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## The Abertay Code Bar – Unlocking Access to University-Generated Computer Games Intellectual Property

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**Abstract:** Progress report on a digital platform and dual licensing model developed to unlock access to a University repository of new and legacy computer games based Intellectual Property (IP) assets for educational and commercial use. The digital creative industries have been identified by a number of governments as a priority area in delivering sustainable economic growth. Code Bar is an innovation that allows digital products to be commercially successful beyond the end of the Dare competition or coursework submission. To be selected for Code Bar, game products must be well designed for both player and market; technically robust (i.e. operating consistently and reliably on a single/multiple platforms), and be free from ambiguity around 3<sup>rd</sup> party IP. We describe various technical, pedagogic and legal challenges in developing the digital platform, licensing model and packaging of computer games products for release through the platform. The model is extendable beyond computer games to other software products.

**Keywords:** computer games; digital economy; intellectual property; knowledge exchange; open-access; open-innovation; licensing models.

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## 1. Introduction

Progression from traditional mass production to post-industrial, knowledge-driven economies has been accompanied by changes in Governmental expectations of the performance of Universities and their contributions to national economic growth. Higher Education Institutions (HEIs) came to be viewed as national strategic economic assets, with demands that they strengthen links with industry and enhance and accelerate the transfer of academic research advances to industry. (David et al: 2006)

Successive models of University business engagement from the early, segmented Linear (Bush; 1945) to the more catholic and interconnected Mode 2, (Gibbons: 1994) Triple Helix (Etkowitz & Leytesdorff: 1997) and Third Mode (Youtie & Shapira: 2008) paradigms) share a common thread, namely, the notion that universities support innovation in industry primarily through the production of deliverables for commercialisation. Indeed, even today, much of the focus on the strategic role of Universities in promoting economic growth remains focussed on the commercialisation of research through patents, licenses and spin-outs. However, in their survey, Hughes and Kitson 2012, (Hughes & Kitson: 2012) showed that direct commercialisation pathways are in the distinct minority of all academic interactions with external organisations. Instead, the most ubiquitous forms of interaction with external organisations involved problem-solving and people-based activities. Similarly, (Perkmann et al: 2013) showed that university income from relationship-based activities is usually a high multiple of the income derived from Intellectual Property (IP); and that a significant proportion of academics pursue academic engagement without conducting commercialisation.

In other words, notwithstanding the focus of government policy interventions on the creation and public dissemination of tangible IP Rights by universities as a means of driving improved national economic competitiveness, the evidence suggests that this may be an overly narrow perspective on University-business links, which are inherently more multi-faceted in nature. Perkmann and Walshe's study (Perkman & Walshe: 2013) suggested that the contribution of university-generated knowledge is not limited to novel inventions and radical innovations, but is also relevant for the latter stages of the innovation cycle, since firms value their relationships with Universities over the whole innovation cycle and not just for the initial supply of inventions. The number of patents, licenses and companies created at universities and public research institutions have dropped since the late 2000's, most likely as a consequence of tighter available knowledge exchange budgets and the greater awareness and focus on the more diverse range of channels for University-business engagement. However, it should be noted that this patenting trend contrasts with broader global trends in patenting activity, where 2012 showed the largest growth in the number of patent applications filed worldwide over the last 18 years. (WIPO: 2013)

There are also disciplinary differences in the intensity of transfer and commercialisation channels used. In particular, Bekkers and Freitas (2008) found that patents, licensing and contract research were the most important channels for R&D intensive sectors (e.g. biomedical and chemical engineering; and material sciences). However, in the social sciences and humanities, patenting was less significant, and personal contacts were more important. Indeed, Hughes et al (2012) found that academics from the Arts and Humanities are less likely to have taken out a patent, license research outputs, formed a business or formed a spin-out or consultancy than other disciplinary groups. However, this observation is not merely an expression of an

academic disciplinary bias. Indeed, it is also a reflection of the distinct natures of the different forms of Intellectual Property. In particular, patents are intended to protect technical inventions (HTC: 2013) rather than literary, dramatic, musical or artistic works which are protectable through copyright. (CDPA 1988)

Nonetheless, the concentration of policy discourse on patenting and licensing, and product/process innovation effectively obscures the significant contributions made by the Arts and Humanities to society and the economy. (Stoneman: 2010) The Brighton Fuse Report notes that while the arts and humanities enhance our culture and quality of life, they also support an innovative, dynamic service economy. (Sapsed et al: 2013) Hughes and Kitson also noted a significant diversity within the Arts and Humanities communities, with the Creative Arts and Media groups being the most highly connected to external organisations and involved in private sector commercial transactions; and displaying connection characteristics as rich as other disciplines with considerable private sector and commercial interactions. Particularly rich seams of new innovations are emerging from University-industry collaborations embracing multidisciplinary combinations of technology, design and engineering (AISBL: 2012). The Brighton Fuse report notes that connecting the arts, humanities and design with creative digital and IT skills enhances business, creativity and growth; with firms that fuse creative arts and design with technology demonstrating faster average and median growth rates. It was also found that more innovative firms are more likely to generate income from royalties or technology licenses. Thus, notwithstanding the traditional focus of University commercialisation activities on licensing patentable technologies, there is considerable scope for licensing digital technologies employing blends of patent and copyright Intellectual Property Rights. However, it should be noted there are particular Intellectual Property challenges in relation to the licensing of digital creative works as noted in the Hargreaves review. (2011)

With the evolution in University-business engagement paradigms, from contract-based research to Open Innovation co-operation models (Guigan: 2013, Gonzalo: 2013), there have been increased calls for the establishment of boundary-spanning capability and intelligent brokering to support innovation. (Wilson: 2012) The structural innovation (Howells: 2011) needed to deliver on this ambition, involves new, innovative forms of institutional governance and configurational relationships within an innovation system, and include new institutional frameworks, including for example, the formation of new Intellectual Property Rights regimes and routines or new mechanisms and practices associated with knowledge transfer and exchange. However, it should be noted that because most of the literature on Open Innovation focusses on the identification of external partners who have already developed an innovation and mechanisms for gaining access to this innovation, there is little known about how organizations engaged in Open Innovation govern their relationship for innovation development through contracts; and, more specifically, the contractual and governance features that contribute to the success of Open Innovation initiatives. (Casper & Miozzo: 2013)

Nonetheless, innovation models continue to evolve at pace. Mass collaboration enabled by the ubiquitous availability of high-speed, high capacity digital communications networks, systems, tools and services, connected by the Internet (Linton & Schuschhard: 2009) has led to emergence of participative innovation as expressed in the Open Innovation 2.0 paradigm. Whereas Open Innovation was premised on externally focussed innovation, Open Innovation 2.0 is based on extensive networking and co-creative collaboration between all actors in society, spanning organizational

boundaries well beyond normal licensing and collaboration schemes. (Curley & Selmalin: 2013) Digital platforms invite many sorts of individuals to join in networks that explore and exploit new entrepreneurial opportunities. Unlike industrial technologies that require extensive capital to acquire, users can more readily access digital technology platforms should they have the motivation and incentives to do so. Consequently, digital platforms have the potential to democratize digital innovation. (Yoo et al: 2010) Indeed, studies (Boudreau: 2012) have shown that varying the number of application software producers availing of a digital platform does not simply increase or decrease the innovation level. On the contrary, it qualitatively transforms the nature and sources of innovation, leading to greater variety. In particular, it was found that increasing the number of application producers reduced incentives of producers of similar applications within the same software genre, whereas adding producers of different kinds of software increased innovation incentives.

