effective interdisciplinary working methods, and is one of Scotland's established construction industry student competitions.

What is curious is why this teaching model hasn't extended further a field, as a need for learning such valuable skills is so important, particularly in todays world of technological exchange and social media where face to face encounters are becoming less common.

Establishing such a course requires a level of commitment from each of the participating institutions, who must all jointly value the benefits that can be gained by students participating in such a course. Rigid and inflexible timetables and structures have to be adapted, but this shouldn't deter such an initiative. Once all the procedures are in place, a framework for delivery is established and aims and objectives clarified by all participating faculties, a similar course can be founded. This should never be considered as static and should be developed and refined in response to student, institution and professional needs. The principles are clearly outlined by Kirby in his text 'Interdisciplinary Design in Practice' (Spence, R., MacMillian, S., & Kirby, P., 2001), where he states that knowledge of the methods and priorities of the other disciplines is not enough to ensure effective collaboration. What is equally important is a set of attitudes including generosity, curiosity and an ambition to work towards the best rather than the adequate.

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