

# Providing the skills required for innovative mobile game development using industry/academic partnerships

**Reuben Edwards & Paul Coulton, Informatics, InfoLab21, Lancaster University, UK**

## Abstract

*Mobile game development is seen as an area likely to exhibit increasing influence on the structure of the games industry although many current pc/console game developers are struggling to adapt their existing practices to this new medium. This is due to both the physical restrictions of the mobile phone and the mobile network as a development environment and the very different demographic of mobile gamer. They are generally ignoring the inherent features of mobility, almost universal connectivity, context, location, and proximity available on mobile phones and thus the possibilities of creating new game genres. Academia is well-placed to teach the skills required to produce the innovation in mobile games development through burgeoning research in pervasive and mobile computing. However, they must also overcome the prejudices of the game industry which has often criticised academic games courses for failing to give students a true insight into its day to day operation of the industry and in particular the commercial pressures of working to budgets and timescales. In this paper we describe the structure around our MSc in Mobile Game Design and M-Commerce Systems which encourages innovation and entrepreneurship within an academic environment by employing an industrial approach to academic game development through collaborative partnerships with industry and the provision of a direct route to market.*

## Index Terms

Mobile Games Education, Symbian, Brew, J2ME, Flash Lite

## 1 Introduction

At the heart of academic research lies the task of pushing the boundaries of knowledge and then to transfer this knowledge to: the wider academic community; students; and increasingly, industry. Whilst academic journals, conferences, etc provide the mechanism for knowledge transfer to the academic community and Higher education provides the same for students, it is the transfer of knowledge, and in particular intellectual property, to industry that remains the most difficult. Specific project collaborations between academics and commercial organisations often provide a means of joint development of new technologies and can be a cost-effective (albeit often slow) mechanism for a company to undertake blue-sky research and development projects. Alternatively, academics could create spin out companies to exploit specific inventions that have arisen from their research, although these companies can oft be short-lived if the original invention is not followed by further innovation. The most common, and arguably, most effective mechanism for knowledge transfer between academia and industry is through the employment of graduates who physically carry their knowledge from academia to their employer. This process is far from perfect: graduates are often employed for generic graduate jobs that use little if any of the specialised knowledge that they have learned at university, or are hampered by a lack of experience in exploiting their knowledge for commercial purposes. As universities become more commercially aware and as the market for graduates becomes increasingly competitive it is important that new structures that provide commercial expertise to both students and academics are formed providing more efficient mechanisms for the commercial exploitation of intellectual property created in academia. In this paper we describe a holistic approach to the teaching of mobile games development and the commercial exploitation of these mobile games. The key aims are: to provide students with skills and knowledge in areas of mobile development where there is currently a shortage of skills; to produce graduate developers who are capable of creating commercially viable software in a commercial environment; to create innovative applications that push the boundaries of what is currently achievable; and to generate revenue by exploiting the IP generated by staff and students. In the subsequent sections we shall explore: the main technologies for mobile games development; the structures that have been created to foster technological innovation within an academic environment and that enable the teaching of computer science/engineering skills in a commercially exploitable manner; examples of some of the innovative applications already developed; together with some of the success stories from this approach to learning and our overall concluding comments.

## 2 Mobile Game Development Technologies

To enable a more open market and to allow innovative application development across a wide developer community mobile phone manufacturers and operators are now producing environments where each application is no longer needs to be developed for a particular make or model of phone (Vaughan-Nichols, 2003) but for a standardised Operating System (OS). However, the market is still relatively fragmented and here are a number of environments in which mobile applications can be developed including [Symbian](#), Binary Runtime Environment for Wireless ([BREW](#)), Microsoft's Windows CE and [Windows Mobile](#) and [Linux](#). There is also a large mobile developer base using the Java 2 Micro Edition ([J2ME](#)) which despite not being an OS it has, until relatively recently, been the only means of cross platform application development (Coulton et al, 2005).