The UK creative industries employed 1.35M people (4.7% of the UK workforce) in 2011 and contributed £69.9 billion to the UK economy (accounting for 5.3% UK GVA in 2010). Its workforce grew at four times the speed of the UK economy overall between 2004 and 2010. (Bakhshi et al: 2013) Within the creative industries, the UK video games industry is the largest in Europe (TIGA: 2013). The global market for video games is estimated to grow at a CAGR of 6.5% to reach US\$86.9bn in 2017, up from US\$63.4bn in 2012 (PWC: 2013). Recognizing this, the UKTI's 'Britain Open for Business—Growth through International Trade and Investment' (UKTI: 2011) report identifies the creative industries as one of a number of priority sectors to rebalance the economy. Scotland is ranked third in Europe's top 50 games developer locations and half of the Scottish games firms are based in Dundee. The cluster of interconnected computer games developers, suppliers and related businesses, coupled with their historical close relationship with the University of Abertay Dundee, and culture of innovation forms the basis for a localised innovation ecosystem (Mercan & Göktaş: 2011) with the University at its heart. Nonetheless, NESTA notes that the UK's strengths are mostly around the creation and supply of goods, content and services, rather than in their distribution or the development of platforms and devices.

This submission describes a case study in structural innovation to unlock access to a University repository of new and legacy student-generated computer games based Intellectual Property (IP) assets and deliver a digital platform for publicly disseminating computer games projects for educational and commercial use. There are relatively few examples of open source digital IP models for computer games. In one such example, Facebook partnered with MIT, Stanford University, University of Waterloo, Carnegie Mellon, University of California, Los Angeles, and many other colleges to pair up computer science students with open source projects that need help — for academic credit. Facebook reported *"We believe that contributing to open source projects is one of the best ways a student can prepare for a job in the industry."* (Facebook: 2013) In another example, MIT while not teaching a formal computer games course provides support through the Game Lab MIT, for any of their students looking to explore a creative gaming project. The Game Lab website includes different games that make use of open source code projects to aid development. The initiative is an academic-centric environment that has strong links with industry as referenced by a quote from an interview by Chris Kohler with Prof. Henry Jenkins. *"...a space where we can move swiftly from pure research into compelling applications and then partner with the games industry to bring the best ideas to market."* (Kohler: 2014)

In the approach MIT took with Game Lab, they have developed a number of research-based games and development tools that they disseminate on their website in order to position the institute as a world leader in the field of games development research. A prominent project that Game Lab has released is physics engine called 'Open Relativity' open source for the games development community. To demonstrate the technology a game was developed utilising this engine called 'A Slower Speed of Light'. Both of these releases have drawn a significant audience "*the game's video trailer alone has been watched more than 625,000 times on YouTube*" (Kortemeyer: 2013) to the Game Lab platform and they have embraced the open source community to allow members of GitHub to iterate the project in their own desired direction. As Game Lab is a research-focussed initiative the platform provides an interesting dynamic for the possibilities of an open source Code Bar as Kortemeyer continues, "*The game's success lends credibility to the idea that producing free, easy-to-play games may provide a viable alternative method to disseminating scientific research to the public.*" (ibid)

Another example is Panda 3D, a game engine originally developed by Disney's Virtual Reality department made available on an open source basis. Carnegie Mellon University took the lead in advancing the project; and it has since been used in a number of commercially released games over the years. Panda 3D is an example of an open source game engine being utilised in industry projects and as Quinn explains "*...it has all the benefits and downsides of open source: you can use it and beat on it as you wish but the support is eclectic.*" (Quinn: 2005) It is significant that the developer choose an open source tool such as Panda 3D for a new project - aside from just looking at what the code can do, adequate support and documentation are essential factors. If these are not at the desired level the decision to go with an open source solution may be cost-effective up-front but potentially costly further down the line when the development team are trying to hit deadlines and cannot overcome a major technical issue with the software.

## 2. Academic Context

The University of Abertay Dundee (Abertay) is internationally recognized for advanced education in the area of computer games development; and is home to the UK's pre-eminent games design and development competition "Dare to be Digital". Abertay University offers a unique opportunity for students to collaborate in multidisciplinary teams on group development projects, with the support of academic and professional games expertise in a dedicated collaborative development studio. This offer, pioneered in Abertay's White Space, is widely recognised as a model of best practice for contextual and experiential skills and knowledge acquisition both by Higher Education, (CIHE: 2010) and the computer games industry. (Livingstone & Hope: 2011) The School of Arts, Media and Computer Games at Abertay (SAMG) was established in 2009 to coincide with its designation as the National Centre for Excellence in Computer Games Education by the Scottish Funding Council in 2009. Uniquely in the higher education sector the School was created, and has evolved, as a multidisciplinary unit. The School brings together academic expertise in computer science, engineering, mathematics, art, design and music with professional digital media production expertise in dedicated studio accommodation designed to support group working and workplace simulation in a knowledge rich 'community of practice'. (Wenger: 2000)

Highlighted by the Council for Industry and Higher Education as "*directly responsible for the rise of the games and interactive media industry in Dundee*" (CIHE:

2010) SAMG has developed a highly productive environment for the education and development of new talent for the video games industry. Dare to be Digital is an example of a highly effective way of engaging with employers in the sector to shape the nature and content of the program in line with current trends and technologies. In line with the CIHE report on Higher Education SME Interaction Dare recognizes that “*employer involvement in course design and delivery should be given far higher status than may sometimes be the case*”. (Forbes et al: 2012)

Recognizing the contribution that SAMG has made to the ongoing health of the games cluster in Dundee CIHE goes on to identify the extended community of practice model in the School and Dare to be Digital.

*The university’s research-informed, multidisciplinary, studio-based workplace simulation, with industrial mentoring based on their international ‘Dare to be Digital’ competition is the basis of all its courses, including an industry-led Masters in Professional Practices. The accreditation process led by Skillset and with broad industry support recognizes the value of this simulation in creating work-ready graduates.”* (CIHE, 2010)

Over the 15 years of the competition the nature of employment in the sector as well as the graduate skillset needed to sustain a career has changed in line with changes in technology or markets. The recent emergence of new mobile technologies and tablet computing, self-publishing platforms and the accompanying online retail models has seen a growth in small independent development studios creating original IP. The resulting shift in emphasis in graduate profiles from deep expertise for highly specific roles in large studios to additional demand for professional skills and entrepreneurship has been enabled through close discussion and involvement with the industry across program design and delivery.

