The intention of this presentation is a light hearted quiz highlighting some skills and concepts of use to architectural students at the start of their commercial careers.

There are twenty questions, some more serious than others, and answers are given in the notes below the slides. At the end are a few slides commenting on some issues and opportunities facing architects from the perspective of an expert in commercialisation.

The questions are designed to a) have some relevance to architecture students and b) to link to the lessons on commercialisation expounded in the paper 'Great Mistakes in Technology Commercialisation' which can be downloaded from: http://www.kkitech.com/Great%20Mistakes.pdf

These lessons can be summarised as
1. Identify user benefits arising from our technology
2. Research markets so you sell the right thing to the right people
3. Make the technology robust enough for 'real life'
4. Manage complex projects to be on time and on budget
5. Understand money and ask for enough
In terms of entry to university courses, architecture is as hard or harder to get into as law school, medical schools and veterinary college. And architects have a six year course including typically a placement year. So we’d expect architects to be as successful and as valuable as these other professions?!
Q.2 In their book, Peopleware, deMarco and Lister link staff productivity to office design. What differences in productivity can be gained by having the right office space?

- 10%
- 75%
- 250%
- 1000%

One of the 'lessons' in the Great Mistakes paper is the need to find 'benefits' for users/customers. Peopleware was an attempt to correlate various factors with the productivity of computer programmers. They expected to identify technical factors such as the type of code, or the computer specification. To their surprise, they found that the main cause of good or poor productivity was a good or poor working environment. Getting the working environment right, let the best programmers be 10 times more productive than the worst on a series of standardised tests. The best programmers were 2.5 times better than the mode. Moving poorer performers into a better working environment brought their performance up to the higher levels. In poor offices the best performers were reduced to 'hiding' in order to find peace and quiet to get their work done - one team met in the crypt of a local church! Clearly one potential benefit of good architecture/design is increased productivity (and another is staff retention).
The following three slides are part of one question. If you were a medical professiona,l which firm of architects would you choose to design your new practice building or small hospital?

This firm won a prize for a small animal hospital. It is 'set unobtrusively into its setting, a massive grassed roof creating a new hillside within the landscape. The building's great triumph is the unique and ingenious way it integrates a very substantial medical facility with a parkland setting'. Would that make you use them?
This firm clearly has a lot of experience designing medical facilities. They have 10 years of experience, a 'highly qualified team... of specialist consultants', and their design area of expertise includes 'day procedure centres, x-ray facilities, pathology laboratories, prosthodontic clinics, general medical centres, etc' and 'computer animated 3-d walk through models'. Would that make you choose them?
This firm, in Atlanta Georgia, has a lot of customer testimonials on its web-site; ‘I would guess our overall productivity has increased by at least 35% and more often than not we are all getting home at least a half hour earlier’; ‘the physicians increasing their productivity by as much as 30%...patients have a minimal distance to travel (within the building); ‘we experienced huge productivity improvements. Patients now walk one half the distance they did’.

Most medical professionals asked by KKI preferred this firm. The things it is discussing (doctor productivity, reduced patient movement) were perceived as real benefits, not just interesting features. Good architecture has the power to improve clients’ lives.
These next two slides forms one question. What links the two bridges portrayed in the pictures?

One of the lessons in KKI’s ‘Great Mistakes’ paper is the need for technical advances to be sufficiently robust when employed in real life. One could quote the Titanic or the Challenger Space Shuttle as examples which failed this test.

This bridge is another. It’s the original Tay rail bridge, near Dundee, which fell down in a storm in 1879. The designers had apparently not taken account of the force exerted on the structure by cross-winds. This failure indirectly lead to the building of the huge, massively over-specified Forth Bridge (the one that always needs painting) completed in 1890.
And this is the Tacoma Narrows bridge in Washington State. It collapsed in 1940. The designers had apparently not taken account of the force exerted on the structure by cross-winds. There is famous movie footage of the bridge warping and flex under the load and throwing cars off the roadway. Unlike the Tay bridge, the only casualty was a small dog.
Poor (or no) project management is a common mistake with technology projects. There is a fairly well-established, slightly dull area of business science that addresses the needs and requirements of multi-disciplinary interdepartmental projects. It's called project management. There are numerous good and usable project management methods, including PRINCE2, which can be used to monitor and control quite complex projects.