Amongst the OS, Symbian is written mainly in C++ and has been optimised for use in small battery-powered devices with extensive communications capabilities. BREW is C based and has a significant presence in the United States and is both a set of APIs that enable developers to create applications, and a means of selling and delivering applications. With regard to the Windows variants there is an often perceived reluctance by mobile phone manufactures to incorporate the Microsoft OS onto their devices, no doubt fearing a repeat of their dominance in the PC market, thus limiting its penetration, although, recent Microsoft initiatives and the highly regarded development tools may well increase its support. Linux enabled phones are still relatively few in number and most current Linux developers appear reluctant to make consumer applications (Longino, 2004). The systems chosen for this innovation environment are the ones we believe currently offer most to potential developers, which are Symbian, Brew, and J2ME, although we also utilise [Python for S60](#) for rapid prototyping, and the increasingly important [Flash Lite](#) for appropriate applications, but acknowledge that, as with any technology area, this may well change in the future.

### 3 Design-Protect-Build-Test-Market-Sell

A standard approach to the teaching of computer science/engineering embraces variants of the “Design-Build-Test” (Elger et al, 2000, Repeing et al, 2005) philosophy. Of course, the reality of the development of a marketable product requires a further degree of iteration to the process with a number of methodologies available for developing products from design to release. However, these methodologies concentrate on design, implementation, and testing with scant regard for organisational business process and can lead to a naïve view of the role of the engineer in industry. Exposing students to the commercial issues of a product’s development leads to a more holistic understanding of the development of a product, and so we have developed an extended view of the Design-Build-Test philosophy, that embraces an understanding of: the need to protect IP; understanding of how mobile applications are marketed and the possible routes in which they may be sold. The process broadly becomes “Design-Protect-Build-Test-Market-Sell”. Again this is a non-linear process with marketing issues pervading the whole process, and the design, build, and test phases still iterative, but with the added input from the sales and marketing operations and the need to protect ideas and designs is permeates the whole process.

#### 3.1 Design

The design of any product is always critical. No amount of coding or testing can rescue a bad design; although to a certain extent a bad product can be sold, albeit at the expense of increased advertising and reduced return. Indeed the games industry is awash with poorly conceived games that have sold well despite being played just once by their owners before being discarded. If design is to be carried out in an industrial context, there must be considerations made that go beyond simply creating a design for the implementation of a specified product. This part of the process must begin with an evaluation of the viability of the product in terms of hardware capability, time, cost, and also in terms of marketability.

#### 3.2 Protect

The design process requires the planning and design of a market-viable application. It is inevitable that such a process will involve the creation of novel – and valuable – intellectual property. Such IP must be protected in a number of ways, and from a number of threats.

The first consideration is the ownership of the Intellectual Property Rights. It is usual for company’s to own the intellectual property of their staff, but in academia students are often involved in the development of the IP and so issues of ownership become more complex. In some institutions their students’ IP is owned by the university, in others, including the author’s institution, the student will own their own IP. It is therefore important that when an original idea is originated, that some form of documentation is used to register such an idea. In practice, we use an internal form within the university to register the idea at the beginning of the process, and a separate revenue sharing agreement to document the relevant contributions to the IP after the product has been implemented, recognising the further input to the IP during the implementation of the idea. The following table illustrates typical revenue sharing arrangements.

Origin of IP	Revenue Share	
	Member of Staff (further development by staff member)	University (50%)
Member of Staff (further development by student)	University (50%)	Student (35%) Staff (15%)
Student utilising commercialisation route (further development by student who must assign IP to University)	University (50%)	University (50%)

**Table 1 IP Revenue Sharing Arrangements**

Secondly, the product must be protected from competitors and the level is decided on a product-by-product basis. For example the games ‘TxTBook’ and ‘Buddy Bash’ described in forthcoming sections don’t include any patentable inventions, but do have potential brand value, and so the use of a trademark will be required to protect the IP therein. The work being carried out on ‘mobslinger’, however, does include protectable IP, and we have taken the necessary precautions to protect our design designs. One important thing to note with all the projects described is that we emphasise innovation and are thus able to produce associated academic publication

#### 3.3 Build

Building the application requires a significant collaboration between the student(s) and their academic supervisor(s). If a saleable product is to be produced strong management is required. Typically our MSc projects involve six months of full-time work, and it is important that this time is managed effectively. Whilst students are provided with the knowledge required to successfully manage their projects, invariably this is their first experience of individually managing a complete project on such a scale. Each student meets individually with a supervisor weekly for a trouble-shooting session. In addition, progress is presented weekly to the industrial partner. Project management software is used to monitor project timelines and milestones, and provides bulletin boards for students on similar projects to problems and solutions.