The *community of practice* is fundamental to the pedagogical and philosophical approach in the School and permeates the student experience, and the experience of the broad constituency of academic, industrial, agency and governmental stakeholders who co-habit the learning space. Participants in the community, individually and collectively contribute to the learning opportunities in the environment. The role of the academic in this space is to manipulate these constituent elements and resources in order to customize learning to different stages of development and learning objectives. The quality of the learner experience is assured through a process of internal quality assurance and external accreditation, in particular, Creative Skillset is the UK Sector Skills Council for Creative Media, their computer games accreditation scheme covers five programs in Abertay. “*Creative Skillset’s course accreditation scheme, devised in consultation with industry and education providers, recognizes courses within the UK that provide exceptional standards of training*”. (creativeskillset.org: 2014)

As an example of this mode of learning, and as a non-credit bearing programme, participation in Dare to be Digital is an ideal opportunity for students to focus on commercialisation opportunities and potential for teams to continue to grow into start-up enterprises, and for industry and support agencies to contribute significantly to the student experience. Applying as a team with a game ‘pitch’ the teams are shortlisted, selected and interviewed by panels of industry professionals before the successful applicants arrive in Dundee in July to start working on their development project. From this point

on the teams are encouraged to think of themselves as a fledgling company. This shift in mind-set, from student to fledgling developer, prepares the students for 13 weeks of intensive games development where they will face the challenge of developing a prototype game working closely with four other team mates with whom they must communicate and negotiate if they are to succeed. They must do this under the scrutiny of the industry professionals who mentor them through the experience. Professional skills and knowledge as well as technical skills are essential for entry into the games industry. Alongside communication and negotiation across disciplines, highly valued professional skills include autonomous and collaborative problem solving, software independence and the ability to learn “...*hybrid skills – technical, business, creative, interpersonal. These are vital prerequisite of monetising content and services for always-on platforms.*” (CIHE: 2010). These skills and knowledge combinations are the primary aim of talent development in both the academic and competitive environment. However, despite the successes of Dare to be Digital and Abertay’s computer games degree courses, one of the frustrations for the students has been in bringing the computer games projects to market. Indeed, with over 100 games created throughout Dare to be Digital’s 11 year history only 2 games have been released to market.

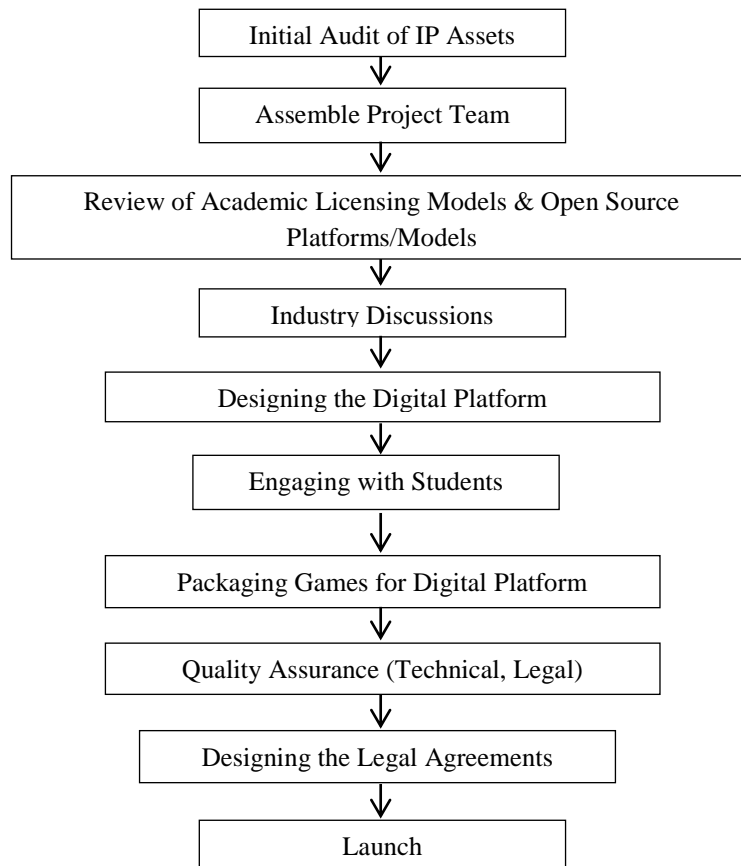
### **3. The Code Bar Project**

The primary goal of the Code Bar project was to bring the University’s computer games IP assets into the public domain, rather than allowing the games to languish in obscurity. Consequently, when fully deployed, the project would showcase the talent which Abertay supports within the computer games development sector, whilst providing an educational knowledge base for games students and hobbyist developers around the world. Any opportunities Code Bar could provide for commercialising the computer games assets would be a welcome addition, but was not the primary focus of the project. In designing Code Bar, we chose to look beyond the short-term perspective of directly generating licence revenue. Instead, the project is predicated on a longer term view, recognizing that enhancing Abertay’s reputation to the wider community should eventually lead to more revenue being brought into the university through other channels such as increased student recruitment and attracting new research partners.

#### *3(a) Project Design*

The Code Bar project was delivered over a period of approximately 12 months, in a collaboration between the School of Arts, Media and Computer Games at Abertay (SAMG) and the University’s Research, Enterprise and Innovation Service (REIS). For point of comparison, it should be noted that while the time required to commercially develop a new computer game varies markedly depending on the complexity of the game, platform and the team size (e.g. simple mobile games have been known to be developed in under a week and some high-end console/online games have taken 5+ years), most games typically require 10-12 months for development.

The Code Bar project comprised a number of logically connected but discrete phases as shown in Figure 1 below. For ease of understanding, these phases are shown in sequence; and are described separately below. However, the reader will understand that at many different points during the project, a number of these phases were ongoing simultaneously as different members of the project team worked in parallel on specific topics relevant to their particular professional specialisms.



**Figure 1** Code Bar Project Phases

*Phase 1: Initial Audit of IP Assets*

An initial audit of archived Dare to be Digital computer games projects was funded by Scottish Enterprise. The initial audit revealed a number of innovative and high quality projects. Unfortunately, the source code of computer games projects was not collected from student teams prior to the 2012 Dare to be Digital competition. This omission resulted in a process-based decoupling of the intangible IP rights residing in a software work from its physical manifestation (in source or object code). This presented a first obstacle for the project because in the absence of available source code, there was no tangible vehicle for the public dissemination of IP in relevant computer games works. Nonetheless, the initial audit provided other very valuable information including a shortlist of games for further investigation, contact details of relevant team-members and a general familiarity of the University's archive of games, their design and corresponding platforms therefor.



### *Phase 2: Assembly of Project Team*

Following Galbraith's dictum (1999) that "innovation is not an individual phenomenon"... "It takes different people in different roles working together to be successful", a multidisciplinary team comprising a video games industry expert, a video games specialist academic, a legal professional and an IP professional, was formed to take the Code Bar project forward. This and subsequent phases of the Code Bar project were kindly funded by the UK Intellectual Property Office through the Fast Forward Competition (<http://www.ipo.gov.uk/whyuse/research/fastforward.htm>).

### *Phase 3: Review of Academic IP Dissemination Platforms and Open Source Platforms and Models*

The introduction discussed a number of digital platforms developed in industry/academic partnerships for the delivery of computer games products. However, these were not necessarily representative of digital platforms developed by Universities themselves for the dissemination of their IP assets. Furthermore, initial conversations amongst team-members suggested an open source dissemination model. Thus, in considering the most appropriate IP regimes and mechanisms for the delivery of Abertay's student-generated computer-games related products, our first step was to investigate existing academic IP dissemination platforms, most notably:

- academic licensing models (e.g. Easy-Access IP);
- open source platforms for source code and asset hosting (e.g. GitHub); and
- open source games development models (e.g. Freeciv).

#### *Phase 3(a) Review of Academic Licensing Models*

The project team reviewed a number of existing academic licensing models and open-source asset hosting platforms in order to identify an appropriate technical and licencing framework that lowered the barriers to accessing IP and encouraged investment while protecting the rights of the IP holders and managing risk to all parties. In particular, Easy Access IP developed by Glasgow University, Click-thru at Edinburgh University and open services GitHub and Freeciv.