PRINCE2 is not software: it's a management process that is effectively 'codified common sense'. For example the project mandate meeting is the event where the project manager and the client pin down and document the clients, needs, benefits, and constraints. They then both agree and sign-off the document. PRINCE2 is becoming increasing common in delivering real projects in areas varying from building construction to software development. The forms are freely available on the net, as are many sites discussing best implementation.

If you are involved in a complex project, good questions to ask are 'Who is the project manager?' and 'are we using PRINCE2 or something similar?'
Buildings account for approximately 40% of the carbon emissions in the UK, with non-domestic buildings responsible for approximately half of this... improving energy efficiency in non-domestic buildings is a major opportunity for cost-effective carbon reduction.

That's why we've been working with real projects to build the commercial case and examine the barriers for low-carbon buildings: both refurbishment of the existing stock and new low-carbon buildings.

From the web-site of the carbon trust
http://www.carbontrust.co.uk/emerging-technologies/current-focus-areas/buildings/pages/buildings.aspx

Again, better building design can have a massive benefit to the environment and to the individual customer (they may soon be asked to pay for carbon credits reflecting their CO2 output).

Btw, air travel, often criticized, is only about 3% of the UK's carbon emissions.
In many offices, charities, and government departments you'll hear people talking about capital and revenue expenditure.

‘Revenue expenditure’ is spending on simple day to day items usually of small value, used there and then. New ink for a laser printer would be a revenue item, as are staff wages.

‘Capital Expenditure’ is expenditure that is incurred on items that have a life of several years (a new building, a car, computer equipment, office furniture, etc). The cost of these is spread over the realistic life of the asset. For example, the value of a car bought for £5,000 might be reduced by £1,000 a year. After four years it would be worth £1,000. This change in value is called depreciation. Depreciation calculations affect the taxable profit of a company quite a lot. So the taxman takes a great interest in the company’s depreciation calculations, and accountants get quite strict (!) about distinguishing capital and revenue items.

In most organisations, capital purchase requires many more approvals and committees than revenue purchases. An architect trying to sell a new building to a client must recognise that the process is likely to be slow! Paradoxically the National Lottery has been criticised for giving capital grants for new projects/building but not paying their revenue costs. A number of initiatives have gone out of operation because the ‘owners’ can’t afford to run their beautiful new premises.
We are now back in the area of ‘being robust in real life’. We’ve learned how UK buildings emit 40% of our carbon emissions - which implies they waste a lot of heat/energy. Here are some of the culprits! These are valves and actuators for HVAC (heating ventilation and air-conditioning) systems. They control flows of hot/cold water and/or air around the building, They are usually integrated into a building management system (BMS) with sensors and a central computer.

Getting the BMS system, wrong can ruin the efficiency of our wonderful new low-carbon building! We have a chronic tendency to under-specify these things in Britain, which is why our air-conditioning hardly ever works well. Large office buildings should have large HVAC systems using some of the big flanged valves at the back of this picture. Building engineers usually buy these by competitive tender which means there is a temptation to put in as many of the small valves (like the brass ones at the front) as they can get away with. And those just don’t have the capacity. This actually wastes energy as users open windows or bring in their own heaters. The result is that the performance of a £10m building is compromised by £20k of components!

Also the flanged valves are large - you have to leave enough space for them in plant rooms etc.
Yes, your team would have a good chance of succeeding! These are phrases which have entered the language of business from something called the ‘Belbin test’ – invented by Dr Meredith Belbin at Henley management School in 1981. The Belbin Team Role Inventory (to give it its correct name) assesses how an individual behaves in a team environment. It is a behavioural tool, and not a psychometric instrument.