#### 3.4 Test

The key to development on any hardware platform is to test early and to test often. Students are encouraged to develop prototypes, usually in Flash Lite (and in some cases Python for S60), as a proof-of-concept and are then required to not only produce a working mobile application, but for that application to be externally tested through a recognised testing programme such as [SymbianSigned](#), [Java Verified](#) or [TrueBREW](#).

Conformation to these standards requires a structured approach to testing, and the project management software supports both bug tracking and formal test documentation.

### 3.5 Marketing and Sales

In addition to having an understanding of the technical requirements of developing a software product, students are expected to develop an understanding of the business processes, including a basic understanding of accounting and finance, marketing, and sales. As well as documenting their application, students are expected to produce a business plan for the sale and exploitation of the product. This plan includes marketing information on the product and competitors, as well as documenting potential routes to market, and incorporating financial forecasts on development costs, support costs, and potential sales and revenue.

## 4 Creating Structures for Technology and IP Transfer to Industry

If the goal is to educate students to a level where they are able to produce software applications to a commercially viable standard, there is only one way to test such viability: in the marketplace itself. However, it is difficult, if not impossible to create a separate business to sell and market each application, and so a structure has had to be created to provide a route to market for each application as it is finished. As each product must address a particular market need, so must any course offered by a university. Such a course must offer education to an appropriate level, as well as providing students with skills attractive to potential employers, and addressing key industrial skill shortages. We have addressed these aims by creating an MSc course and a company to exploit the output of that course. The course design combines our academic expertise with support from industry to address key skill areas.

<b>MSc in Mobile Games Design and M-Commerce Systems</b>	
<b>6 Taught Modules (6 months - 50% of the final mark)</b>	
<b>1. Game Design in Symbian</b>	Project varies and is generally associated with University spin-out company m-ventions ltd.
<b>2. Information Management Systems</b>	
<b>3. Games Characters and Worlds</b>	
<b>4. Real Time Programming</b>	
<b>5. M-Commerce Systems</b>	
<b>6. Business Management</b>	

**Table 2 MSC Course Structure**

To foster an environment where the walls between academia and business are broken down, we have a new building Infolab21 which has been designed to facilitate the transfer of knowledge between industry and academia through its physical design. Finally, we have created a limited liability company, m-ventions ltd, to speed the process of taking student applications to market.

### 4.1 Industrial Collaboration

The Department overseeing this innovation environment benefits from a non-exclusive sponsorship program provided by Nokia and Symbian both through access to their commercial developer programs and the provision of devices, both of which contribute significantly to the student learning experience and the ability to recruit high calibre students.

### 4.2 InfoLab21

[InfoLab21](#) is [Lancaster University](#)'s world-class research, development and business centre in Information and Communication Technologies (ICT). It is a well equipped, high tech environment for academic research staff, research students and businesses. The building contains two wings, the first containing academic researchers working in the fields of Computer Science and Communication Systems, the second wing hosts the Knowledge Business Centre (KBC) which provides incubator space for start-up, spin-in, and spin-out companies. Between the two wings are mixing areas supporting interaction between business and academia.

### 4.3 m-ventions Ltd

[m-ventions](#) Ltd is a registered UK company with limited liability, that has been created to market student-developed mobile applications. The creation of a single company geared to exploiting multiple product lines streamlines the commercial exploitation of the University's software output, and creates a market channel for such software bridging the academic environment with industry. The company is chaired by a businessman with extensive experience of the computer games industry, and has business support and sales team. Research and Development are steered by academics who act as directors of the company. Since the Intellectual Property is owned by the University, applications are licensed exclusively through m-ventions which is then responsible for the sales and marketing of each application. The IP allocation structure appears quite complex as shown in the following figure but this arrangement ensures that the rights of all parties are adequately protected.