#### *Easy Access IP*

Easy Access IP was established by Glasgow University using Fast Forward Funding from the 2011 competition and is a system which forgoes any immediate licensing costs to allow the IP to be utilised by a 3rd party in an efficient and effective manner. This allows SME research outcomes to be realised more quickly, allowing evaluation without pressure of an initial license payment; instead, a royalty share of any revenue may be required further down the line.

On investigation, it appeared that the Easy Access IP initiative wasn't as restraint-free as first thought, especially for today's digital SME's who are used to accepting terms, downloading and being able to utilise the content in their project immediately. For Easy Access IP SME's have to firstly contact the University IP holders to make a case that they are a company of suitable reputation capable of taking the IP forward, stating intent and also agreeing to a future licensing fee or royalty rate. There are claw-back clauses if the technology is not progressed in the proper manner by the SME within the set timescales.

It seems that the main convenience is with the Easy Access IP agreements themselves where they are viewable by both parties up front and short form - designed to speed up the contractual process, however for digital SMEs in particular this provides no real advantage unless the content can be accessed readily. These unworkable timescales for digital SME's can be outlined by a quote from an Easy Access IP project promoting the efficiency of the process "*The deal between Glasgow and Boulder Nonlinear Systems was completed within eight weeks of the initial discussion*". (University of Glasgow: 2013).

For a traditional university technology-transfer licensing process this is an efficient duration but not for the digital creators of today. Immediate access is what is required as having any administrative hurdle/duration would be off-putting to most fast-moving digital businesses. The requirement is for the digital SME to be able to get 'hands-on' with the technology immediately to see if it will be of any use to their business even before they would think about the potential licensing terms that would be required to utilize commercially.

### *Click-thru*

Edinburgh Research and Innovation established the click-thru licensing model as an online shopping cart where businesses can register, agree to licensing terms, pay a fee and then be physically sent the software, bio-research or training materials that the platform offers. Whilst the process sounds simple it is not entirely automated by the ERI website and there are a number of stumbling blocks, namely: there is no downloadable trial basis for the software projects prior to purchase;

- there has to be an email exchange with the prospective licensee before the licensing of IP and payments are agreed;
- payment is not handled online; and
- the majority of the IP is not available for download but instead sent to the licensee on disc.

### *Phase 3(b) Review of Open Source Platforms/Models*

One of the factors in considering whether to adopt a fully open-source dissemination model was the availability of ready-built open-source platforms on which the University could host their games-related projects. Using these platforms would obviate the necessity of designing our own bespoke digital platform. Furthermore, the games-related projects would be exposed to a wide audience of potential users through the open-source community. Similarly, the platforms would support the creation of potential derivative works, be allowing users to check-in and check-out relevant source code. Thus, as part of the project plan, we investigated the suitability of some of the main open-source platforms.

### *GitHub*

GitHub is a web-based hosting service for software development projects that use the Git revision control system. GitHub offers paid plans for private repositories, and free accounts for open source projects. As of December 2013 GitHub announced that 10 million repositories (see Figure 2) had been created since 2008. (Doll: 2013) GitHub's

success provides a clear indication of the importance of cloud-hosted solutions for digital developers and also the growing power of open source initiatives.

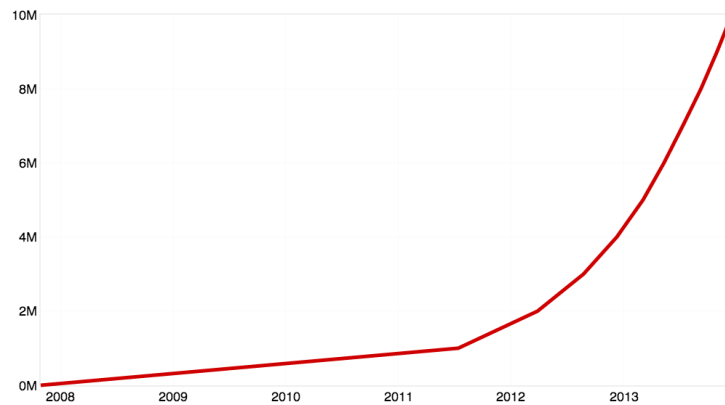


Figure 2- Year on Year Growth in Number of Repositories Created by GitHub Users (Doll: 2013)

### *Freeciv*

Freeciv is a free and open source turn-based strategy game for PC, HTML5 and Android inspired by Sid Meier's popular Civilization game series. Developed and released originally by student developers at Aarhus University in 1996 Freeciv was maintained by an engaged coding community who fixed bugs, added features and ported the game to other platforms. The successful open source community built around the game demonstrates a willingness from the different contributors that has continued the game's development to the present day all without any desire or requirement of commercial gain. The Code Bar project has and can continue to draw key learnings from this project both in the possibility of the development of student projects being progressed by a wider community, independently of the original creators and also the importance of engaging a community with a game that is clearly fun to play (PC Gamer: 2013) and to work on collaboratively.

### *Phase 4: Industry Discussions*

As part of the design of the Code Bar, the project sought the opinion of games professionals in leadership roles in thirteen games development studios who have contributed their expertise to understanding the barriers that have limited the commercialisation of Dare IP in the past. In their opinion games on the Code Bar should demonstrate market awareness and appropriate platform adoption. Monetisation strategies are now so dominant in the social/casual market that they must be designed into the gameplay itself, to ensure that the game offers opportunities for sustained engagement and consequently sustained purchasing. Alternatively, content can be developed to operate over a range of devices. The business model in this case might be to grow the product virally through ubiquitous exposure, in the hope that growth on a number platforms will result in profitability. In this case the game must operate functionally across a range of platforms. Comments collected from games industry stakeholders also

highlight the importance of functional robustness. Describing the problems of working with student-generated content a CTO of SME Games Technology and Development Studio told Code Bar,

*“In lacking release-quality polish...these projects are difficult to publish as they haven't been developed to any set coding standards, and don't contain enough levels for example. Sometimes they may have the wrong control mechanisms, art style or targeted for the wrong platform”.*

In order to ensure that students succeed in achieving robust functionality, platform providers and hardware manufacturers work with students in the School and participants in Dare to be Digital to ensure that the latest technologies are available and development processes are understood. Companies such as Adobe, Intel, Microsoft, Samsung, Sony Computer Entertainment and Wacom all contribute expertise and technology to ensure the robustness of the product. Professional expertise in integration and implementation is supported by the many development studios that contribute time and energy to the project. The survey revealed that games developers wanted to,

- quickly download and experiment with source code of a computer game in an open-source fashion to enable them to evaluate the game; and
- secure exclusive commercial rights for a computer game in the event they were interested in finishing and releasing the computer game project themselves.

In addition, the survey participants expressed particular concerns that Abertay would not be in a position to guarantee that all of the IP within a given computer games project was created completely by the student creators. To address this issue, the Code Bar project employs a rigorous legal quality assurance step (as discussed below). Similarly, there were some concerns about the legal ownership status of student-generated IP (JISC, 2007), and whether Abertay had the right to make the computer games projects available to the public.