Good work teams need someone to fulfill certain roles within them, especially in multidisciplinary projects. The ‘plant’ is the ideas person, while the ‘shaper’ likes to get things up and running. The ‘monitor evaluator’ likes to check everything’s OK and the ‘completer-finisher’ is the one who remembers that the deadline is 2pm not 5pm and the client wants 5 copies! (CF’s can be rare but very valuable in architectural offices!). The ‘team worker’ may not seem to do much but if you take them out the team rarely functions so well. Poor team rarely deliver good projects!

Belbin’s work has been used by work teams, sports teams, and the military. The common team roles such as those above have entered the language of business, and you’ll hear managers saying ‘she’s a really good completer-finisher’.

Q.9 Would you be happy if your work team had

- One ‘plant’
- A ‘completer-finisher’
- Two ‘shapers’
- One ‘monitor-evaluator’
- A ‘team worker’

Why?
The building overheads are £30,000 pa
Contract and cleaning fees for each office rented out are £700 pa
You want to make 30% over your costs
How much will you charge for each office?
What if you think you will only rent out 50 of them?

Overheads are costs such as rent, rates, site security. You have to pay these irrespective of whether you actually rent out any rooms! The costs that you only incur when you rent a room out are called direct or variable costs. In most firms, charities, government departments you’ll hear people saying ‘how do we get the overheads down?’ (Energy efficiency can be one answer).

The sum here is: 100 rentals 50 rentals

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<thead>
<tr>
<th></th>
<th>100 rentals</th>
<th>50 rentals</th>
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<tbody>
<tr>
<td>Overhead cost per office</td>
<td>£300</td>
<td>£600</td>
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<tr>
<td>(£30k/100)</td>
<td></td>
<td>(£30k/50)</td>
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<tr>
<td>Direct cost per office</td>
<td>£700</td>
<td>£700</td>
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<tr>
<td>Total cost per office</td>
<td>£1000</td>
<td>£1300</td>
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<tr>
<td>Add on 30% profit, rental price is:</td>
<td>£1300</td>
<td>£1690</td>
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If you’ve sold 50 rooms at £1690, you have paid all your overheads and have a choice when it comes to room 51. You can only charge the direct cost plus a profit - £700 +30%. This is called ‘marginal costing’. Or you can charge the ‘full cost’ of £1690. University research grants used to be paid on a marginal cost basis, now they have to be calculated on a ‘full economic cost’ basis.
We are back to project management again. These are scheduling tools that show you ‘what is happening when’ in a project. The one on the left is called a Gantt chart, which is basically a time-line of activities. It was invented by a Mr Gantt back in 1917. Many research grant applications require a Gantt chart as part of their application.

The one on the right is a PERT chart, invented in the 1950’s and applied to large scale building and development projects. It’s basically an intelligent flow chart. The activities are linked together by dependencies (‘we cant put the roof on until we’ve had the walls approved’). You can calculate the route through the flow chart that determines how long the whole project will take (the ‘critical path’ – another phrase that has entered common business language).

These things are not computer programmes – they were in existence long before the invention and wide use of computers. However their take-up has been greatly speeded by the advent of the PC. Microsoft have something called MS Project, while Mac users might like to look at Merlin or AEC Software FastTrack. They are widely used in architectural offices and generally in the construction industry.
In technology commercialisation we pay a lot of attention to what we call the 'business model' - shorthand for 'what will you sell and who will you send the invoice to?' For example, I advised an agricultural college not to sell their land management software as a product to farmers, but to set up a land management advisory business using the software as a basis. This was a) so they would get repeat business and b) so they control the quality of work done using their software.

A common business model for architects is 'we will do the design and get paid a percentage of the total price of the project'. The real project mentioned above involved using several different professionals and it became unduly complex as a result. In particular the architects original estimate of what the project would cost and what the builder wanted to charge were a long way apart and required the QS to intermediate.