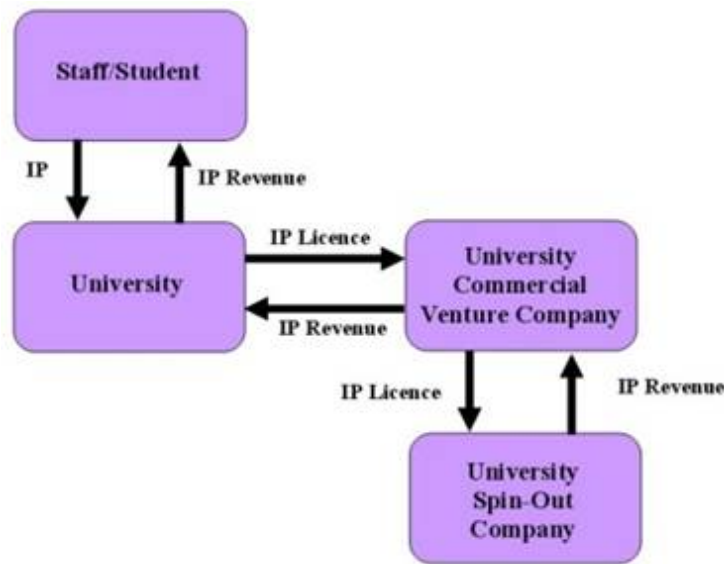


Figure 1 IP and Revenue Sharing Arrangements

## 5 Game Development

The second cohort of students are half way through the programme and with m-ventions ltd has already released commercial software although as a company it is still in its relative infancy. However, there are already a number of success stories both in terms of the fact that students on the course are being aggressively targeted by recruiters and of the original cohort all students gained jobs in mobile applications development and half in mobile games specifically, further one student now runs the European game deck for the biggest mobile games aggregator in the UK. Below we describe a sample of the games created by students demonstrating the range of output and originality of application that can be generated from within an academic environment and that the need to produce academic research can be maintained. Furthermore, two applications have already won prizes: an application m-post won a business idea prize in May, 2004, and in November 2004, the m-football application, described below, was shortlisted for the Orange/Nokia S60 Challenge.

### 5.1 Buddy Bash

Buddy Bash is an addictive reaction testing boxing game with the added twist that you can add a picture of a 'friend' as the face of your opponent and has been developed in Symbian S60. The game requires a mobile phone with a camera and you take a picture following the simple menu instructions. The game is played in rounds which you win by scoring a punch before your opponent. The punches are made by hitting the key number highlighted on the screen as quickly as possible. If you're fast enough you hit your opponent but if your reactions are too slow they hit you. The game speed increases between rounds and if you reach the high-score it is preserved until your next big fight.



Figure 2 Buddy Bash Splash Screen and Level Screen

### 5.2 Mobslinger

Mobslinger (Clemson et al, 2006) is a game developed in Symbian S60 that enables spontaneous stimulated social interaction between mobile phone users by utilising proximity information from Bluetooth. This innovative game takes the form of a wild west, quick draw, 'shoot-em-up'. Mobslinger runs as a background application on suitable mobile phone which periodically scans for other users in the vicinity who are also running the Mobslinger application. Once detected, a countdown timer is initiated on both phones which alerts the user by sounding an alarm and vibrating the phone. The user then has to 'draw' their mobile and enter the randomly generated number which has appeared on the screen as quickly as possible. The person with the fastest time is the winner and the loser is 'killed', which means their application is locked out from game-play for a set

period of time. The game is playable in a number of different modes that allow different numbers of players and game play. The modes are Quick Draw, Bloodbath, Last Man Standing, and Outlaws.