#### *Phase 5: Designing the Digital Platform*

The Code Bar digital platform was designed as a self-contained module embedded within the University's corporate website. Consequently, it was important to maintain consistency between the look and feel of the Code Bar platform and the rest of the corporate website. Code Bar was designed as a minimal maintenance platform, which is entirely automated so that approved members of staff can follow a set of guidelines and add IP to the platform without having to request the assistance of University Information Services. In view of the large size of computer games related software files, in the interests of avoiding putting too much strain on the existing University IT infrastructure, a dedicated server was purchased to host the Code Bar computer games projects.

While the inclusion of a registration system would have allowed Abertay to identify parties using the provided computer-games related IP (and would have helped the connected license system embedded in the Code Bar agreements), registration presents a barrier for entry of potential users. The inclusion of a registration facility also adds to the technical complexity of a digital platform and creates potential privacy issues by way of the UK Data Protection Act 2013. Thus, in the Code Bar system, the only registration needed to gain access to the source files of a project is a valid email address, to which the

University sends an email including a link and password for the Code Bar archive. The provided email address is collected by the Code Bar email account, thereby allowing basic monitoring of the type and number of users accessing and downloading material from the archives for evaluation purposes.

Reflecting the desire articulated during the industry interviews for the ability to secure exclusive commercial rights for an attractive computer game project, a mailing list facility was established into which users could place a bid to secure the commercial rights including the figure they were offering to pay for the project. In particular, once a bid was received for a project (minimum of £5,000) there would then be a two-week window for further bids until the project would be sold - the bidding companies' details would remain anonymous.

#### *Phase 6: Engaging with Students*

Understanding the complex contractual, license and intellectual property environment of computer games development and their role in protecting the commercial rights holders in the commercial environment is an example of 'collateral learning' (Lee et al: 2008, Jegede: 1999) where knowledge is acquired because it is necessary for the completion of goals. This is an example of an environmental learning event that can be insinuated into the learning environment through access to expertise in the community of practice. As an overall pedagogical approach the 'community of practice' best describes the way the School of Arts, Media and Computer Games at Abertay works to integrate the broad range of domain expertise necessary for the design and development of computer games while addressing the concerns of the industry and assuring that the games on the Code Bar are well design and developed, market and platform appropriate and functionally and legally robust.

To complete the legal arrangements, and address concerns voiced by survey participants regarding the legal status of student-created IP, agreements were developed to enable students to assign their IP to the University, thereby allowing the University to make the student-created computer games publicly available under the Code Bar twin-track licensing approach (discussed below).

In keeping with the "community of practice" pedagogic model, it was clear from the outset, that securing the buy-in and co-operation of academics and students was essential to ensure a continued pipeline of new computer games ideas. We actively engaged in discussions with students and academics to explain the Code Bar project, the rationale behind the IP assignments and twin-track licensing model (discussed below). As part of this, we provided that income generated from the Code Bar commercial licenses would be shared with the students on a 60:40 basis in the favour of the student creators. However, balanced against this, it was important to explain to students that since there was no guarantee commercial rights would be bought by users, there might not be direct revenue coming to the students (because the computer games assets would otherwise be made available on evaluation licence). However, since the works on the Code Bar platform would include explicit attribution to the student creators, and the Code Bar platform would include links to student profiles on social networking sites like LinkedIn, there were other benefits to the student creators of being a part of the project, because Code Bar would act as a vehicle for publicising the students' work to potential employers. To support the QA (legal) process discussed below, it was also stressed to students, the

importance of taking a note of all 3rd party tools and materials they used within their game projects.

#### *Phase 7: Packaging Games for the Digital Platform*

In view of public sensitivities about the depiction of violence (Ferguson: 2008) and sexuality (Meli:2012) in video games, there were concerns that the University's reputation should not be damaged through the public dissemination of offensive computer-games content. To minimise the risk of reputational damage, computer games projects were screened to remove from consideration, games whose content was more likely to be problematic (e.g. 1st person shooters and 18+ games). The next stage in the selection process was identifying those computer games projects whose creators were agreeable to allowing their game to appear on the Code Bar platform. Finally, the selected computer games were assessed to determine whether their game codebase and assets were of suitable quality. Applying these criteria to an initial set of 35 candidate computer game projects, revealed 7 that were viable for the Code Bar Platform:

#### *Phase 8: Quality Assurance*

##### *Phase 8(a) Quality Assurance: Technical*

Since the inception of Abertay's game development course and the Dare to be Digital competition, students at Abertay have been renowned for creating a wide-ranging array of original and exciting game projects; this has been mainly down to the creative freedom they have been provided in terms of platform and tools. However in terms of trying to build a process that would continually supply the Code Bar with new projects this diversity means that no two projects are the same regarding coding structure, language, SDK, asset management and binary creation. Before being able to release (and potentially sell) a Code Bar project each game project needs to be built and run to provide a degree of comfort that all of the required tools and assets are present and that the game is relatively bug-free. The multi-platform/coding language diversification makes this verification process difficult and time consuming. This rings especially true in legacy projects from past students as it is likely that some of the libraries and tools that were used would be out of date meaning that the game won't be able to be properly verified. An industry (McGrath: 2011) example of this can be found in the difficulties of porting older Playstation One games to their newer consoles where the code isn't compatible and they don't have access to the original development teams – it can therefore take SCEE several months, if able to at all, to port a game over to a new platform.

The problems mentioned above are mirrored in the legacy projects identified by academics at Vienna University of Technology "...more advanced technology also means that older games cease to run on modern platforms"(Guttenbrunner: 2010). By focusing on new game projects this would no longer be an issue due to games being developed for current platforms also providing up-to-date/relevant game design and context.

Portability of code in general is an important issue to consider when packaging game projects as most modern-day games (and the majority produced at Abertay) utilise a 3<sup>rd</sup> party game engine. It is important to bear in mind however that if the game engine does not allow binary executables for multiple platforms - even if the game has commercial potential in terms of design - if a commercial suitor cannot see a simple development path

to bring the game to their desired platform –as it is “...*notoriously dependent on the game engine.*” (*ibid*) then the project will become an unattractive proposition.

#### *Phase 8(b) Quality Assurance: Legal*

Alongside functionality, the most common concern raised during the market survey related to the potential license and IP infringement or non-disclosure of 3<sup>rd</sup> party IP. Sony highlights the potential legal issues that can arise when trying to release a game based on another companies code. “*In cases like these, permission has to be sought to publish the game or a license has to be renewed and this can take large amounts of time and/or money, or might simply just not be possible.*” (McGrath: 2011)

A wide range of software tools are commonly used in the development of computer games, content creation tools for the creation of visual art or audio assets, middleware such as game engines that are used to compile assets and manage the complex functions and libraries that make up the game. Engines offer a framework for original code and assets that are compiled into the final game, where combined with middleware and 3<sup>rd</sup> party asset libraries, the resulting product can be constituted from a complex mix of original and 3<sup>rd</sup> party IP and End User License Agreements (EULAs). The risk to any company acquiring a game through Code Bar is most likely to come from unacknowledged use of 3<sup>rd</sup> party IP.

*“It would have to be made clear to the students at the beginning of the year that the code and assets have to be 100% their own work or they should make it clear that and 3rd party tools or libraries etc. that they have used within the project.”* (CEO, Games Development Studio, Code Bar Consultation)

Ideally games created in the academic context of the School or competitive context of Dare to be Digital would use 100% original IP. However, this is an unrealistic expectation given the constraint on development time and the quality expectation of stakeholders in the processes. As a precautionary measure, the Code Bar has created guidance for the use of 3<sup>rd</sup> party IP that is made available to all students and participants in Dare. Throughout the development process they are asked to record and declare any use of 3<sup>rd</sup> party material in the design or development of the game and to ensure that they have agreement for its commercial use and/or distribution.