Is there an opportunity for architects to have a more controlling role in the overall project (which would stop other professions 'muscling in' on their territory), and if so would they need a different charging mechanism? In other words, do they have the best 'business model'?
Sadly, what I find is mainly a description of various types of computers! This tells me that

a) the computer industry is always going on about their latest new and exciting product. Which often isn’t that exciting...

b) Architects don’t seem to be very good or experienced at articulating the benefits of their work to potential clients and sponsors.

That seems a shame to me as an outsider, as we’ve talked about a lot of potential benefits that good architecture can bring (client productivity, reduced costs, energy/carbon efficiency).
All of these things are of course possible, and they all fall under the area of robust technology or design. They are also all things which create potential major ‘anti-benefits’ or ‘dis-benefits’.

In one of our major new teaching hospitals the corridors are too narrow for two intensive care patient beds to pass each other – so they have to have a ‘one-way system’ which is inconvenient to staff and the patients.

Although the architects often ‘get the blame’ for examples like this, it’s often not their fault. In this case there should have been a more robust process for identifying user needs - in other words it’s a project management failure, not an architectural one. It’s the kind of problem that PRINCE2 (and its mandate meetings) is designed to address, which is why it’s a good thing for architects to be aware of such techniques.
Q.16 What is the difference in energy consumption/m² between the best and worst offices/houses?

- Very small – less than 5%
- Around 40%?
- About 100%
- Over 500%?

Its over 500%! The energy consumption in domestic houses and some offices is given in an energy performance certificate (the coloured bar chart above). Houses in Band G have typically 5 times the energy consumption per area than those in Band A. For offices see here - types 1 & 2 are non-A/con, cellular are open plan, types 3 & 4 are A/c:

![Energy Performance Certificate](image)

<table>
<thead>
<tr>
<th>Table 5. Typical and good practice energy consumption in offices in the UK.</th>
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<tbody>
<tr>
<td>kWh/m² of treated floor area</td>
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<tr>
<td></td>
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<tr>
<td>Type 1</td>
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<td>---------</td>
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<tr>
<td>Good practice</td>
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<tr>
<td>Heating &amp; hot water</td>
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<tr>
<td>Cooling</td>
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<tr>
<td>Fans, pumps and controls</td>
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<td>Humidification</td>
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<td>Lighting</td>
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<td>Office equipment</td>
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<tr>
<td>Catering</td>
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<tr>
<td>Other electricity</td>
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<tr>
<td>Computer room</td>
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<td>TOTAL</td>
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Based on DETR (2003b) op cit.
Many business people (including job interviewers) will ask whether you are financially literate. In many cases the test they use is whether you can read a balance sheet. Actually you can and should!

Cash (money in the bank), stock (things you can sell), and debtors (money owed to you) is all the money you expect to have or get your hands on over the next 12 months. In many accounts these are summarised as 'Current Assets'.

Creditors (money owing to suppliers), Tax account (money owed to the taxman) and bank overdraft (not the facility, but the amount you've actually borrowed), are all things you expect to have to pay within the next 12 months. These are called 'Current Liabilities'.

Essentially, you want the current assets to be bigger than the current liabilities. Sometimes this sum is done for you on the balance sheet - its called 'Net current assets' and it should be positive. If they are not, the company (or charity) is technically insolvent, and its quite risky for you to do business with them as a supplier or customer!

You should develop a habit at looking for the accounts of companies you deal with and checking this on their balance sheet. And you can get the accounts of any UK Ltd company for a few pounds from Companies House.
Q.18 What does this mean?