Figure 3 Mobslinger Splash Screen and 'Draw' Screen

### 5.3 PAC-LAN

[PAC-LAN](#) (Rashid et al, 2006a) is a mobile location based game (Rashid et al, 2006b) based on the Namco arcade game Pacman in which human players play the game on a maze based around the Alexandra Park at Lancaster University. One player who takes the role of the PAC-LAN character collects game pills (using a Nokia 5140 mobile phone equipped with RFID reader shell), which are in the form of yellow plastic discs fitted with stick-on RFID tags placed around the maze. Four other players take the role of the 'Ghosts' who attempt to hunt down the PAC-LAN player. The game uses a J2ME application, running on the mobile phone is connected to a central server using a GPRS connection. The server relays to the PAC-LAN character his/her current position along with position of all ghosts based on the pills collected. The game pills are used by the Ghosts, not to gain points, but to obtain the PAC-LAN characters last known position and to reset their kill timer which must be enabled to allow them to kill PAC-LAN. The Ghosts can 'kill' the PAC-LAN character by detecting him/her via an RFID tag fitted on their costume. Once PAC-LAN is killed the game is over and the points for the game are calculated in the form of game pills collected and time taken to do so. When PAC-LAN eats one of the red power pills he/she is then able to kill the Ghosts. 'Dead' ghosts must return to the central point of the game maze where they can be reactivated into the game.



Figure 4 PAC-LAN Trials Image and Screen Shots from PAC-LAN Phone Client

### 5.4 m-footy

[mfooty](#) (rashid et al, 2004) is a mobile application developed in Symbian, Brew, J2ME, and Flash Lite that allows users to follow the results of soccer matches as they progress throughout the match-time. Updates on goals and scorers, and other relevant match events are pushed to the phone via GPRS keeping users informed on the match progress. Additionally, users can participate in a real-time fantasy football game, managing their own team of players, and making substitutions from their chosen squad of players during the match day. Further versions have been developed for Cricket, Baseball, and Tennis, and versions can be created for virtually any sport.



Figure 5 Screenshots for J2ME Version of m-footy

### 5.5 TxT Book

The [TxT Book](#) is a novel multiplayer mobile game based on the surrealist technique of 'Exquisite Corpses' (Bamford et al, 2006) and the old Victorian parlour game of 'Consequences'. The game builds to produce a massively multi-authored book. New players are invited to contribute to the game by sending a text message with a link to the game as shown in the figure below. Each player takes a turn writing a contribution to the book based upon only the last 160 characters entered as also shown. The game is easily passed from player to player as no software is required to be installed on the phone as it is based on WAP pages.