For each of the projects published in the Code Bar, development teams were required to report on use of any third party resources used in this way. The terms of the licence were then reviewed to ascertain any obstacles to redistribution on the platform. The information reviewed is made available through the Code Bar website as part of the supporting information about the game, where there is any doubt or lack of clarity in this information the game will not be uploaded to the site.

As would occur with licensing of a computer game product in a commercial context, the existence of third party material is acknowledged in the legal agreements referred to in the next phase as set out below. From a legal perspective, the key area of risk is the prospect that redistribution of the material might constitute a breach of licence or

infringement of third party rights – e.g. by using unlicensed content or breaching the terms of any existing licence. Analysis was undertaken to assess whether even distribution of the materials in the Code Bar platform itself would constitute infringement and to ensure that any mandatory requirements for redistribution of open source components required as a condition of the relevant licence were met. Beyond this, however, the risk is primarily borne by the party who undertakes commercialisation under the applicable legal agreements.

#### *Phase 9: Designing the Legal Agreements*

##### *Dual licensing models*

To address the requirements identified from the surveyed developers, a two stage approach was devised in which,

- source code from Abertay's back-catalogue of computer game projects is made available through a bespoke evaluation/educational licence which enables users to experiment with the source code and develop their own prototypes; and
- assignments (sale agreements) for the computer games are made available through an online bidding process.

While these licences share certain features with most recognised forms of 'open source' licence, neither can be described as 'open source', in terms of most industry-recognised definitions of that term, including that of the Open Source Initiative (<http://opensource.org/osd>) which was used as a reference point on the project (Shemtov and Walden: 2013) Most importantly, neither licence permits free redistribution of the software. The evaluation licence is intended to permit detailed analysis and experimentation with the code through the creation of derivative works etc. but does not permit redistribution of such works.

The grant of the evaluation licence was consistent with the initial aims of the Code Bar project. However, the exclusion of commercial distribution rights and the requirement for a subsequent purchase of those rights arose through realisation that certain key University and student objectives might not be met if a true open source distribution route was used. While the ability to obtain wider distribution and recognition of innovative, high quality work created by students at the University was possible, open source distribution would achieve this at the expense of any residual commercial potential within the assets which would be detrimental to the University and the students concerned. As such, the two-stage model was decided upon to try and maximise the distribution and availability of the materials on a non-commercial basis while expressly excluding commercialisation rights.

The open evaluation approach employed within the design of the Code Bar platform has the disadvantage of being difficult to monitor and ensure that any code and assets within project archives are not misused in new projects without securing commercial rights thereto. To provide some degree of protection against this problem, digital steganography was used to embed hidden watermarks (with the Abertay copyright notice) within the digital computer games files.

#### *Phase 10: Launch*



The Code Bar platform was launched in April 2013 to significant media acclaim, most notably, the launch received coverage on:

- the Develop website <http://www.develop-online.net/news/code-bar-to-connect-student-devs-with-investors/0114520>
- BBC website: <http://www.bbc.co.uk/news/uk-scotland-tayside-central-22093205>
- TSB \_Connect: <https://connect.innovateuk.org/web/pipeline/article-view/-/blogs/abertay-university-launches-code-bar-connecting-game-design-students-with-commercial-investors->
- The Scotsman; <http://www.scotsman.com/news/education/abertay-launches-linkup-project-for-game-designers-1-2887381>
- Gamasutra: [http://www.gamasutra.com/view/presseleases/190182/Code\\_Bar\\_project\\_connects\\_student\\_games\\_with\\_commercialinvestors.php](http://www.gamasutra.com/view/presseleases/190182/Code_Bar_project_connects_student_games_with_commercialinvestors.php)

Code Bar launched with the source code and detailed explanatory notes for 7 games projects, including:

- *Legendary Crusaders* - a 2D platform puzzle game set in a medieval world of three pages;
- *Epoch Defence* - 3<sup>rd</sup> Person Combat Game for PC
- *Grrr!* - a multiplayer casual action-RTS game for the PC that is played with a Wii Controller
- *GravTech* - 2.5D Physics-based platformer for PC
- *Into The Sky* – a space-age aerial 3<sup>rd</sup> Person Combat Game for PC
- *Shapeshifter* - a platform designed for touch screens, which centres around the idea of morphing into different objects to give a player different physical properties; and
- *Space Whale* - A psychedelic explosion of colour, fish and meta-galactic mammals. Swing through space using the gravity of planets, growing bigger as you eat until you can devour entire galaxies.

#### **4. Preliminary Results**

Since its launch, the Code Bar website attracted almost 13,000 visitors, over 11,000 of which were unique visitors. There were almost 200 incidences of the Code Bar computer games being downloaded under the evaluation licence. The vast majority of the visits to the Code Bar site occurred within the first month of the launch. The number of visitors dropped sharply thereafter. This may be attributed to a change in personnel within the University and an associated drop in dedicated resourcing for the project to maintain an ongoing dialogue with the user community and add fresh new content/games projects to the Code Bar platform.

#### **5. Future Plans**

Twelve months down the line since the launch of the platform (having adopted a more closed approach allowing evaluation of code only) despite the significant traffic that has been excellent for building profile of Abertay and its students, there has been no

commercial purchases of any of the projects. This outcome may have occurred due to a number of reasons:

- The fixed price point for a project was set to be £5,000 – was this too high?
- The standard of projects was not high enough to warrant a company paying to secure the commercial rights – are companies willing to purchase student IP?
- Are there enough companies willing to purchase independent projects that haven't been developed internally at their own studio?
- Are these projects too time consuming for their coding teams to be able to progress/finish the game to release standard?
- Does the potential 3<sup>rd</sup> party material infringements pose too much of a risk for potential purchasers?
- Did the model of allowing a high volume of users immediate access to the project source and associated files de-value the projects commercial worth?
- Was the platform marketed well-enough for a sustained period?
- The platform was not maintained/updated on a regular basis – i.e. no new projects were added, no blog posts or further press releases were initiated – perhaps companies felt that the platform was no longer supported – reducing confidence in the platform

The above reasons are only assumptions at this stage and would require further investigation to establish an accurate understanding of why none of the projects have been commercialised to date. One observation is that for Code Bar to be progressed/refined it will require a concerted effort and either additional funding or for Abertay to allocate internal resource to the project. The target would be for Abertay to decide what the most valuable outcome of the platform is going to be for the institution and its students. If this additional resource/funding will only be for a limited period then the process will have to be streamlined to allow it to be more easily updateable and with less restrictions. An open source solution would address a number of these issues as once released the open source community will take ownership, however as mentioned it can be difficult to establish a community to successfully support an open source project.

A major issue with Abertay student projects is that they are not independently tested and the university has no available budget for this. An idea that emerged throughout the building of the Code Bar was for the 2<sup>nd</sup> year quality assurance (QA) module to be utilised for this process providing both experience to 2<sup>nd</sup> years working on a 'live' project and providing free QA to help with Code Bar verification. A stipulation however would be that projects would have to be worked on in parallel in order for bugs to be found by the QA team, claimed fixed (by the project team) and finally, verified by the QA team. It is important to stress that QA is a very difficult process for any game to go through and that it is unlikely that any game will ever be 100% free from bugs due to the complex nature of the way they are developed and the many different permutations of how they can be interacted with as explained by Newman.