‘The brick facade maintains a dialogue with the local context’

If they were using the language of benefits, they might say something like:

‘It looks nice and makes passers-by happy’
‘Other property owners in the street don’t feel overshadowed’
‘The building isn’t ostentatious or oppressive, and anti-globalisation rioters will probably leave it alone’
‘Your neighbours won’t hate you’

Possibly,
‘there will be less crime on your street than there might have been’
‘your employees will be measurably happier’

And so on...
Q.19 Who has the highest and lowest charge-out rates as a profession?

- Lawyers,
- Doctors,
- Accountants
- Architects

Sadly, architects are apparently the least well paid out of the 'high skills professions.'

I was presented with this information by one of the University Architecture Faculty for a lecture I gave last year:

The Commercial Problem with Architecture

- Lawyers, high entry qualifications, 6 years training, charge £120+/hr
- Doctors, Accountants, etc
- Architects, high entry qualifications, 6 years training, charge £40/hr

In the US the figures are similar

be estimated, they will give you a general idea of the salaries, wages, incomes, and benefits for architects. According to US Department of Labor statistics, in May 2006 architects in the USA earned between $41,320 and $119,220 a year. The mean annual wage was $76,750 per year, and the mean hourly rate was $36.90.
This is a good team exercise, not just for architects! Used dried spaghetti, and one pack of marshmallows. The structure must be able to support the weight of a small toy soldier (a metal warhammer figure is the one I use), and the height is measured from the ground to the base of the figure.

You can spend anything from 20 minutes to several hours on this, and 3-4 people is a good size for a team. You'll find pasta makes quite an interesting building material - its strength is actually 'realistic' in proportion to the size of building you are constructing.

Please don’t do this anywhere with a nice carpet, or where you can’t wash your hands! Things get quite sticky...

I find that the strength of the team work is a more reliable predictor of success than outright technical skill. Although I’m not a psychologist or HR professional, I can often predict which Belbin role people fit into by watching them doing this test ‘He’s definitely a Plant, she’s definitely a Shaper’.

Q.20 What’s the tallest structure you can build with dried pasta and marshmallows? and why is this relevant to anything?!
And the good news is that although I have done this game many times, with managers, engineers, boy scouts, research chemists etc, the current record of 42 inches was set in Dec 2009 by a team of Edinburgh University Architecture Students!
We have been talking about benefits through this talk/quiz. The terminology comes from the advertising industry and is explained here.

‘My new building has a natural brick façade’ would be a feature

‘My staff turnover has decreased by 20% since we moved into our new building’ would be a benefit.

See http://www.kkitech.com/training.php
For a video explaining this in more detail
Some thoughts

- Why when I google ‘architecture office productivity’ do I get stuff about IT?

- ‘The study by the Commission for Architecture & the Built Environment and the British Council for Offices has found even simple things such as good lighting and having adequate daylight can reduce absenteeism by 15 per cent and increase productivity by between 2.8 per cent and 20 per cent.’

- Maureen Glabman (American Medical News, Jan. 26, 1998 v41 n4 p11 (3)) estimated that a moderately disorganized $100,000/yr manager loses one hour per day to disorder or $12,480 annually based on a 40-hour week. The lost time includes looking for misplaced files and paperwork, inaccessible files and resource books, lost phone numbers, and stress caused by being unorganized.

More potential benefits here!
Some things that Architects should probably be aware of...

Include:
Project Management
Money and budgeting
Structures and engineering
Building operation and efficiency
Techniques for working in teams

It’s not that you have to be an expert but that you should know enough to recognise someone who is

PS. Buffy the Vampire Slayer is a good role model here - she always goes to the Library to ‘market research’ her projects… ‘hmm, how do I kill the vampire this week?’
So this talk has been a quick, but I feel hopeful, excursion into the Opportunities and Issues facing Architects from a commercialisation perspective. There clearly are great benefits that architects can bring to their clients but they need to be better at expressing them. And it may be that Architects need to adapt their business model, controlling input from others in order to make sure those benefits are actually delivered. The Architect should be 'Guardian of the Benefits'.

Any comments gladly received at kevin@kkitech .com!