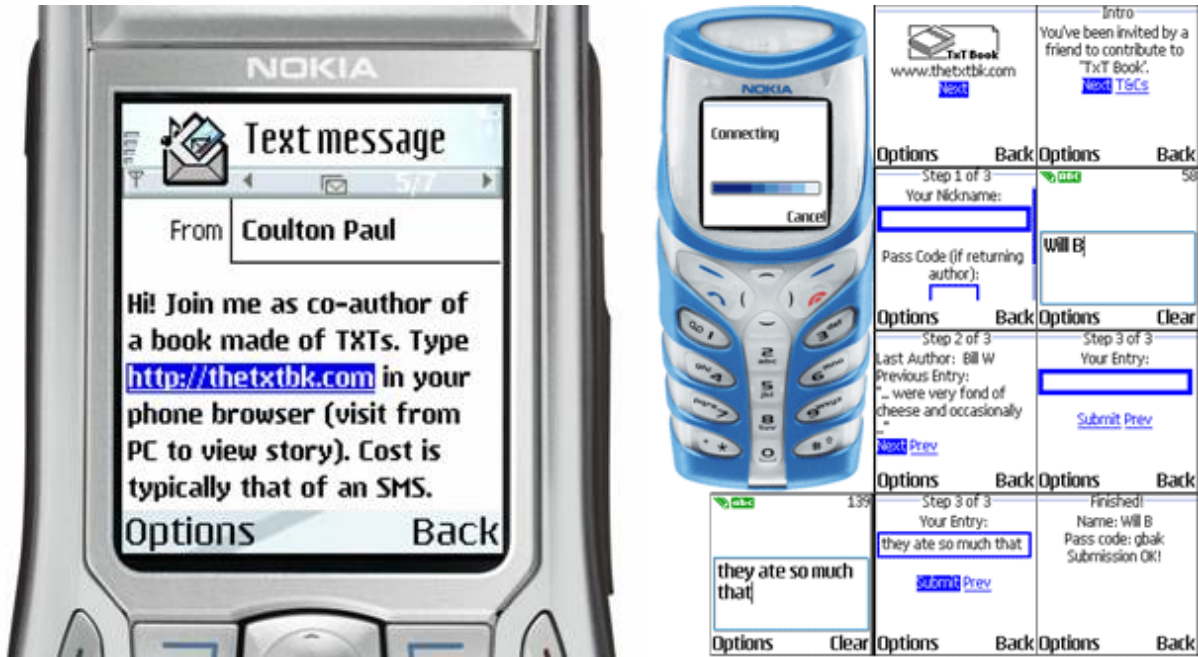


Figure 6 Text Invitation with Book Link and WAP Update Procedure

We have added other elements to the game to increase both the sense of community and a competitive element for hardcore gamers. In particular, the website offers both the ability to make an entry and also gives larger snippets of the book to allow people to identify with the larger community of authors. There is also a list of contributing players and the number of entries they have made. We felt this was analogous to the high score tables which are often used to address the competitive desire of hardcore gamers and encourage greater levels of participation in games.

**T&T Book**

Welcome to T&T Book, an open, collaborative story book with a difference. Each author can only contribute a maximum of 160 characters (standard SMS length) to the book at a time and they may only see the last entry before considering their own. Have fun!

Home	Search <input type="text"/>	No. of Authors	Total Words
Participate		53	7073
Author Rank			Words/entry
FAQ			25.44

By

**Random passage from the book** | [refresh](#) | [show all entries](#)

... Papa New Guinea. He had a package that he had stowed there and needed to retrieve it. The package consisted of an electric saxophone and a large assortment of Right Said Fred LPs (well, three actually). As he was broke, he intended to reach Papa New Guinea using a raft that he'd made out of old sponge cake! Not the best material to use, but he thought if he got hungry along the way he could always take a quick nibble . He passed the long months at sea by blasting out funky riffs on his bass, and it was during this time he wrote and recorded his first album called the "Best Funk Album in the World ... Ever! Volume I". This title was rather presumptuous and contradictory, nevertheless he went on to produce five more albums before he lost a hand in a tram accident. After this he vowed to further research into robotic hands and so he embarked upon a quest towards Japan where robotic gizmos are in no short supply. He was too tired to look properly so he used an Aibo as his new hand which, in hindsight, he realised was a huge mistake. A small robotic dog makes a poor hand substitute. Still, at least he still had his pet

Figure 7 Website for Book

## 6 Conclusions

In this paper we have described an infrastructure that has been created to encourage the teaching not just of computer science and engineering skills but those of innovation and entrepreneurship and to bridge the transfer of knowledge from academia into industry. We have addressed the emerging market of mobile applications to educate students in the skills needed to create applications in a mobile environment. Furthermore, we have extended the traditional engineering concept of Design, Build, and Test to embrace the skills needed to innovate and sell, namely to Design, Protect, Build, Test, Market, and Sell. Students are provided with the key business skills required to manage a business and the tools to create innovative applications, reinforced by the expectation that student applications will be tested against industry standards, through standard quality assurance programmes, and their applications taken to the market place within a structure that is mutually beneficial financially. We have described a subset of applications currently under production by our students that demonstrates the innovation possible given such a supportive environment. Finally, we would say that while this innovative approach is particularly well suited to mobile applications development we believe it could be successfully applied to a wide range of technology sectors.

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## Biographies



Reuben Edwards is Lecturer in Management Information Systems and M-Commerce and has been at the forefront of innovative multimedia application development for over ten years and is renowned for his extensive knowledge of development environments across all platforms. He has also pioneered the use of many platforms in technology education and produced many cutting edge courses.



Paul Coulton is a Senior Lecturer in Mobile Systems and Applications and was one of fifty developers worldwide, selected from a community of two million, to be a Forum Nokia Champion. He has over 10 years' research and development experience in mobile systems and applications and has published extensively in this area. The main focus of his current research surrounds socio-technical interaction with innovative mobile entertainment applications.