*The problem for curators and archivists of digital games is that the games are inherently unstable. As a range of commentators have explored, gameplay in digital games often takes quite unexpected,*

*unpredictable and emergent directions as players probe at the boundaries of rules and systems.” (Newman: 2012)*

If the Code Bar project could be embedded into the Abertay games course structure throughout all of the key phases (such as QA as mentioned above) it would provide a highly-innovative learning resource for the students and for the University. It would offer students practical experience in working with and managing different teams and also an outlet for their game projects once completed. On the whole, it would provide an added incentive above the passing of a module to produce excellent work due to the knowledge that their project might be released onto a live platform.

As previously discussed, the likelihood of a potential purchase of a computer game project was likely to have diminished greatly if projects have not gone through both a technical and legal due diligence process before being submitted to the Code Bar platform for public access. If the release model was tweaked so that the output for Abertay was more focussed on dissemination (for marketing and credibility purposes) and attribution for both the institution and the student creators, then if an open source model was adopted some of the technical and legal verification process could potentially be eliminated. Certainly from a technical perspective if a project were to be released open-source the community would be able to support and fix any problems that may surface as the project progressed. An advisory at this juncture would be that the game project would most likely have to be innovative and polished in order to spike the interest of new open source contributors.

Notwithstanding the above, the Code Bar offers the opportunity for digital products to be commercially successful beyond the end of the Dare competition or coursework submission. For this to be the case, student developers must demonstrate technical and creative competencies, enterprise and innovation, and the game products must fulfil a number of additional criteria. To be successful on the Code Bar, the game products must be well designed for both player and market; technically robust, which means it must operate consistently and reliably on a single or multiple platforms, and free from any ambiguity around 3<sup>rd</sup> party IP.

It will also be understood by the skilled reader that the approach for engaging with students, dual licensing model and digital platform employed in the Code Bar project are also applicable to other subject areas beyond the computer games realm. However, it should be noted that the Code Bar approach is more suited to the public dissemination of copyright works; and that the dissemination of patentable inventions presents added complications through the necessity for non-disclosure prior to filing, significant periods of time required to secure patent protection and the substantial costs involved in securing this protection. However, these challenges are surmountable with some further developments on the underpinning Code Bar licenses.

## References

1. AISBL (2012) Science/Business Innovation Board, *Making Industry-University Partnerships Work – Lessons from Successful Collaborations*, p. 11 <http://www.sciencebusiness.net/assets/94fe6d15-5432-4cf9-a656-633248e63541.pdf>, accessed June 2012
2. Bakhshi, H. Hargreaves, I. & Mateos-Garcia, J. (2013), *A Manifesto for the Creative Economy*. NESTA. London, <http://www.nesta.org.uk/publications/manifesto-creative-economy>, accessed 24 April 2013
3. Bekkers R. & Freitas, I.M.B (2008) "Mapping public support for innovation: A comparison of policy alignment in the UK and France", *Research Policy* 37 p.1837-1853
4. BinSubaih, A. Maddock, S & Romano, D. (2007). *A Survey of 'Game' Portability*, Tech. Rep. CS-07-05, University of Sheffield, Sheffield, UK, 2007 p.1-3 <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.303.2716&rep=rep1&type=pdf>
5. Boudreau, K.J. (2012) "Let a Thousand Flowers Bloom? An Early Look at Large Numbers of Software App Developers and Patterns of Innovation" *Organization Science*, 2012, 23(5), p.1409-1427
6. Bush, V. (1945) *Science, the Endless Frontier: a Report to the President*. Washington, D. C.: U.S. Government Printing Office, 1945 <http://www.nsf.gov/od/lpa/nsf50/vbush1945.htm>
7. Casper, S. & Miozzo, M. (2013) *Open Innovation and Governance: Innovation partnerships between Industry and University in Science-based Sectors*, 35<sup>th</sup> DRUID Celebration Conference, Barcelona, Spain 17-19 June, 2013 [http://druid8.sit.aau.dk/acc\\_papers/hk5v45ht5016i4nrv8hq3ehx19ld.pdf](http://druid8.sit.aau.dk/acc_papers/hk5v45ht5016i4nrv8hq3ehx19ld.pdf)
8. (CDPA 1988) Copyright, Designs and Patents Act 1988 Secn 1 (1) (a)
9. Council for Industry and Higher Education (2010) *The Fuse: Igniting High Growth for Creative, Digital and Information Technology Industries in the UK*. London. p.13
10. Creative Skillset course accreditation scheme <http://www.creativeskillset.org/games/accreditation/> accessed 2<sup>nd</sup> April 2014
11. Curley, M & Salmelin, B. (2013) *Open Innovation 2.0 A New Paradigm*, White Paper, Open Innovation Strategy and Policy Group (OISPG) [http://www.ec.europa.eu/information\\_society/newsroom/cf/dae/document.cfm](http://www.ec.europa.eu/information_society/newsroom/cf/dae/document.cfm)
12. Etkowitz, H. & Leydesdorff L. (1997) *Universities in the Global Knowledge Economy: A Triple Helix of Academic-Industry-Government Relations*. Cassell Academic, London
13. Facebook Engineering, Facebook. *Facebook Open Academy: Bringing open source to CS curricula*. Retrieved March 27th, 2014, from Facebook Engineering Page: <https://www.facebook.com/notes/facebook-engineering/facebook-open-academy-bringing-open-source-to-cs-curricula/10151806121378920> accessed November 13th, 2013
15. Ferguson C.J. (2008) "The school shooting/violent video game link: causal relationship or moral panic?" *J. Investig. Psych. Offender Profil.* 5 (1-2) p. 25-37
16. Forbes, P. Madeleine King, M. & Ternouth, P. (2012) *Higher Education SME Interaction: Working with SMEs*, Council for Industry and Higher Education (CIHE) p.3 <http://www.ncub.co.uk/reports/higher-education-sme-interaction.html>

17. Galbraith, J., *Designing the Innovating Organization*, Centre for Effective Organizations (CEO) Publication G99-7, p. 7, IMD, March 1999, <http://ceo.usc.edu/pdf/G997366.pdf>
18. Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P., Trow, M. (1994) *The New Production of Knowledge The Dynamics of Science and Research in Contemporary Societies*, SAGE Publications Ltd, London, 1994
19. Gonzalo, L. (2013) *Analysis of University-driven Open Innovation Ecosystems: the UPM case study*, Universidad Politecnica Madrid (UPM), August 2013 [http://www.upm.es/sfs/Montegancedo/documentos%202013/documentos%20finales/UPM-driven%20open%20innovation%20ecosystem\\_ok2.pdf](http://www.upm.es/sfs/Montegancedo/documentos%202013/documentos%20finales/UPM-driven%20open%20innovation%20ecosystem_ok2.pdf)
20. Guinan, E. Boudreau, K.J. & K. R. Lakhani, K. R. (2013) “Experiments in Open Innovation at Harvard Medical School”, *MIT Sloan Management Review*, Spring 2013, 54(3), p.45-52
21. Guttenbrunner, M. (2010). Keeping the Game Alive: Evaluating Strategies for the Preservation of Console Video Games. *The International Journal of Digital Curation*, Volume 5. Number 1. p.65.
22. Hargreaves, I. (2011) *Digital Opportunity: A Review of Intellectual Property and Growth*, Independent Report. IPO London, May 2011, <http://www.ipo.gov.uk/ipreview-finalreport.pdf>
23. Howells, J. & Edler, J. (2011) “Structural Innovation: Towards a unified perspective?” *Science and Public Policy*, 38(2), March 2011, p.157-167
24. Hughes and M. Kitson (2012) “Pathways to impact and the strategic role of universities: new evidence on the breadth and depth of university knowledge exchange in the UK and the factors constraining its development” *Cambridge Journal of Economics*. 36. p.723-750
25. Hughes A., Kitson M., Probert J., Bullock A A Milner I. (2011) Hidden Connections: Knowledge Exchange Between the Arts and Humanities and the Private, Public and Third Sectors, a Report to the Arts, Humanities Research Council, Centre for Business Research, University of Cambridge, May 2011 <http://www.ahrc.ac.uk/News-and-Events/Publications/Documents/Hidden-Connections.pdf>
26. *HTC Europe Co Ltd v Apple Inc* [2013] EWCA Civ 451
27. Jegede, O. (1999) Science Education in Northwestern Cultures: Towards a Theory of Collateral Learning in, Semali, L. & Kincheloe, J. eds. (1999) *What is Indigenous Knowledge?: Voices from the Academy*. Routledge. London
28. *JISC Legal Investigation into Student Work and IPR*, JISC Legal Information, 19 April 2007 <http://www.jisclegal.ac.uk/ManageContent/ViewDetail/ID/90/Jisc-Legal-Investigation-into-Student-Work-and-IPR-19-April-2007.aspx>
29. Kohler, C. (2007,). *Today's Homework: Make Good Games*. Retrieved March 24th, 2014, from Wired Magazine: <http://archive.wired.com/gaming/gamingreviews/news/2007/02/72707> accessed 13th February 2013
30. Kortemeyer, G. Tan, P. & Schirra, S. (2013): “A Slower Speed of Light: Developing Intuition about Special Relativity with Games”, FDG ‘13 *Proceedings of the International Conference on the Foundations of Digital Games*. ACM New York, NY, USA p.400-402
31. Lee, R. Johnson, J. & Grewal, R. (2008) “Understanding the antecedents of collateral

- learning in new product alliances” *International Journal of Research in Marketing* 25 p.192–200
32. Linton, P. & Schuchhard, P. (2009) *The Digital World in 2025- Indicators for European Action*, European Internet Foundation, 29 September 2009 <https://www.eifonline.org/component/content/article/25-brochure-documents/15-the-digital-world-in-2025.html>
  33. Livingstone, I. & Hope, A. (2011) *Next Gen. Transforming the UK into the world’s leading talent hub for the video games and visual effects industries*. NESTA, London. p.76
  34. McGrath, R. Playstation Store, Sony Computer Entertainment Europe (SCEE). *PSone Classics: Where We All Stand*. Retrieved April 7th, 2014, from Playstation Europe Developer Blog: <http://blog.eu.playstation.com/2011/01/31/psone-classics-where-we-all-stand/> accessed January 31<sup>st</sup> 2011.
  35. Meli, M (2011) *The Most Controversial Video Games*, UGO Networks, p. 11 <http://www.ugo.com/games/most-controversial-video-games-rapelay>, July 19, 2011
  36. Mercan, B. & Gökteş, D (2011) “Components of Innovation Ecosystems: A Cross-Country Study” *International Research Journal of Finance and Economics* 76 p.102-112
  37. Mowery, D. & Sampat, B. (2006) “Universities in National Innovation Systems”, in Fagerberg, J. Mowery, D. & Nelson, R. eds. *Oxford Handbook of Innovation*, Oxford University Press, USA, 2006
  38. Newman, J. (2012) “Ports and patches: Digital games as unstable objects”. *Convergence* 18(2) p.135
  39. OECD (2013) *Commercialising Public Research: New Trends and Strategies*, OECD Publishing, 2013
  40. Perkmann, M. Tartari, V. McKelvey, M. Autio, E. Brostrom, A. D’Este, P. Fini, R. Geuna, A. Grimaldi, R. Hughes, A. Krabel, S. Kitson, M. Llerena, P. Lissoni, F. Salter A. & Sobrero, M. (2013) “Academic Engagement and Commercialisation: A Review of the Literature on University-industry Relations” *Research Policy*, 2013, 42 p.423- 442
  41. Perkmann M. & Walshe K. (2007) ”University-industry relationships and open innovation: Towards a research agenda” *International Journal of Management Reviews*. 2007, Vol.9 Issue 4 p.259-280
  42. PwC: Video Games segment of the *Global Entertainment and Media Outlook: 2013-2017*, PwC, <http://www.pwc.com/gx/en/global-entertainment-media-outlook/segment-insights/video-games.jhtml>
  43. Clark N. Quinn (2005): *Engaging Learning: Designing e-Learning Simulation Games*. Pfeiffer. San Francisco p.160
  44. Sapsed, J. Nightingale, P. Mateos-Garcia, J. Voss, G. Camerani, R. Coad, A. Byford, J. Miles, S. Docherty, D. Jones P. (2013) *Brighton Fuse – The Final Report to the Arts, Humanities Research Council*, 2013, <http://www.brightonfuse.com/wp-content/uploads/2013/10/The-Brighton-Fuse-Final-Report.pdf>, accessed 15 October 2013
  45. Shemtov, N. and Walden I., (2013) *Free and Open Source Software: Policy, Law and Practice*, Oxford University Press, Oxford, UK
  46. Stoneman, P. (2010) *Soft Innovation: Economics, Product Aesthetics and the Creative Industries*, Oxford University Press, Oxford UK, 2010

47. UKTI (2011) *Britain Open for Business Growth through International Trade and Investment*. The UKTI's five-year strategy, UK Trade and Investment, <http://www.ukti.gov.uk/download/file/148280.html>, published 20 May 2011
48. University of Glasgow. *A fresh approach to Intellectual Property: Easy Access IP*. Retrieved from <http://www.ncub.co.uk/a-fresh-approach-to-intellectual-property-easy-access-ip.html> accessed 1<sup>st</sup> November 2013
49. Wenger, E. (2000) *Communities of Practice and Social Learning Systems*. Organization May 2000 7 p.225-246
50. Wilson T. (2012) A Review of Business–University Collaboration, February 2012, [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/32383/12-610-wilson-review-business-university-collaboration.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/32383/12-610-wilson-review-business-university-collaboration.pdf)
51. World Intellectual Property Office (WIPO) *World Intellectual Property Indicators 2013* Edition, [http://www.wipo.int/export/sites/www/freepublications/en/intproperty/941/wipo\\_pub\\_941\\_2013.pdf](http://www.wipo.int/export/sites/www/freepublications/en/intproperty/941/wipo_pub_941_2013.pdf)
52. Yoo, Y. and Lyytinen, K. J. and Boland, R. J. and Berente, N, *The Next Wave of Digital Innovation: Opportunities and Challenges: A Report on the Research Workshop 'Digital Challenges in Innovation Research' (June 8, 2010)*. Available at SSRN: <http://ssrn.com/abstract=1622170> or <http://dx.doi.org/10.2139/ssrn.1622170>
53. Youtie, J. & Shapira, P. (2008) “Building an innovation hub: A case study of the transformation of university roles in regional technological and economic development” *Research Policy* 2008, 37 p.1188-1204